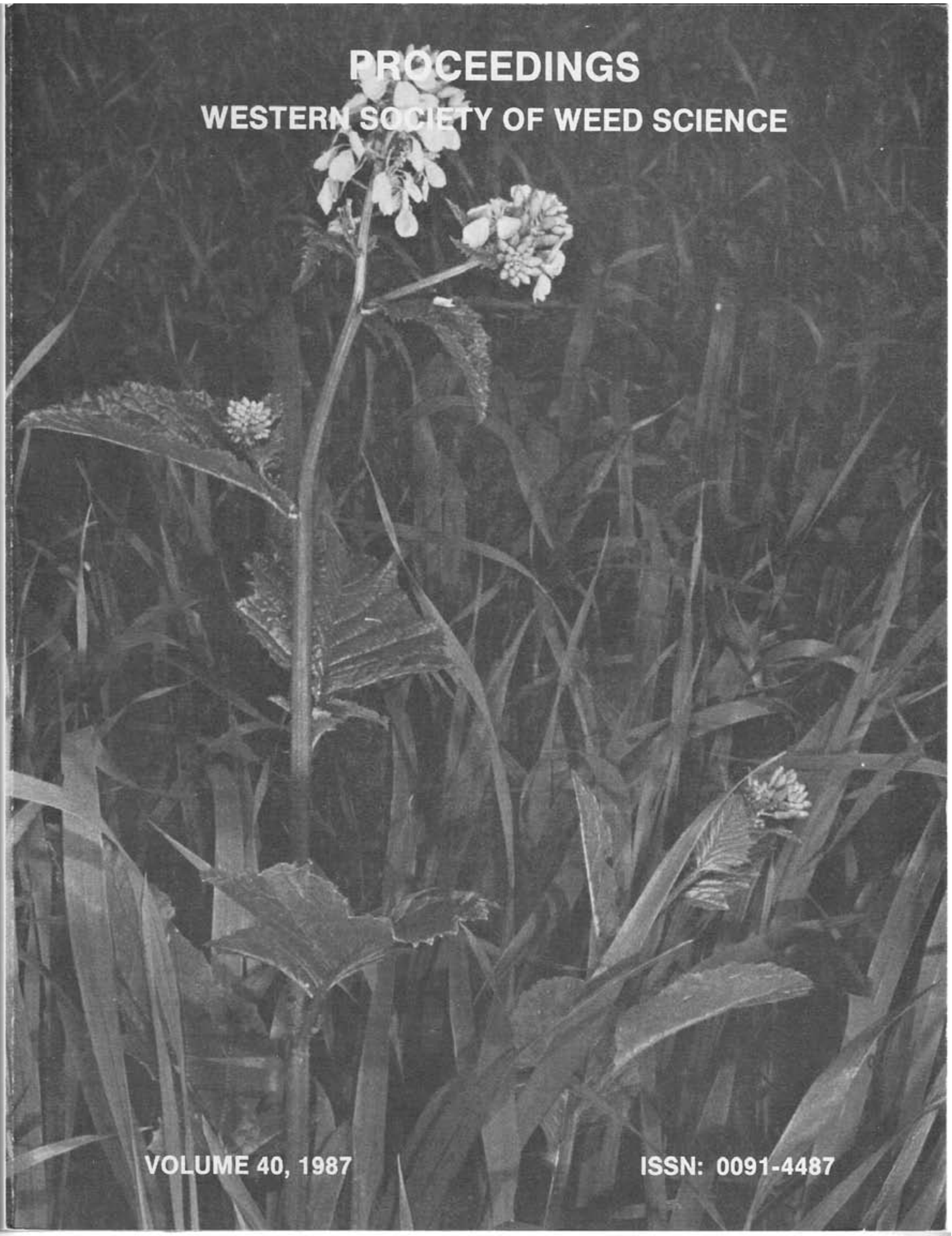
PROCEEDINGS

WESTERN SOCIETY OF WEED SCIENCE



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PROCEEDINGS

OF

THE WESTERN SOCIETY OF WEED SCIENCE

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VOLUME 40

PAPERS PRESENTED AT THE ANNUAL MEETING

MARCH 10, 11, 12, 1987

RED LION-RIVERSIDE MOTOR INN

BOISE, IDAHO

PROGRAM AND TABLE OF CONTENTS

OPPORTUNITIES AND CHALLENGES FOR WEED SCIENTISTS

John O. Evans
PRESIDENTIAL ADDRESS

Fellow weed scientists, students of weed science, honored guests and friends, ladies and gentlemen; welcome to the 40th meeting of the Western Society of Weed Science.

You have come to Boise with great anticipation of an enlightening and satisfying experience during our three-day annual conference. I promise, you will not be disappointed! Larry Mitich and the program committee have worked tirelessly to prepare a program of relevant topics to inform and educate of opportunities and challenges in this exciting discipline. From the printed program you have noted the balance, variety and professionalism of this year's meeting.

The open forum approach in seven thrust or research areas is a unique characteristic of the Western Society of Weed Science. These discussions create a friendly and learning atmosphere to encourage spontaneous discussion of practical problems and provide solution models. The old adage that ten heads are better than one is used to good advantage in WSWS, and further if we relied solely upon individual scientist contributions, many viable alternatives would never surface. Other regional and national societies of weed scientists have failed to recognize the importance of using all assembled to interpret research results and solve pressing problems.

I specifically recall lengthy discussions about potential ground water problems with herbicides more than a decade ago in both the Agronomic and Range and Pasture Projects. These discussions took place well in advance of the current national emphasis on ground water. More often than not, these sessions result in research projects of regional and national significance and place the Western Society of Weed Science on the forefront of new discovery.

It has been a great experience for me to serve as your President this past year. New and exciting developments have surfaced and continue to come forth. One example is the great detail in which we now understand the mechanism of action of photosynthetic inhibitor herbicides, and similarly we know the mode of action of glyphosate at the molecular level, and most importantly, we are beginning to apply this new knowledge in practical weed control programs, particularly the suggested release of crop varieties with tolerance to major herbicides. Our society is growing with a membership just short of 500 individuals at this time. Extremely well trained individuals who are enthusiastic, ambitious and willing to serve, make up our membership. I could elaborate on at least a dozen events that have taken place to substantiate my enthusiasm, but time will only permit brief reference to a couple of items.

First, we have just celebrated the 100th anniversary of the Hatch Act, a federal provision which established agricultural research at each of the newly created land-grant colleges of agriculture and mechanical arts. The goals of the Hatch Act were to "aid in inquiring and diffusing among the people of the United States useful an practical information on subjects connected with agriculture and to promote scientific information and experiment respecting the principles and application of Agricultural Research."

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[1]Professor, Plant Science Dept., Utah State University, Logan, Utah

Also the Western Society of Weed Science is celebrating its 50th year as a weed control organization. It all started here in Boise in June, 1936, when the initial proposal to organize was formulated, and during the ensuing twelve months, the organization of the Western Weed Control Conference took place. One of the promoters put it this way, "I am taking the liberty of suggesting that an annual symposium be arranged whereby individuals working on weed problems in the western states could be brought together. It would aid materially in coordinating the various programs and furnish a valuable opportunity to interchange suggestions in regard to our many weed problems. At present, there is no active organization, to my knowledge, studying as a unit, the weed problems facing the various western states." He went onto clarify his position by stating, "American agriculture appears to have gone in heavily for far-sighted programs of agricultural planning. Yet, to date far too little emphasis has been placed upon our weed problem when compared to other agricultural ills. Control and eradication of weed pests and the prevention of continued mass spread are vitally necessary if we are to guarantee the future generations of our nation an adequate food supply. This statement can be substantiated by merely considering our present areas of fertile agricultural land which have been appropriated by perennial weeds and rendered almost worthless to crop production in a comparatively short number of years. In our mad desire to get out of our present economic rut, have we overlooked an agricultural problem vastly more important to our future as a nation than that of solving temporary income fluctuations. Certainly the solution of this problem bears as directly on conservation of natural resources as does erosion control, grazing control or other projects now being emphasized in long-term planning. What national industry would not be distressed if it found its annual losses amounting to the huge sum of three billion dollars?"

The provisions of the Hatch Act have been in place for a century now, and we have been organized for half a century. How can we as weed scientists of WSWS contribute today to ensure a bright tomorrow. Probably the greatest opportunity exists in knowing our weedy plants better as has been done for crops, soils, animals and many other pests. I am convinced that our ability to manage selected species of troublesome weeds is in great jeopardy and currently progressing very slowly because we don't understand most weeds and their interactions with the surroundings. It's time that weed scientists study every aspect of the biology of weeds. We need ways to deplete our soils of noxious weeds and not let them go to seed in the field just because we cannot insure an immediate monetary return by removing them. We need to develop new innovative weed management systems and new integrated strategies utilizing every possible tool at our disposal. We desperately need every creative idea with regard to weed control strategies if we anticipate lowering the 18 billion dollar burden to agriculture from weed losses and present control expenditures.

We need to attract top students to weed science. It is an especially challenging field, and we must convey this to promising individuals. They need to understand the personal satisfaction and accomplishments available in our profession. Our past record in this respect has been satisfactory, but we now face new, stronger competition. Energetic, creative students are being recruited more intensely by other disciplines, and coupled with the present economic stress in agriculture, discourages those preparing for long-term professional commitments. A few days ago a cartoon appeared in the university newspaper. It showed two morticians meeting in a patch of waisthigh rye; each pushed a table with the remains of a person and an identification tag attached to the big toe. The caption below the cartoon read, "When a body meets a body coming through the rye." It was very pertinent in view of the tremendous battle that is waged in the western states to control rye in winter grain. Perhaps some wheat farmers and high school students that spend much of their summer vacation rogueing rye may have nightmares that this is their destiny after a lifetime of battling this weed in their crops.

Possibly the term "weed" has negative overtones. Perhaps some who have not kept abreast of the tremendous scientific and technological advances in our discipline in recent times might believe weed scientists merely spray chemicals to kill weeds. Mind power will determine the future efficiency and economic performance of American agriculture.

It is alarming when we observe a 28.5 percent decrease in undergraduate majors in agriculture and land-grant colleges of agriculture and life sciences. Further the scholastic aptitude (SAT) scores of U.S. high school graduates planning a college major in agriculture has slipped by 28 points while the SAT scores averaged over all other intended majors has increased 9 points.

At the graduate student level, the graduate record examination (GRE) scores of graduate students planning to major in agriculture is approximately 150 points lower than the average GRE scores for other majors. Further, there appears to be an indication of even greater differences in the future. Finally the bottom line of economic profitability and scientific excellence is expertise.

In conclusion, WSWS has many accomplishments to its credit. Some of the original goals have been realized--many others still appear as dreams on the horizon.

We have established a cadre of devoted weed scientists and have in place an organizational structure in which they can meet, develop weed control technologies and disseminate information to land managers and producers.

We have established in place weed control strategies that provide for crop and plant production with minimal impact from the extreme competition imposed by weedy types particularly at the individual field level.

On behalf of the society--welcome to Boise. Thanks for your continuous support and effort toward weed science. Please enjoy the meetings!

FUTURE IMPACT OF PENDING GLP REGULATIONS ON WEED SCIENTISTS CONDUCTING FIELD RESEARCH

Carol N. Somody

I would like to review some of the regulatory background which has led to these proposed regulations from the EPA.

In 1976, the Food and Drug Administration originally proposed GLPs or Good Laboratory Practices. The primary impetus was the Industrial Biotest Laboratory audit which showed several problems with some toxicology data which had been generated. There were inconsistencies between the raw data and the final reports, the test protocols were poorly written, the objectives

[1]Research Specialist, Ciba-Geigy Corporation, Greensboro, North Carolina

were not well defined, the test information was not properly maintained and the test directors were unqualified. In other words, everything that could have gone wrong did.

The proposed FDA GLP regulations set standards only for toxicology studies. These standards related to the personnel, the facilities, the equipment, the protocols, the test conduct, the recording and handling of the data records and reports and quality assurance.

Subsequently, in December of 1978, the FDA GLP became law, and in June, 1979, EPA proposed similar GLPs for tests conducted under FIFRA. These would be the tests that we as weed scientists would be involved with. Industry, through NACA (the National Agricultural Chemicals Association) offered inputs to EPA in July of 1986. The final proposed document should be finalized some time in early 1988, so we are getting very close to the time when we will have a final document which should be followed.

Before I get into the impact of these regulations on weed scientists, I would like to talk about SOPs, since SOPs are very important to the concept of GLPs. Standard Operating Procedures, or SOPs, are necessary to ensure that an institution's compliance with GLPs is well defined and consistent, regardless of the personnel conducting the research. The SOPs of Monsanto or BASF would be different from the SOPs of CIBA-GEIGY, and the SOPs of Oklahoma State University would be different from those of any other university. That's okay. The important thing is that every institution does have Standard Operating Procedures so that, for example, when a CIBA-GEIGY field rep in North Dakota is doing a study, he follows the same documented procedures as a CIBA-GEIGY field representative in Florida or California. This is the purpose of Standard Operating Procedures, and there could be many different kinds of Standard Operating Procedures. I've listed some examples here. There can be SOPs 1) to define the institution's system of generating, approving and revising SOPs; 2) to indicate the specific duties of field and farm personnel in supervisory capacity; 3) to explain what information to log when chemicals are received; 4) to specify how to operate, calibrate and maintain specific pieces of equipment, such as a Mettler PC-220 Balance; 5) to indicate how to design residue trials and take residue samples; 6) to define how to record raw data and what raw data to record; 7) to specify how to package and ship residue samples, and 8) to explain how to input and verify computerized trial data. All of these are possible examples of the types of things that could be discussed in a company's or university's Standard Operating Procedures. You have probably noticed that several of the SOP examples I've given deal with residue tests, and I want to mention at this point that presently, it is expected that the GLP guidelines which will be finalized soon will impact weed scientists predominantly in their conduct of residue trials and soil dissipation trials.

Now I'm going to discuss, in detail, some of the probable impact of these regulations on weed scientists, as I interpret the regulations.

The first topic I would like to discuss is pesticide storage. Pesticide storage will be impacted by GLP regulations. The facility should be temperature controlled and monitored because chemicals should be stored within the temperature ranges that are required to maintain their specified level of activity. The pesticide storage facility should be secure. Certainly, we all know this from the aspect of safety, but additionally it must be secure in order to be able to make sure that the chemicals have not been tampered with, i.e., to make sure that the chemical that you think you are applying is really that chemical. The individual container should be air-tight and properly labeled as to full identity, special storage conditions and expiration date. And again, all of these issues deal specifically with being able to insure that the chemical and the formulation concentration which you _actually_ apply in the field is the same as that which you _think_ you are applying.

The second topic which I would like to discuss is record keeping. Record keeping is a crucial area of GLP compliance, and I'm going to spend quite a bit of time on it today. The notebooks that any institution keeps its records in should be some type of official-type notebook. Everyone in a particular department should have the same type of notebook. It should be hard-bound so that pages cannot be ripped out. The book and the individual pages should be numbered so that it is clear that all of the pages are intact within the book. The data should be recorded directly in ink, dated and signed; so that all of the data is actually the raw data, so that it cannot be easily tampered with and so that it is easy to know who recorded the information. Changes to the data must not obscure the original entry. If an error is made or found later on and a correction is necessary, that correction can be made, but a single line should be made through the data so that the original data is still readable. In addition, the reasons for the correction should be documented next to the correction, dated and signed. All of these things are very important to be able to have a clear record of what went on in that study and when.

I'm now going to speak specifically of three types of notebooks or logs which are very important to GLP compliance for weed scientists involved in field research. First, a chemical log. The types of information which may be included in this type of log are the date that the chemical is entered into the log; the identifying numbers of that chemical (such as shipping paper numbers or batch numbers); the trade name, technical name or compound number; the formulation; the quantity which you received; the condition at receipt (whether the material had possibly broken and contaminated another material in the box shipped, etc.); the use or disposition date of the material; what quantity was used or disposed and how it was used or disposed (whether in a residue test, sent to another individual who was short of material or returned to a company headquarters at the expiration date, etc.). Therefore, in this chemical log you have a very detailed record of everything which was done with that chemical; and hopefully, at the end of the shelf-life of that chemical, all of the chemical used, plus any remaining chemical, should add up to the amount which you received. If it doesn't, there is a possibility that in some of those tests errors were made and a different amount of chemical was applied than indicated in the record. And this may sound like it's a way of finding errors and getting people in trouble, but keep in mind that an error found in a detailed, well-documented log book, gives a company or a university a way of possibly explaining deviant data. It actually is more helpful, for example, for a company to be able to show that an error was made than to have to set residue tolerances at higher levels than are actually necessary because of a deviant piece of data which may have occurred due to error; so it's very advantageous to be able to document where errors have occurred and how they may have occurred because this gives companies a way of arguing successfully with EPA when certain studies should not be included in the data package.

The second log I would like to discuss is an equipment use and maintenance log. The types of equipment that GLP compliance would seem to impact are balances and pesticide application equipment, since these types of equipment are very important in affecting the accuracy of chemical applications. The type of information which you might put into such a log are the date logged (again, it is very important that everything is always dated and signed when you're handling GLP record keeping); the item and the model number of that piece of equipment (model number can be very important because different pieces of equipment may require different handling techniques, different calibration and different maintenance); and the operation which you performed on that date (whether you cleaned the equipment, calibrated it, repaired it, etc.). If there was a malfunction, you would indicate in the log the type of malfunction and the date it occurred or was discovered (which is not the same thing). If you know that it occurred on the date that you are making the entry, that of course is very helpful information; however, if you don't know when it occurred, your data between the date of discovery and the last time that you knew it was working properly can be suspect. Also record any remedial action which was necessary in order to repair the equipment.

You should also indicate in this log both the recorded and actual weights of calibration weights which you should be using regularly to test for accuracy of your balance. It is not enough to have a serviceman come in and check your balance once a year or twice a year; there is no way that his check can prove to you that within the whole 12-month period between the time he last visited and the present, that the balance was working properly at all times. In addition, he may come in, calibrate it and find that it hasn't been calibrated correctly. You then have no idea of when the calibration went bad, and your data certainly becomes suspect. Calibration, i.e., weighing of calibration weights periodically to determine that the balance is weighing what it says it's weighing, is very important; we don't do enough of it. We need to do more of it, not only for our residue tests and our soil dissipation studies under GLPs, but for our performance tests as well. The more often that we calibrate and that we weight calibration weights and keep records of those weights, the more confident we can be that our balances are working properly for all the weighings which we do.

You should have Standard Operating Procedures for all your different types of equipment. However, if some different models of balances, for example, are handled similarly (i.e., if the instruction manual indicates that you can calibrate them with similar principles and maintain them similarly), you could write one SOP covering several models of equipment. However, when equipment is treated differently and has to be operated, maintained or calibrated differently, you should have different Standard Operating Procedures for each type of equipment. And in those SOPs, routine calibration and maintenance schedules should be specified plus any deviations which would be allowable before professional service is required. Thus, anybody in your institution could take out that Standard Operating Procedure when using that piece of equipment and know how your institution expects that piece of equipment to be handled.

The last log that I would like to discuss is a raw data collection log. All raw data should first be recorded in this log book. If you are using a hand-held computer to enter some data, a printout from this device should be either permanently attached in the notebook or cited in the notebook as being stored in a specific file. This is important because if you do use a hand-held computer device, that output is your raw data. It certainly would not be accurate to enter data on a hand-held computer and then copy it from the printout into a raw data collection log. That would not be raw data anymore, so whatever your raw data really is should be maintained as your raw data and signed, dated and kept in a safe place. However, most of us are still not using hand-held computer devices; instead, we're writing our data down somewhere. If we are doing that, we shouldn't be writing it all over the place on scraps of papers. We should be writing it into good record keeping techniques like writing in ink and making single lines through mistakes and explaining why changes have been made, etc. If you do your calculations to determine how much that you are putting out on specific plots, you should record all those calculations done to determine the grams per plot or the mls per plot, etc., for each product, including the plot size, the formulation and any other data which is needed to do the calculations. This is important--it's not enough to say that you applied 2 lbs. per acre of Atrazine on this plot. You didn't apply 2 lbs. per acre--you put so many grams or so many mls of a certain product formulation onto a certain plot size, and this is the true raw data. This is the information which is necessary for someone to be able to go back and determine if the calculations were done right and if the proper amount of chemical was applied to that field. If some of you are using computer programs to generate the grams per plot or the mls per plot, certainly that is allowable, but some type of printout should be permanently maintained so that one can go back again and see exactly what quantity of chemical was applied, what the formulation was and what the plot size was.

There are two other areas I would like to discuss relative to GLP compliance. One of these is verification of trial data. It is very important that the final record which is sent to a company headquarters or put into a university's annual report is correct. This is often not the case; there are often errors in the final report that, if that final report were compared to the raw data, would be noticed and could be corrected. It is necessary to verify computer printouts or annual reports or any other "submitted data," i.e., data which lands up being used in an EPA submission to establish tolerances or determine soil dissipation. Therefore, when a company field representative submits data to his headquarters or when university people compile their data into an annual report, that data should be evaluated for errors, omissions, etc. It should be corrected if necessary, and the final correct output should then be signed as an official document which can be submitted to EPA for use in the registration of products. It's very common, especially if a computer is used for data entry, to hear complaints about how the data which came out did not look exactly like the data going in. The point is not who made the error--that is not important here--the important thing is that the person or persons who are responsible for that trial and responsible for the accuracy of that data look at that final report carefully and make sure it is accurate and it is complete.

Lastly, I'd like to say a few words about quality assurance. Quality assurance is very important to the concept of GLP compliance. The EPA does not have the manpower nor the time to come out and look at how everyone of us is performing our tests and collecting our data. There are just too many of us; we're spread all over the United States; we're working with universities, with private consultants and with companies. However, it would be very helpful to the EPA if they could go to one quality assurance unit within each institution, which has been responsible for collecting the records, making sure the SOPs are followed, making inspections randomly and periodically to ensure that the data is being collected according to that institution's Standard Operating Procedures and having all this information in one place if and when the EPA wants to come in and see how an institution is complying with GLPs. Therefore, anyone who plans to comply with the GLP regulations should have some type of internal quality assurance unit. This unit should not be the same people who are conducting or directing the studies; rather, they are supposed to be a group of "umpires" separate from the people who generate the data.

I've not covered every issue in GLP compliance; however, the proposed guidelines have been published in the Federal Register. Again the final document is expected sometime in 1988; however, I would recommend that if anybody wants to comply with GLPs, if they are going to be doing residue trials for instance, it will be necessary to comply with GLPs sometime in 1988 when these regulations are finalized. Anyone who wants to do this should not wait until 1988 to address this issue. GLP compliance is not easy. Clearly many of us view it as a hassle, but if we think about it, it really is very similar to the way we were originally taught to collect data and handle our records back in our original eighth grade laboratory course. That was what was stressed to us in the very beginning, the record keeping; now we're being asked to go back and do things in that careful fashion again. We've learned a lot of short-cuts along the way and that's basically the problem with being able to document all of our data now. The short-cuts don't allow the documentation. So I do suggest that if any of you are interested in doing the types of tests which require compliance, start becoming familiar now. Start developing Standard Operating Procedures now. Don't wait for the regulations and expect that you can immediately comply. CIBA-GEIGY, for example, has been addressing this issue with our field pesticides studies involving residue tests for two years now, and we're not there yet. GLPs are not easy--at CIBA-Geigy we say GLPs don't really stand for Good Laboratory Practices--they stand for Good Luck People!

CLOSING THE COMMUNICATIONS GAP

Ron Kolb

There are several reasons for the "gap" that seems to exist between scientists and reporters. They are mostly based on perceptions...first, of scientist who feel:

- Reporters are shallow, ill-mannered commentators who are best avoided at all costs.
- Reporters only want to sensationalize the news, and thus distort stories to fit their pre-conceived attitudes.
- Reporters don't have the background to fairly report on your area of expertise and little interest in learning about it.
- Reporters are only interested in 30-second stories, and scientific research simply can't be boiled down to 30 seconds.

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[1]Director, News and Communications, University of California, Berkeley, California

And there are perceptions of reporters that:

- Scientists are arrogant, self-centered eggheads who hide behind their research like a shield.
- Scientists can't deal with simple questions and answers and are lost in a world of jargon and formula.

- Scientists don't want the world to know about their work because people won't understand it or will take it the wrong way (fear of being misunderstood). Do they have something to hide?

I suggest several reasons to close the gap. They include:

- The science world's responsibility to the public, especially in state-supported institutions and in areas where the public welfare is affected.

- A scientist's role as "ambassador," or representative of an institutional image (public or private). A positive image requires public support at all levels.

- For land-grant institutions, the obligation to share knowledge with all who might benefit from it.

- A need for the general public to fully appreciate science and research, an appreciation that could translate into continued and increased funding at the state and federal levels (which directly affects all scientists).

To close the gap, both sides should assume certain responsibilities. For reporters, their commitment must be to:

- objectivity
- fairness
- accuracy
- completeness (in context)

For scientists, the obligations should be to:

- truth
- cooperation
- loyalty to the institution (not self)
- the limits of their expertise

Scientists must recognize the media's limitations. These include the following, with suggestions for how scientists can adapt their responses to best serve the interests of the media and the institution:

- deadlines (limited time to do research on a subject). SOLUTION: **Summarize, contextualize, explain.**

- time and space (TV is brief, print may be confined in length) SOLUTION: **Brief messages, concise and clear.**

- audience (they try to appeal to the "lowest common denominator"). SOLUTION: **Simplify messages, be non-academic and non-scientific.**

- visuals (TV needs action). SOLUTION: **Find visual elements and illustrations to help tell your story.**

- education (reporters are generalists, without extensive scientific background). SOLUTION: **Help them understand; teach.**

Scientists aren't expected to become instantly comfortable with the news media, even with the suggestions mentioned above. Like anything else, it takes practice. But there is help available within institutions or companies:

- Public information and public relations specialists are trained to provide:

  - news releases, to clearly state your work and point of view

  - a "buffer" between you and the media, so that you don't have to answer all the questions, and you can be alerted to the tough ones

  - media training, to make you more comfortable in front of camera or microphone and assist in how to respond

  - news briefings and press conferences, to get a "first step" and turn a defensive situation into a positive one

Ice Minus: A CASE STUDY

<u>The Problem</u>: A University of California scientist wishes to test his frost-prevention bacteria on a field of potatoes in Northern California. It will be the first such test of a genetically-altered organism in the natural environment (outside the lab). While he and other scientists and the EPA are convinced of the safety of the experiment, residents of the region are not. And an activist in Washington files a suit to prevent release of the organism in the environment, supported by the neighbors in Tulelake. The courts issue a temporary restraining order, halting the experiment pending further review and evaluation. The residents are relieved, at least temporarily. The university and the scientist are frustrated and angry. Progress is slowed by politics.

<u>The Question</u>: How do you close the communications gap between the scientific community and the public?

<u>The Answer</u>: Education, which should lead to a positive public response to free the scientist to do his research. And the method most centrally used to influence public opinion is using the news media. The media can be the "bridge."

The Methodology: Total cooperation and sensitivity to the issue and the concerns must be exhibited. To be otherwise suggests arrogance and selfishness, which will only breed more suspicion and contempt. Non-cooperation or aloofness will only widen the gap and potentially result in further delays. Good will is accomplished by constant and complete availability for speaking engagements, interviews and press briefings. Get your message out in a concise and understandable way (news releases, TV appearances, radio talk shows, etc.);

- Media packets developed with background information, Q-and-A with the scientist, photos, news releases
- Videotape prepared for public presentation and use by TV stations
- Press briefings in conjunction with major public meetings, and press conferences at key junctures in the process; interviews arranged as appropriate
- Media training of the scientist, to rehearse responses and fine-tune answers to difficult questions

The Result: Except for small pocket of concern among residents in the area, there has been overwhelming support for the project in the media, recognition and respect for the scientist's work and very little general public opposition. Court challenges have delayed the experiment pending time-consuming environmental reviews, but the university has every reason to believe that the tests will go on, as scheduled, in the near future with minimal public outcry.

Summary questions (the following questions were not presented during the public presentation, but they are anticipated as being fairly typically asked within the scientific community):

Q: I've been burned by several reporters who distorted my words and misrepresented my research. Why should I continue to deal with them if they're just going to publicly embarrass me?

A: The fault may be in the way you explained yourself or in the way the reporter misunderstood what you said. I'd try to be more clear and careful in my responses. Also remember, there are bad reporters. But don't let the few reflect on the many. There are bad scientists, too, but there are more good ones. Same for journalists. If they make a mistake, tell them about it. Tell their boss about it. And if they persist in unprofessional conduct or repetitious error, graciously decline future interviews.

Q. My profession and my colleagues make me accountable for what I do. Seems to me that reporters aren't accountable to anybody? Is that fair?

A. You're wrong. They, too, are accountable to their profession. Journalists are supposed to adhere to a strict dictum of ethics and morals (fairness and accuracy). If they don't, they should be called on it. They have bosses, too, and if they make too many mistakes, they'll either lose their sources or lose their jobs. This self-policing generally works.

Q. In the weed science discipline, we're constantly caught in the middle, between the company's interest in profitability and growth, agriculture's interest in productivity and improved quality and the public's sometimes distorted concern about chemical-free environments. To whom do I pledge my allegiance?

A. First, to the institution or agency which signs your pay check and to yourself. When confronted with a question involving ethics and morality, avoid being an uncomfortable situation in which you are asked to make value judgments. Stick to the science of your job, the benefits of the work hazards and safeties, if appropriate, and above all, emphasize its ultimate value to society. don't get caught speculating or venturing into subject areas beyond your expertise. And finally, truth is the best defense, the greatest virtue, the safest answer.

Q. What if I just refuse interviews? What is the cost in doing that?

A. First, refusal to talk suggests to the reporter that you have something to hide; that suspicion might be reflected in the media. You become "under suspicion," wrongly accused. So does your institution. And that could translate into loss of confidence in your employer and, eventually, loss of support financially or politically. It's the "domino" theory of image development. If one scientist makes one reporter feel good, resulting in a fair story, then everyone in the organization benefits. Same thing if the situation is a bad one--all suffer.

Q. If a reporter calls, and I feel he clearly has his mind made up--he just wants me to verify his negative attitude about a particular pesticide, or he's convinced that I'm trying to perpetuate a toxic danger through my work on a substance--why should I buy into that set-up?

A. Nothing's ever certain; you might be the last line of defense for your company or for the agricultural community. Try to make him understand your key points if you suspect he has distorted or misrepresented the facts. Be cooperative and understanding. Your responsibility is to represent your work in the clearest and most accurate way. But you also have the right to end the conversation at any time if you feel you are being manipulated or ignored. And if you feel a question is unfair or outside of your jurisdiction, graciously decline to respond. That's your right. Just keep your cool and be polite.

THE EFFECT OF PPG-1721 ON RIPENING AND PREMATURE FRUIT DROP OF APPLES

K.R. Luff and T.C. DeWitt

Abstract. Ethylene, a by-product of several physiological processes and a product of many plant parts, causes several effects in an apple crop. During the maturation process of apples, ethylene is generated in the fruit which consequently initiates the process of ripening and abscission, often resulting in preharvest fruit drop. In laboratory experiments low rates of PPG-1721 applied to McIntosh apples late in the growing season have increased postharvest "ripening resistance" as measured by the percentage of fruit producing ethylene at a rate greater than 1 ul/kg hr. Field results from Idaho and California have shown that PPG-1721 solutions of 200 ppm applied at 400 GPA have increased fruit removal force of Red Delicious apples by 20 to 40 percent over the untreated check. Studies in Washington have resulted in increases of similar magnitudes for both Red and Golden Delicious apples. In

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[1]PPG Industries, Inc., One PPG Place, Pittsburgh, PA 15272

addition, applications of PPG-1721 have demonstrated apple stop drop activity equivalent to standard NAA applications. The first full year of orchard testing with PPG-1721 has shown positive indications that this compound warrants further testing for control of apple fruit ripening and drop.

A GUIDE TO THE MOST TROUBLESOME BROADLEAFED WEEDS OF NEVADA

E. I. Hackett, J.C. Davison, R.L. Post, K.R. Hill and E.A. Isidoro[1]

Abstract. Eleven of Nevada's most troublesome broadleafed weeds are featured on 35 mm slides and accompanying fact sheets. The fact sheets list identifying characteristics, line drawings, biology and recommended control techniques. The slides depict immature, mature and flowing phases of each weed. Each plant is also discussed in detail on a narrated cassette tape provided with each guide.

Although the guide is produced in Nevada, the featured weeds are common to all the western states. The guide is intended to be used as a teaching aid in college classes, grower meetings, company training seminars and government agency educational programs. It can be purchased from the Department of Range, Wildlife and Forestry, University of Nevada--Reno, Reno, Nevada 89557-0004.

[1]University of Nevada, Reno, Nevada

SETHOXYDIM FOR USE IN ALFALFA

D.C. Wiley, G.R. Oliver, C. Lambert and J.O. Pearson[1]

Abstract: Sethoxydim{2-(1-(ethoxyimino)butyl)-5-(2-(ethylthio(propyl)-3-hydroxy-2-cyclohexene-1-one} has been tested since 1981, on alfalfa in the major producing areas of the western United States. Sethoxydim has Federal registration on several crops and is sold under the trade name POAST.

Sethoxydim is a selective broad spectrum post-emergence herbicide for the control of annual and perennial grass weeds in alfalfa. It does not control sedges or broadleaf weeds. Sethoxydim rapidly enters the plant through the foliage and translocates throughout the plant.

Control symptoms exhibited is a slowing or stopping of growth, generally within two days. Reddening of the foliage and leaf tip burn often occurs within a few weeks, depending on environmental conditions.

Application may be made to new stands or to established stands of alfalfa.

Grasses under stress, due to lack of moisture, herbicide injury, cold temperatures, etc., can be reasons for unsatisfactory control. Actively growing plants are necessary for acceptable results.

[1]BASF Corporation, AG. Chemical Div., Research & Development, Parsippany, New Jersey 07054

Rate and timing of application will vary with grass specie and geographical location within the United States. Refer to the label for details.

Always add a non-phytotoxic oil concentrate to the spray solution at the rate of two pints per acre.

Sethoxydim should not be applied if rainfall is expected within one hour.

The product will have a 20-day post-harvest interval for hay production and a 7-day post-harvest interval for feeding, grazing or harvesting forage.

No more than 5 pints of product can be applied per acre in one season.

Two Section 18 emergency exemptions were allowed by the State of California and the use of sethoxydim on alfalfa in 1986. One was for the control of green and yellow foxtail (Setaria verids and S. lutescens) in the Sacramento and San Joaquin Valleys. The second exemption was for control of cupgrass (Eriochloa spp.) in Imperial and Riverside Counties.

BASF expects to have a Federal registration for the use of sethoxydim on alfalfa early in 1987.

SELECTIVE CONTROL OF RANGELAND COMPOSITES WITH CLOPYRALID

Steven G. Whisenant[1]

Abstract. Sprays of 2.2 kg ae ha^{-1} of the propylene glycol butyl ether ester of 2,4-D {(2,4-dichlorophenoxy)acetic acid} and 0.5, 1.1 or 2.2 kg ae ha^{-1} of the monoethanol amine salt of clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) were applied at four Utah sites. Applications of 2.2 kg ha^{-1} 2,4-D resulted in 79 to 97% mountain big sagebrush (Artemisia tridentata Nutt. #[2] ARTTR spp. vaseyana) and 41 to 57% threadleaf rubber rabbitbrush [Chrysothamnus nauseousus #CYTNA var. consimilis (Greene) Hall & Clem.] mortalities, respectively. The same rate of clopyralid killed 87 to 98% of the mountain big sagebrush and 83 to 97% of the threadleaf rubber rabbitbrush. Applications of 2.2 kg ha^{-1} of 2,4-D resulted in 84% mortality of antelope bitterbrush [Purshia tridentata (Pursh) DC.] and killed 96% of the Saskatoon serviceberry (Amelanchier alnifolia Nutt.). Clopyralid applications of 2.2 kg ha^{-1} killed only 5% of the antelope bitterbrush and 6% of the Saskatoon serviceberry. Small amounts of fourwing saltbush (Atriplex canescens (Pursh) Nutt. #ATXCA), present at one location, were killed by 2,4-D and not damaged by clopyralid. Thus clopyralid is a potentially effective alternative to 2,4-D for control of mountain big sagebrush or threadleaf rubber rabbitbrush when the desirable shrubs, antelope bitterbrush, Saskatoon serviceberry or possibly fourwing saltbush are present.

Introduction

Big sagebrush covers approximately 58 million ha in the 11 western states, and frequently becomes dense enough to reduce forage production and

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[1]Asst. Prof., Dept. Botany and Range Science, Brigham Young University, Provo, Utah

[2]Letters following this symbol are a WSSA-approved computer code from Composite List of Weeds, Weed Sci. 32, Suppl. 2. Available from WSSA, 309 West Clark Street, Champaign, IL 61820

inhibit livestock movement. Dense stands of big sagebrush are serious obstacles to range improvement through grazing management and seeding of desirable plant species. Improvement of degraded big sagebrush communities usually requires such practices as prescribed burning, mechanical control or herbicide applications (5, 6, 8, 11).

Rabbitbrush species (Chrysothamnus spp.) occupy a wide variety of habitats in western North America. They occur on open plains, valleys, foothills and mountains from sea level to 3300 m (4). At least eight species occur in the intermountain area, but most herbicide applications have been directed at the various subspecies of rubber rabbitbrush and green rabbitbrush (Chrysothamnus viscidiflorus). Rubber rabbitbush vigorously invades disturbed sites such as roadcuts and overgrazed rangelands. Removing big sagebrush with fire, heavy grazing or herbicides may increase the abundance of rubber rabbitbrush until it becomes the dominant species (11).

Previous herbicidal control studies on rubber rabbitbrush have stated that the best control is obtained when new leader growth exceeds 7.5 cm (5). In dry years, rubber rabbitbrush may not produce enough new growth to reach a susceptible stage of development. Mohan (9) evaluated areas treated with herbicides over a 14-yr period in central Oregon. He found that consistent rubber rabbitbrush control could be obtained if certain conditions were met: (A) at least 7.5 cm of new leader growth; (B) use 2.2 kg ae ha^{-1} of 2,4-D ester; and (C) apply 2,4-D only when adequate soil moisture is present.

Cluff et al. (3) evaluated the efficacy of picloram {4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid}, dicamba {3,6-dichloro-2-methoxybenzoic acid}, silvex {2-(2,4,5-trichloro-phenoxy)propionic acid}, 2,4,5-T {(2,4,5-trichloro-phenoxy)acetic acid} and tricopyr {[(3,5,6-trichloro-2-pyridinyl)-oxy]acetic acid} on threadleaf rubber rabbitbrush in central Nevada. They reported threadleaf rubber rabbitbrush mortality averaged 87% when 2.2 kg 2,4-D ha^{-1} was applied at the optimum time.

Antelope bitterbrush is a desirable browse species for domestic livestock and many wildlife species (6) and occurs throughout most of the sagebrush ecosystem. Saskatoon serviceberry is a desirable shrub but of lesser importance than antelope bitterbrush to herbivores in the sagebrush ecosystem. Unfortunately, attempts to reduce big sagebrush density with herbicides often result in considerable damage to antelope bitterbrush and Saskatoon serviceberry.

Hyder and Sneva (6) described a method of acquiring some degree of selectivity between big sagebrush and antelope bitterbrush by carefully timing 2,4-D applications. Applications of 2,4-D between the time of antelope bitterbrush leaf appearance and early fruit development resulted in progressively greater antelope bitterbrush damage. Spraying 2,4-D at any time killed virtually all antelope bitterbrush leaf tissue. However, spraying at the time of leaf origin and before stem elongation or flower development killed only a small amount of tissue on large plants (6). Dormant buds initiated new growth, following treatment, and the plants appeared to have recovered by autumn.

The selectivity of carefully timed applications of 2,4-D restricts application dates and results in some damage to antelope bitterbrush even under the best of conditions. The use of a more selective herbicide for big sagebrush control would greatly reduce damage to many desirable shrubs and forbs. Clopyralid is a relatively new, hormone-like herbicide with potential for selective control of several range weed and shrub species (2). Research results indicate potential for increased selectivity of clopyralid, compared to other commonly used hormone-like herbicides (1,2,7,10).

The objectives of this study were to evaluate clopyralid for control of mountain big sagebrush and threadleaf rubber rabbitbrush and to determine whether clopyralid is more damaging to associated shrubs than is 2,4-D, which is currently recommended for big sagebrush and rubber rabbitbrush control.

Materials and Methods

Study sites. Experiments were established near Heber City (Wasatch County), Holden (Millard County), Salina (Sevier County) and Antimony (Garfield County), Utah. The Wasatch County site was dominated by mountain big sagebrush, antelope bitterbrush and Saskatoon serviceberry. This site is at 1900 m elevation with a mean annual precipitation of roughly 47 cm; approximately 70% of which falls as snow between November and March. The mean frost-free period is 83 days. The soil is Watkins ridge silt loam (fine-loamy, mixed, frigid, typic Calcixeroll).

The Millard County site was characterized by mountain big sagebrush and antelope bitterbrush on Pavant gravelly sandy loam (loamy, mixed, mesic, shallow, aridic petrocalcic Palexoroll). This site is at 1735 m elevation and has a mean annual precipitation of 36 cm. Precipitation is fairly well distributed throughout the year but is lowest in the summer. The mean frost-free period is approximately 132 days.

The Garfield County site contained mountain big sagebrush and was at 2290 m with a mean annual precipitation of 36 cm. About 50% of the precipitation falls during the 90-day growing season. The soil at this site is a Codley silt loam (fine, silty, carbonatic, frigid ustic Torriorthents).

The Sevier County site was dominated by threadleaf rubber rabbitbrush on a silty loam (fine, silty, mixed, frigid Xerollic Haplargid) soil. This site is about 1,919 m in elevation with a mean annual precipitation of 37 cm. About 80% of the annual precipitation falls between November and April. The mean forest-free period is about 100 days.

Herbicide applications. Treatments were initially applied in Millard County on 8 June 1983 and the experiment was repeated on 13 June 1984. During both applications, mountain big sagebrush had approximately 5 cm of new stem growth. Antelope bitterbrush had well developed fruits and 4 to 6 cm of new stem growth. The air temperature was 27 C and the relative humidity was 22% during treatment applications in 1983. The temperature and relative humidity were 24 C and 29%, respectively when treatments were applied in 1984.

Treatments were applied in Sevier County on 14 June 1984 (21 C and 34% relative humidity). Threadleaf rubber rabbitbrush leader growth was approximately 4 to 8 cm at application.

Treatments were applied in Wasatch County on 18 June 1983 (21 C and 43% relative humidity) and 29 June 1984 (23 C and 61% relative humidity). Mountain big sagebrush new stem growth was about 10 cm, antelope bitterbrush was in full flower and new stem growth was 8 cm long. About 5 cm of new stem growth was present on Saskatoon serviceberry.

Herbicides were applied in Garfield County on 20 July 1983 (22 C and 65% relative humidity) and repeated on 29 June 1984 (19 C and 56% relative humidity). Mountain big sagebrush had little apparent new stem growth, and the seeds were well developed at the time of treatment in 1983. Herbicides were applied in 1984 when mountain big sagebrush had 3 to 5 cm of new stem growth. During both applications threadleaf rubber rabbitbrush had approximately 5 to 12 cm of new leader growth.

Treatments were applied to 3- by 30-m plots replicated three times in randomized complete block designs. Herbicides were applied with a CO_2-powered backpack sprayer in 140 L ha^{-1} of water. A commercial surfactant (a mixture of alkyl-polyoxyethylene glycols, free fatty acids and isopropanol) was included at 0.5% (v/v) of total solution. Treatments consisted of either the propylene glycol butyl ether ester of 2,4-D or the monoethanol amine salt of clopyralid.

Shrub evaluations. Evaluations of treatment effects were conducted in October 1985 and October 1986. Sampling was conducted along a single 25-m-long and 2-m-wide belt transect in each plot. Percentage canopy reduction (CR) of each woody plant in the belt was visually estimated. If the canopy was eliminated, the plants were examined for presence of new basal or stem sprouts. The ratio of completely defoliated plants with no new sprouts to the total number of plants was used as an estimate of apparent mortality (AM). Mean CR and AM values for each species were calculated for each plot.

Statistical analysis. CR and AM plot means (x) were transformed to the arc sin x and subjected to analysis of variance pooled over site and application date for each species. However, the treatment by site interaction was significant for both AM and CR data of mountain big sagebrush. Consequently, analysis of variance and mean separations of mountain big sagebrush data were pooled over application date and conducted by site for each treatment. The treatment by site interaction for threadleaf rubber rabbitbrush data was significant (P 0.05) for both AM and CR data. Consequently, analysis of variance and mean separations on threadleaf rubber rabbitbrush data were pooled over application date for the Garfield County site and conducted by site for each treatment. Antelope bitterbrush data were pooled over site and application date for analysis and presentation. Saskatoon serviceberry data from the Wasatch County site were pooled over application date. Least significant difference (LSD) at the 5% level was used to separate treatment means.

Results and Discussion

Mountain big sagebrush. There was no consistent efficacy advantage to using clopyralid instead of 2,4-D for control of mountain big sagebrush. However, clopyralid was as effective as 2,4-D at two sites and significantly more effective at a third site (Table 1). Mountain big sagebrush AM varied from 72 to 97% following clopyralid applications of 1.1 kg ha^{-1}, and varied from 87 and 98% following applications of 2.2 kg ha^{-1} of clopyralid. Applications of 2,4-D at 2.2 kg ha^{-1} resulted in 79 to 97% AM compared to 88 to 92% AM following applications of 2,4-D at 4.4 kg ha^{-1}. Mean AM of mountain big sagebrush (81%) resulting from applications of 1.1 kg ha^{-1} clopyralid would be considered acceptable control for many rangeland situations, particularly those being developed for wildlife habitat improvement. However, the more effective control (92%) provided by 2.2 kg ha^{-1} clopyralid may be desirable in some situations.

Mountain big sagebrush mortality was lower at the Millard County site than at the other sites. This may be a result of the relatively coarse soil texture at the Millard County site and differences in phenological development at the time of herbicide application. Sand, silt and clay fractions were 67, 23 and 10% at the Millard County site compared to 25, 52 and 23% and 22, 58 and 20% at the Wasatch and Garfield County sites, respectively. Soils at the Wasatch and Garfield County sites had higher water holding capacities than soils at the Millard County site. Because of the winter precipitation pattern and treatment dates based on antelope bitterbrush growth stage, the Millard County site was treated near the time when soil-water contents, stored from snow melt, were depleted. This may have reduced the effectiveness of herbicide treatments at the Millard County site.

Threadleaf rubber rabbitbrush. Threadleaf rubber rabbitbrush AM and CR were lower at the Sevier County site than at the Garfield County site. In excess of 90% AM was obtained with 1.1 to 2.2 kg clopyralid ha^{-1} at the Garfield County site (Table 2). The same treatments at the Sevier County site were less effective (Table 3). The best results at the Sevier County site were obtained with 2.2 kg clopyralid or 4.4 kg 2,4-D ha^{-1}.

The Sevier County site was much drier during the growing season than the Garfield County site despite having similar annual precipitation rates. This was due to the winter precipitation regime of the Sevier County site compared to the Garfield County site which receives much more summer precipitation. By the time leader growth was sufficient for spraying, at the Sevier County site, soil-water contents were apparently depleted; resulting in less effective control of threadleaf rubber rabbitbrush.

Several consistent trends were apparent in this study. Applying 3.3 kg 2,4-D ha^{-1} greatly reduced canopy cover, but several of the threadleaf rubber rabbitbrush plants began regrowth in the next season following treatment. Under the best of conditions, 2,4-D killed up to 90% of the threadleaf rubber rabbitbrush plants.

The Sevier County study site contained fourwing saltbush in at least 1 plot of each treatment. Because of the poor distribution, no statistical tests were made on the effects of these herbicides on fourwing saltbush. It was apparent that 2,4-D treatments killed fourwing saltbush, but clopyralid caused no apparent damage. This observation is consistent with the observations of Jacoby et al. (7), who observed no damage to fourwing saltbush following clopyralid applications in west Texas. Other studies have reported increased selectivity between certain plant families with clopyralid (1, 10).

Antelope bitterbrush. Applications of 2,4-D at 2.2 kg ha^{-1} resulted in an antelope bitterbrush AM of 84% with a mean CR of 91% (Table 4). AM and CR were both increased to 97% by applying 4.4 kg ha^{-1} 2,4-D at the Millard County site (data not shown). Clopyralid applications of 2.2 kg ha^{-1} resulted in an AM of only 5% and CR of 10%.

Saskatoon serviceberry. Saskatoon serviceberry AM at the Wasatch County site was significantly higher on plots treated with 2,4-D than on plots treated with clopyralid (Table 5). Application of 2,4-D at 2.2 kg ha^{-1} resulted in 96% AM and 98% CR of Saskatoon serviceberry while the same rate of clopyralid resulted in only 6% AM. However, clopyralid significantly reduced the mean canopy area of Saskatoon serviceberry, compared to the untreated plots. Saskatoon serviceberry canopies were reduced 12 to 25% by clopyralid.

Potential for selective control. Antelope bitterbrush and Saskatoon serviceberry were highly susceptible to 2,4-D and relatively tolerant of clopyralid at rates to 2.2 kg ha^{-1}. Antelope bitterbrush was slightly damaged by 1.1 or 2.2 kg ha^{-1} applications of clopyralid, but the same rates effectively reduced mountain big sagebrush. However, Saskatoon serviceberry was less tolerant of clopyralid than was antelope bitterbrush.

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[3]Herbicide Handbook of the Weed Science Society of America, 5th Ed.--1983. Weed Sci. Soc. Am., Champaign, Illinois

The reasons for clopyralid's selectivity are not known. Clopyralid remains in plants as the unchanged chemical, yet appears to be fairly selective between certain families[3]. Jacoby et al. (7) reported clopyralid to be effective for honey mesquite (Prosopis glandulosa Torr.# PRCJG) control, yet associated brush and weed species were not controlled as effectively as with herbicides containing picloram (4-amino=3,5,6 trichloro-2-pyridinecarboxylic acid). In another study, clopyralid was effective for selective control of Canada thistle [Cirsium arvense (L.) Scop.# CIRAR] in rapeseed (10).

These data are interpreted to indicate that mountain big sagebrush and threadleaf rubber rabbitbrush can usually be effectively controlled (90% mortality) with 1.1 to 2.2 kg clopyralid ha^{-1} or 4.4 kg 2,4-D ester ha^{-1}. In addition, clopyralid effectively controls big sagebrush without causing significant damage to antelope bitterbrush or Saskatoon serviceberry. Clopyralid may be a potential alternative to 2,4-D for mountain big sagebrush or threadleaf rubber rabbitbrush control when antelope bitterbrush and/or Saskatoon serviceberry are present.

Literature Cited

1. Bovey, R.W. and R.E. Meyer. 1981. Effects of 2,4,5-T, triclopyr and 3,6-dichloropicolinic acid on crop seedlings. Weed Sci. 29:256-261.

2. Bovey, R.W., R.E. Meyer and J.R. Baur. 1981. Potential herbicides for brush control. J. Range Manage. 34:144-148.

3. Cluff, G.J., B.A. Roundy, R.A. Evans and J.A. Young. 1983. Herbicidal control of greasewood (Sarcobatus vermiculatus) and salt rabbitbrush (Chrysothamnus nauseosus spp. consimilis). Weed Sci. 31:275-279.

4. Hitchcock, C.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1969. Vascular plants of the Pacific Northwest. Part 5: Compositae. U. Washington Press, Seattle, WA 343 p.

5. Hyder, D.N., F.S. Sneva, D.O. Chilcote and W.R. Furtick. 1985. Chemical control of rabbitbrush with emphasis upon simultaneous control of big sagebrush. Weeds 6:289-297.

6. Hyder, D.N. and F.A. Sneva. 1962. Selective control of big sagebrush associated with bitterbrush. J. Range Manage. 15:211-215.

7. Jacoby, P.W., C.H. Meadors and M.A. Foster. 1981. Control of honey mesquite (Prosopis juliflora var. glandulosa) with 3,6-dichloropicolinic acid. Weed Sci. 29:376-378.

8. McDaniel, K.C. and J.F. Balliette. 1986. Control of big sagebrush (Artemisia tridentata) with pelleted tebuthiuron. Weed Sci. 34:276-280.

9. Mohan, J.M. 1973. 14 years of rabbitbrush control in central Oregon. J. Range Manage. 26:448-451.

10. O'Sullivan, P.A. and V.C. Kossatz. 1982. Selective control of Canada thistle in rapeseed with 3,6 dichloropicolinic acid. Can. J. Plant Sci. 62:989-993.

11. Young, J.A., R.A. Evans and R.E. Eckert Jr. 1981. Environmental quality and the use of herbicides on Artemisia/grasslands of the U.S. intermountain area. Agric. and Environ. 6:53-61.

CATTAIL (TYPHA SPP.) CONTROL WITH HERBICIDES

Wanda K. Schimming, Kevin B. Thorsness, Michael V. Hickman, Calvin G. Messersmith and Rodney G. Lym[1]

Abstract. Cattail may reduce water movement in drainage and irrigation channels resulting in increased deposition of silt and reduced water transport efficiency. Dense stands in water treatment ponds inhibit water movement resulting in reduced oxygenation and microbial activity. Two species, common cattail (*T. latifolia*) and narrow leaved cattail (*T. augustifolia*), may be found growing in monospecific or intermixed stands throughout North Dakota. Herbicides labeled for cattail control include 2,4-D {(2,4-dichlorophenoxy)acetic acid}, dalapon {2,2-dichloropropanoic acid}, glyphosate {N-(phosphonomethyl)glycine} and until recently, amitrole {1H-1,2,4-triazol-3-amine}.

Two experiments were established in a roadside drainage ditch by the weed science research area at Fargo, North Dakota, to evaluate herbicides labeled for cattail control. Visual evaluations for percent cattail control based on reduction of weed density were taken 2, 10 and 14 months after treatment for Experiment 1 and 2 months after treatment for Experiment 2. Cattail control generally increased between 2 months and 10 months but was declining at 14 months for Experiment 1. Glyphosate at 3.4 kg/ha provided over 89% control on all evaluation dates. Glyphosate at 1.7 kg/ha and amitrole at 5.6 and 11.2 kg/ha provided over 79% control 10 months after treatment. Dalapon and 2,4-D provided less than 50% control Glyphosate was less effective than amitrole for cattail control at 2 months after treatment in Experiment 2, but a better final assessment will be the observations to be taken at 12 months. Glyphosate would be the herbicide of choice for cattail control Amitrole provided good control but no longer is labeled for use in water.

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[1]Department of Agronomy, North Dakota State University, Fargo, North Dakota 58105

TEACHING WEED SEEDLING IDENTIFICATION

J.E. Nelson and P.K. Fay

Abstract. Every year growers lose millions of dollars in wasted chemicals, application costs and yield losses. The reason: improper identification of weeds that results in poor weed control. Proper identification of seedling weeds is the single most important step in making a weed control recommendation.

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[1]Montana State University, Bozeman, Montana

Agriculture is a profession that requires diversified skills. Producers, consultants, agribusiness fieldmen and extension agents often have little or no training in many important areas. Weed identification skills are used intensively only two or three months each year with low user retention from one season to the next. The weed identification process can be difficult and frustrating because of apparent similarities between weed seedlings.

The Montana Cooperative Extension Service has developed a weed seedling identification training workshop to respond to this need. Leadership training was offered to consultants, agribusiness fieldmen and county agents. Trained leaders interested in presenting workshops were provided with necessary materials and support. Materials included the weed seedling pocket guide, identification keys, weed species slide set and weed seed packets. Leaders made arrangements with a local greenhouse business, community college or university research center to grow weed specimens.

Training included grass and broadleaf seedling morphology, weed seedling identification and instruction on proper use of the pocket identification guide and identification keys. The program consisted of pre- and post-training identification quizzes using live plants, plant dissection, slides of 11 grass and 22 broadleaf weed species and hands-on practice with live plants. Workshop attendance was restricted to 30 participants per workshop to protect program quality.

Approximately 100 leaders were trained in 1986. The only leader clientele group that requested support to provide their own training were the county agents. Approximately 250 producers attended nine winter extension workshops in 1986. Pre- and post-testing procedures indicated an average improvement of 300 percent by program participants.

In 1987 the program will again be offered to trained leaders and availability will be expanded to include the high school vocational agriculture curriculum. Weed seedling identification lends itself well to the video medium. Video taped instruction would replace the requirement for trained leaders and may possibly expand program use. Funding is currently being sought to produce video instruction modules.

CHEMICAL CHARACTERIZATION OF LEAFY SPURGE *EUPHORBIA* spp. BY PYROLYSIS GAS CHROMATOGRAPHY

J.M. Torell, J.O. Evans[1], G.S. Reddy and G.G. Smith[2]

Abstract. Patterns of chemical variation in the *Euphorbia esula* L. complex were investigated using curie-point pyrolysis-gas chromatography of latex. Plant propagules (rootstocks) representing populations throughout North America and eastern Europe were used to produce the greenhouse-grown collection of plants used in this study. Fifteen microliters of latex was collected in 400 ul dimethylacetamide and sonicated to produce a suspension. Four to five microliters of this suspension were placed on a 61^{o} C curie-point wire and dried. The curie-point wires were subjected to pyrolysis and

[1]Plant Science Department, Utah State University, Logan, Utah
[2]Department of Chemistry and Biochemistry, Utah State University, Logan, Utah

the pyrolyzate was analyzed by a Hewlett-Packard 5880A gas liquid chromatograph (equipped with a dual FID detector) using a RSL-150 capillary column (0.32 mm ID, 30 m, SCOT). The oven temperature was kept at 50° C for 5 min and then programmed to 200° C at 5° C/min and held at the final temperature for an additional 15 min. Retention times and peak areas were recorded and subjected a principle components analysis to facilitate the recognition of overall patterns of chemical variation.

Reproducibility between replicate samples was excellent with respect to retention times and less consistent with respect to peak areas. Thus, the present data provided an excellent qualitative analysis. A plot of the first two principle components indicate at least two clusters of accessions. Further studies are being conducted by pyrolysis-gas chromatography-mass spectrometry to determine the identity of chemical compounds that are responsible for observed differences.

Introduction

Leafy spurge, (*Euphorbia* spp), is a tenacious deep-rooted perennial weed that is troublesome on large areas of rangeland and pastureland in North America. Leafy spurge in North America was first reported from Massachusetts in 1827 but western infestations are thought to be largely derived from introductions made in the late 1800's. The range of leafy spurge has expanded rapidly despite a concerted control effort utilizing chemical, cultural and biological control methods (Dunn, 1985; Watson, 1985). Leafy spurge accessions have exhibited differential responses to control agents, and it has been suggested that the differential responses are related to a high degree of genetic variability within the *E. esula* complex and the presence of biochemical defenses against herbivory (Nowierski, 1985; Mahlberg, 1984).

Taxonomy and Phytochemistry

Leafy spurge has been variously treated by different taxonomists and several taxa have been described morphologically. These taxa include several putative hybrids and intraspecific taxa. The existence of intergrading morphological forms has complicated the study of taxonomic affinities in this group. Recent cytological evidence indicates that leafy spurge is a segmental allohexaploid derived from hybridization events involving three ancestral diploid species (Radcliffe-Smith, 1985; Schaeffer and Gerhardt, 1985).

An important anatomical feature of leafy spurge is the nonarticulated laticifer, a multinucleate cell that is initiated in the embryo and grows intrusively throughout the plant. The laticifer is responsible for the production of the milky latex that is exuded when a leafy spurge plant is cut. The latex is a complex mixture of chemical compounds that are thought to have systematic and ecological importance. Latex triterpenoids have proven useful in the analysis of species relationships in many euphorbiacious plants. Secondary products of the laticifer are thought to have defensive functions against herbivory. Thus, laticifer phytochemistry may be the key to understanding taxonomic affinities within the *E. esula* complex and the molecular basis for the response of leafy spurge accessions to biocontrol agents (Mahlberg, 1984).

Pyrolysis Gas Chromatography

Pyrolysis gas chromatography is a form of analytical pyrolysis which utilizes pyrolytic methods to make complex mixtures of biological molecules amenable to separation by gas chromatography. Pyrolysis is the thermal degradation of organic compounds in the absence of oxygen to form fragments that are characteristic of the parent material. The curie-point pyrolyzer consists of an evacuated chamber in which sample coated curie-point wires are placed between two inductive coils. The ferromagnetic curie-point wire is composed of an alloy designed to reach a desired temperature (the curie point) when it becomes paramagnetic after rapid heating between the inductive coils. The pyrolysis fragments (pyrolyzate) are swept into the injection port of the gas chromatograph and are separated on an analytical column by partition between the gaseous moving phase and the liquid stationary phase. Conventional packed columns or capillary columns may be used but capillary columns are preferable for separations involving complex pyrolyzates because they have a much higher number of theoretical plates. As individual products leave the column, a detector sends a signal to the recorder which prints the peaks. The record of peaks from a single sample is known as a pyrogram. Most instruments record the retention time and area under each peak. The retention time provides a qualitative indication of the presence of a compound while the peak area is directly proportional to quantity. Compounds may be tentatively identified by comparison of standard peaks with those present in the pyrogram of a biological sample. Stronger evidence for the identification of pyrolyzate components is achieved by interfacing the py-gc system with a mass spectrometer or fourier transform infrared spectrometer. Computer library search techniques are frequently used to facilitate comparison of complex spectra (Irwin, 1979).

The objectives of this study were: 1) to determine overall patterns of biochemical variation within the Euphorbia esula L. complex; 2) to evaluate pyrolysis gas chromatography as an analytical tool in plant chemosystematics; and 3) to determine taxonomic affinities within the Euphorbia esula L. complex based upon biochemical evidence.

Materials and Methods

Propagules from leafy spurge plants representing populations in North America and Europe were acquired, and a collection of greenhouse-grown plants was established. Fifteen microliters of latex was collected in 400 microliters of dimethylacetamide and sonicated for one hour to form a more uniform suspension. Polystyrene was added as an internal standard. Three to five microliters of sample were applied to a 610^{o} C curie-point pyrolysis wire contained in a sample tube. The wires were rotated to insure uniform removal of solvent. The curie-point wires were subjected to pyrolysis, and the pyrolyzate was analyzed with a Hewlett-Packard 5880A gas liquid chromatograph equipped with a dual flame ionization detector and a RSL-150 support coated open tubular capillary column (0.32 mm ID x 30 m). Oven temperature was programmed at 50^{o} C for the first 5 minutes and 5^{o} per minute increase thereafter to a maximum temperature of 200^{o} C. The carrier gas was helium and the flow rate was 40 ml per minute. Retention times were recorded and peak areas were determined by an electronic integrator.

Pyrolytic techniques were developed as an alternative to derivatization of samples for gas chromatography. Initially, pyrolytic analyses were directed at synthetic polymers that degrade in a reproducible way. In recent years py-gc has been successfully applied to taxonomic problems in microbiology as a means of providing a chromatographic phenotype that represents the overall biochemical composition of the organism. Pyrolysis mass spectrometry, a similar pyrolytic technique, has been applied to the study of leafy spurge and the Triticeae grasses (Torell and Evans, 1985; Windig et al. 1981)

Results and Discussion

Reproducibility between replicate samples was excellent with respect to retention times and less consistent with respect to peak areas. Thus, the pyrograms provided an excellent qualitative analysis of pyrolyzate components. Further studies are being conducted by pyrolysis gas chromatography/mass spectrometry to determine the identity of chemical compounds that are responsible for observed differences between pyrograms of different leafy spurge accessions.

This study indicates that pyrolysis gas chromatography is a useful tool for rapidly generating a biochemical phenotype for a plant. Differences between accessions are discernable by visual inspection of pyrograms (Fig. 1).

Literature Cited

1. Dunn, P.H. 1985. Origins of leafy spurge in North America. pp. 7-14. In: Watson, A (ed) Leafy Spurge. Monograph Series No. 3. Weed Science Society of America.

2. Irwin, W. 1979. Analytical pyrolysis--an overview. J. Anal. Appl. Pyrolysis 1:3-25.

3. Mahlberg, P. 1984. Personal Communication

4. Nowierski, R. 1985. Prospects for biological control of leafy spurge. pp. 90-95. 1985 Leafy Spurge Symposium, Bozeman, Montana.

5. Radcliffe-Smith, A. 1985. Taxonomy of North American Leafy Spurge. pp. 14-25. In: Watson, A. (ed)

6. Schaeffer, J.R. and S. Gerhardt. 1985. Cytogenetics of leafy spurge. pp. 19-20. Leafy Spurge Symposium. Bozeman, Montana.

7. Torell, J. and J.O. Evans. 1985. Biochemical studies of the *Euphorbia esula* complex. pp. 38-39. 1985 Leafy Spurge Symposium. Bozeman, Montana.

8. Windig, W., H.L.C. Meuzelaar, B.A. Haws, W.F. Campbell and K.H. Asay. 1983. Biochemical differences observed in pyrolysis mass spectra of range grasses with different resistance to attack by *Labops hesperius* Uhler (Hemiptera:Miridae). J. Anal. Appl. Pyrol. 5:183-198.

9. Watson, A. 1985. Introduction -- the leafy spurge problem. pp. 1-6. In: Watson, A. (ed)

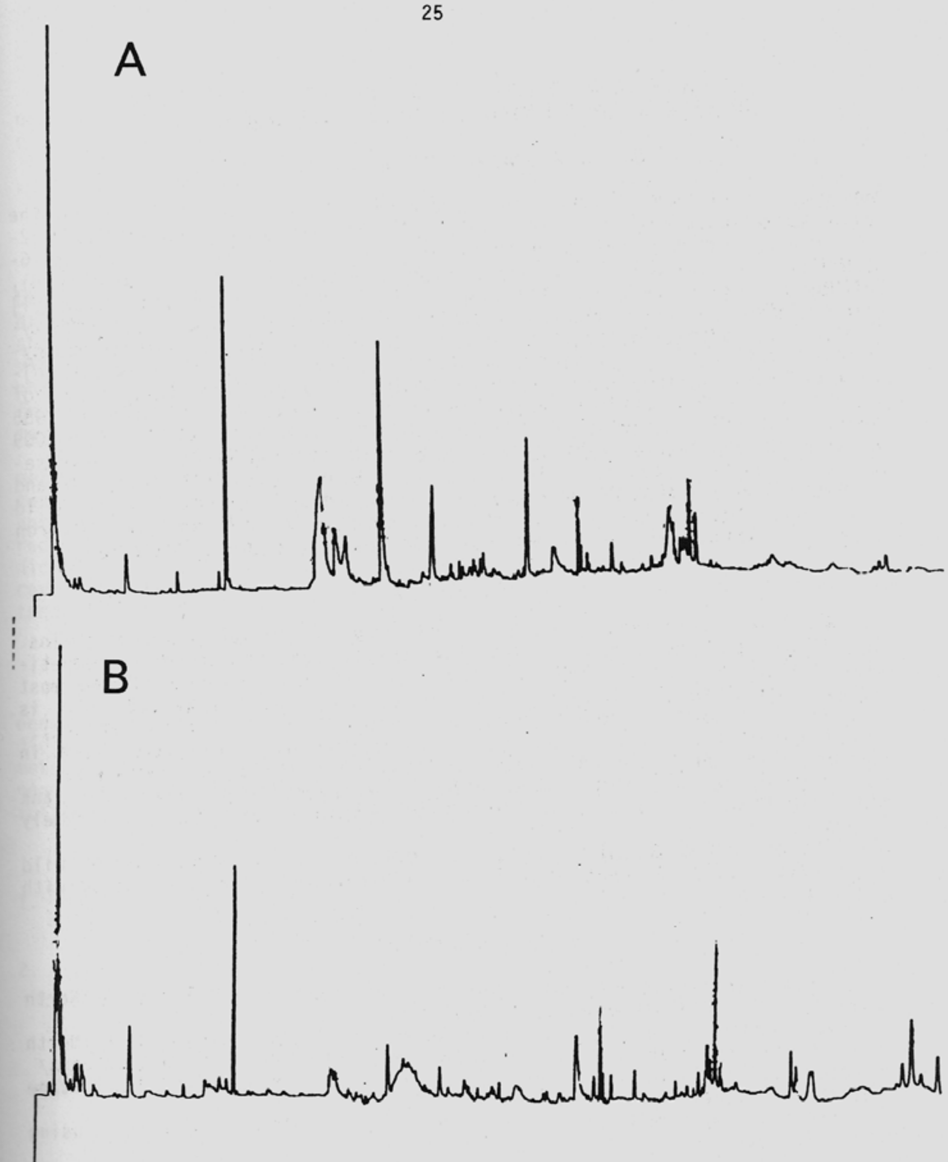

Figure 1. Pyrograms of latex from two leafy spurges (A & B) collected in Hungary.

THE INTERACTION BETWEEN THE SULFONYLUREA HERBICIDES AND DICLOFOP-METHYL ON CONTROL OF WILD OAT (AVENA FATUA L.)

Robert W. Downard and John O. Evans[1]

Abstract. Field experiments were conducted for two years to determine the influence of chlorsulfuron {2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino] carbonyl] benzenesulfonamide}, metsulfuron {2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino] carbonyl] amino]sulfonyl] benzoic acid}, DPX-M6316 {methyl 3-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] amino sulfonyl]-2-thiophenecarbonylate} and DPX-R9674 {methyl 3-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl]amino=carbonyl]amino-sulfonyl]-2-thiohenecarbonylate + methyl 2-[[[[[3-(4-methoxy-6-methyl-1,3,5-triazin-2yl)N-methyl]amino]-carbonyl]amino]sulfonyl]benzoate} in combination with the methyl ester of diclofop {2-[4-(2,4-dichlorophenoxy)phenoxy] propanoic acid}. Studies in 1985 showed that chlorsulfuron, DPX-M6316 and DPX-R9674 at rates of .018 and .009 kg ai/ha in combination with diclofop-methyl at .84 kg ai/ha did not adversely affect wild oat control. In 1986 chlorsulfuron and DPX-R9674 at .018 and .009 kg ai/ha and DPX-M6316 at .018 kg ai/ha did not adversely affect wild oat control when tank mixed with diclofop-methyl. In both years metsulfuron severely affected wild oat control when tank mixed with diclofop-methyl.

Introduction

Wild oat is a serious weed in annual crops, particularly cereal grains. Pavlychenko and Harrington (1) classified weeds according to their competitive ability in cereals and reported that wild oat was one of the most serious competitors. In North America, Australia and Europe wild oat is considered the most economically harmful annual weed of cultivated land (2).

Grain producers would like to control wild oat and broadleaved weeds in one herbicide application to reduce trampling of crops and to lower costs.

A characteristic which makes sulfonylurea herbicides promising for tank mixing with diclofop-methyl is their high herbicidal activity at extremely low rates.

The objective of this study was to determine if an antagonism on wild oat control occurred when the sulfonylurea herbicides where tank mixed with diclofop-methyl.

Materials and Methods

Field experiments were conducted at Logan, Utah, in 1985, and in North Logan in 1986. Plot size was 2.7 m by 7.6 m.

Oat counts (Avena sativa L.) at Logan and (Avena fatua L.) at North Logan at the time of herbicide application were 160 plants/m^2 and 25 plants/m^2 respectively. Herbicide treatments were applied at the 1- to 3-leaf stage in 1985 and at the 3- to 4-leaf stage in 1986.

Treatments were applied at a rate of 187 L/ha, 207 kPa and 4 km/hr using 8002 Teejet nozzles.

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[1]Plant Science Department, Utah State University, Logan, Utah

One square meter plots were harvested from within each treatment. The oats were then separated from grain and counted, and the grain was threshed, cleaned and weighed.

Each experiment was a 4 by 3 factorial plus five controls with four replications.

Results

In 1985 combinations of diclofop-methyl with chlorsulfuron, DPX-M6316 or DPX-R9674 at a rate of .009 or .018 kg/ha appeared to have no antagonistic effect. The combination of metsulfuron and diclofop-methyl did indicate an antagonism (Fig. 1). The number of panicles/m^2 closely correlated with visual evaluations, with the exception of diclofop-methyl in combination with metsulfuron at a rate of .018 kg/ha which showed no significant difference from compatible herbicide combinations (Fig. 2). Poor oat control in 1985 may have resulted from high plant densities/m^2.

Results from the 1986 experiment indicated combinations of diclofop-methyl with chlorsulfuron and DPX-R9674 had no detrimental effect on oat control. DPX-M6316 with diclofop-methyl at a rate of .009 kg/ha had no antagonistic effect on wild oat control, whereas at the rate of .018 kg/ha a reduction in wild oat control was observed. Metsulfuron in combination with diclofop-methyl did reduce wild oat control (Fig. 3). The panicle/m^2 closely correlated with visual evaluations, but the only statistically different treatment was the weedy check (Fig. 4).

Conclusions

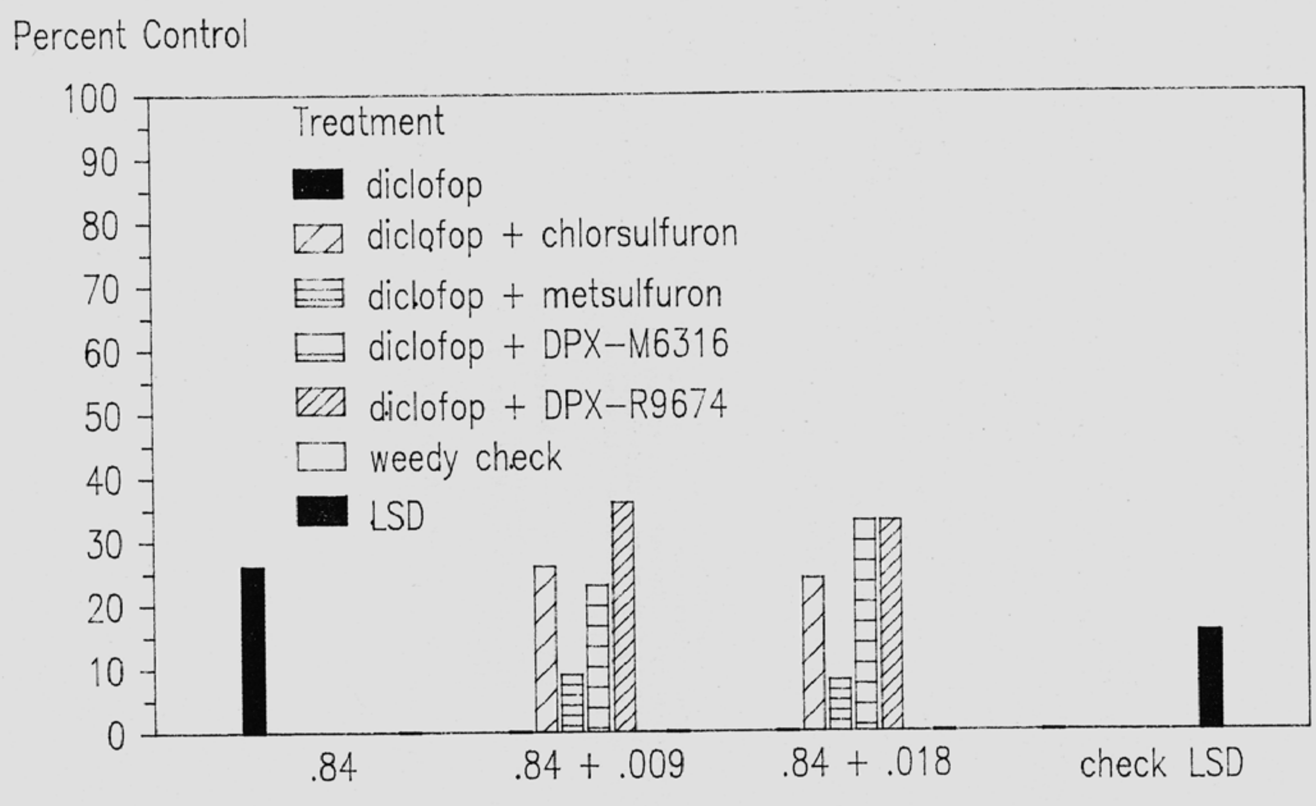
The results indicate no antogonistic interaction to wild oat control occur when chlorsulfuron. DPX-M6316 and DPX-R9674 are tank mixed with diclofop-methyl. However, reduced control of wild oat is encountered when metsulfuron is tank mixed with diclofop-methyl. This investigation illumates need for further research to determine the extent of these herbicide interactions.

References

1. Nalewaja, J.D. 1977. Wild oats: global gloom. Proc. West. Soc. Weed Sci. 30:21-32.

2. Pavlychenko, T.K. and J.B. Harrington. 1934. Competitive efficiency of weeds and cereal crop. Can. J. Res. 10:77-94.

Figure 1. Evaluation of herbicide treatments on control of *Avena sativa* L. in 1985



diclofop (refers to methyl ester)

Figure 2. Evaluation of herbicide treatments on the number of panicles per square meter of Avena sativa L. in 1985

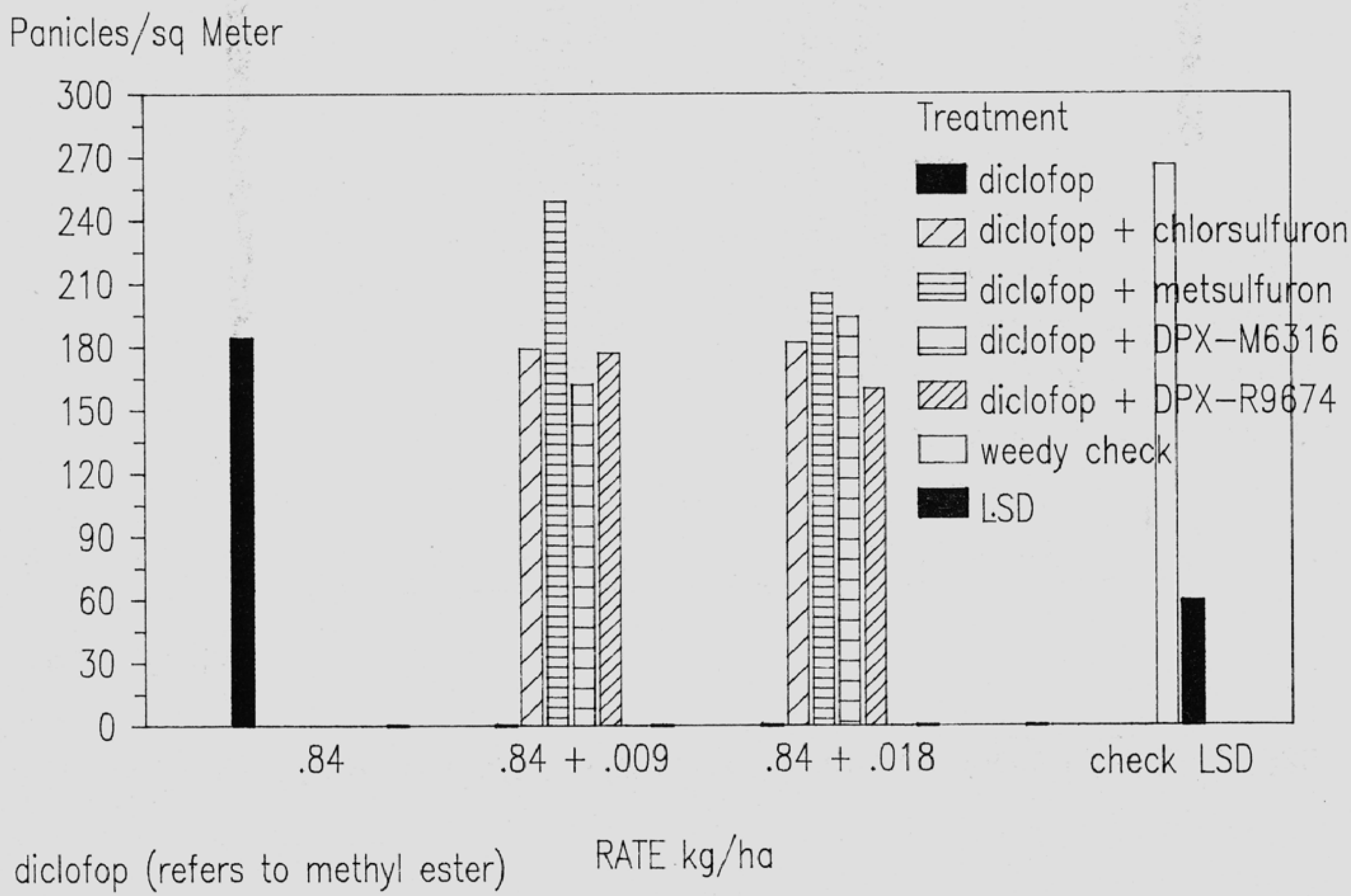


Figure 3. Evaluation of herbicide treatments on control of *Avena fatua* L. in 1986

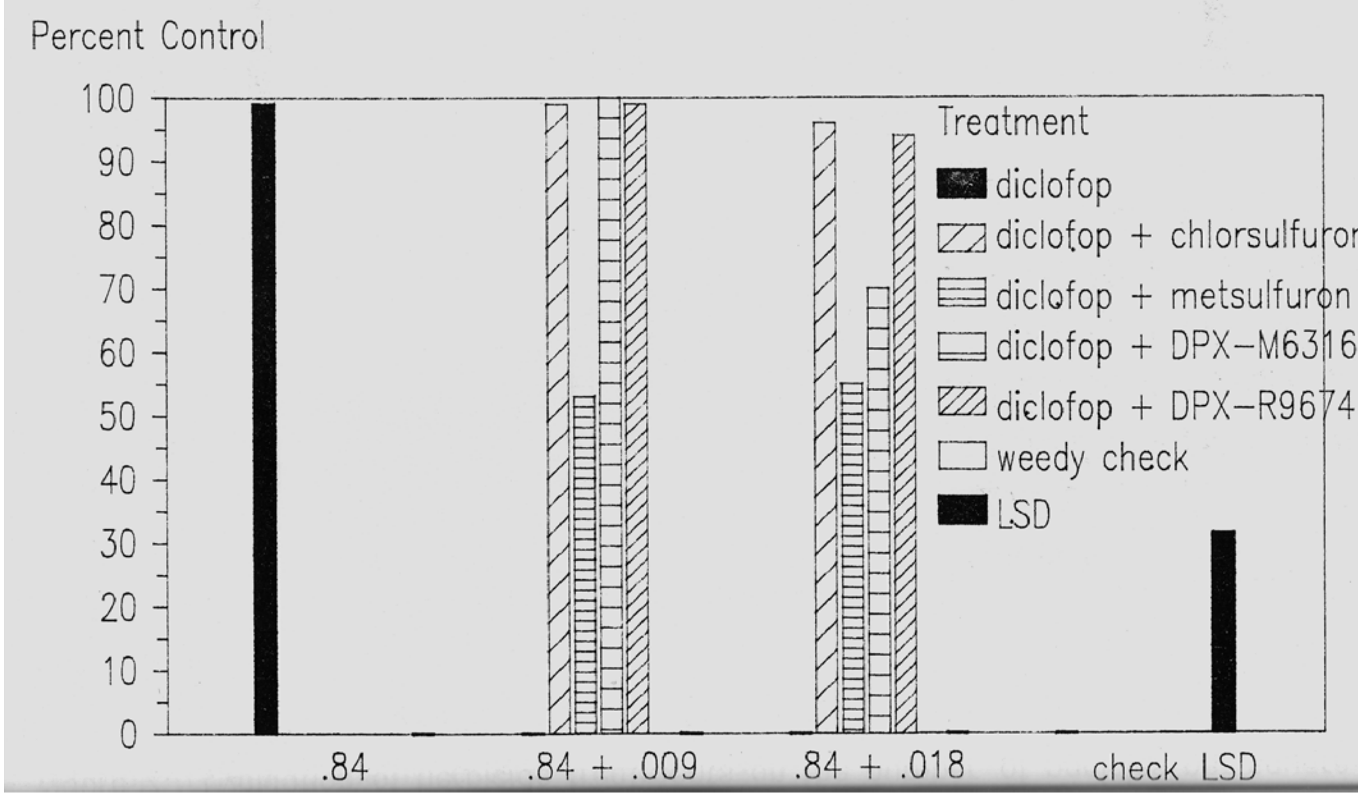
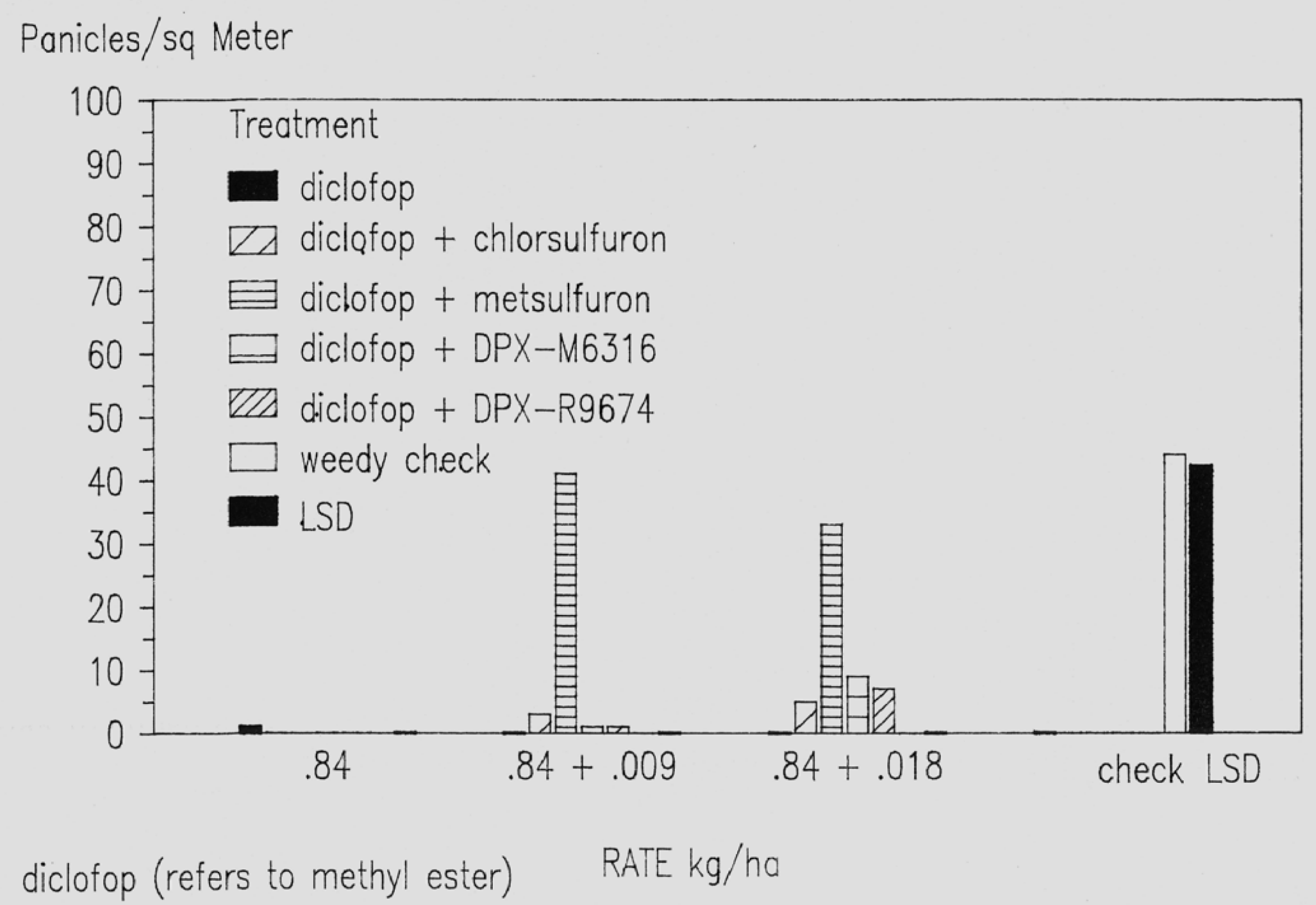


Figure 4. Evaluation of herbicide treatments on the number of panicles per square meter of *Avena fatua* L. in 1986



PHOTOSYNTHETIC RESPONSE OF FIELD BINDWEED TO DIFFERENT LIGHT INTENSITIES

H. R. Mashhadi, J. O. Evans and B. G. Bugbee[1]
Utah State University, Logan

INTRODUCTION

Field bindweed (Convolvulus arvensis L.) is a unique weed capable of growing and competing with established perennial shrubs. Bindweed appears to be able to establish itself in environments with very low light intensities. This may be due to several factors:

1. The leaves may be able to acclimate to low light environments during initial growth stages,

2. Bindweed plants may use their extensive root reserves to initiate new growth, and

3. Unique morphological characteristics of slender twining stems may require minimum carbon for initiate shoot growth. The stems attach to surrounding plants and bindweed rapidly climbs above the existing canopy.

Bakke (1939) reported that shaded bindweed plants lost their prostrate habit and became twining plants. Bakke and Gassler (1940) determined the effect of various light intensities on aerial and subterranean parts of field bindweed and reported substantial decreases in total available root carbohydrates when plants were subjected to four years of reduced light intensities of 650 ft. candle (130 umoles m^{-2} s^{-1}).

Low light acclimation of plants has been well studied. Sun species such as Atriplex triangularis strongly adapts to the radiation environment in which they were grown . (Bjorkman et al. 1972). Studies on identical genotypes grown under different light regimes, and comparisons between sun and shade leaves of the same individual plant, demonstrate that the light response characteristics of a given plant or individual leaf may be strongly modified by the light intensity (Bjorkman 1981). The photosynthetic response of plants to quantum flux thus represents a combination of both genetic and environmental influences.

Richards (1986) studied the grazing tolerance of two bunchgrass species and found that photosynthesis during regrowth after grazing outweighed stored carbohydrates as a source of carbon for shoot regrowth. Richards and Caldwell (1985) reported that Agropyron desertorum, a grazing-tolerant bunchgrass, consistently produced more regrowth in the absence of photosynthesis (total darkness) than A. Spicatum, a less grazing tolerant plant. Meristematic limitation appeared to be the major factor that could explain the difference between the two species. No correlations were found between regrowth and crown non-structural carbohydrate concentrations, total pool, or amount utilized during regrowth.

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[1]Plant Science Department, Utah State University, Logan, Utah

The ability of field bindweed plants to initiate growth under extremely low light environment prompted a study of the response of field bindweed to varying amounts of photosynthetic photon flux (PPF).

Materials and Methods

Field bindweed seeds, collected in the field near Logan, Utah, were soaked in 16 M sulfuric acid for one hour and water rinsed for 15 minutes. Scarified bindweed seeds were planted in vermiculite and irrigated with half strength modified Hoagland Solution. Three-week-old bindweed seedlings were transferred to nutrient solution and grown in a greenhouse under 16-hour photoperiod of natural and supplemental high pressure sodium lights (300 umoles m^{-2} s^{-1}). The greenhouse temperature was $25^{o}/18^{o}C$ (± 4) day/night temperature. Six, uniform, five-week-old bindweed plants were transferred to a whole plant gas exchange system in a growth chamber as described previously. (Mashhadi et al. 1986). Light was varied by placing different mesh screens between the plant chambers and the lights. There were six plant chambers and the results are the average of the six replications.

A Licor quantum sensor was used to measure PPF on a sunny August mid day at soil level near bindweed stem that were growing under a dense canopy of juniper shrubs.

Results and Discussion

Photosynthetic rate of field bindweed showed a linear response to PPF levels. The light compensation point was about 65 umoles m^{-2} s^{-1} PPF. Photosynthesis and transpiration both decreased at the same rate in response to decreasing PPF. There was a small amount of transpiration even in darkness. This is probably due to cuticular transpiration, but the stomates may not have closed completely. PPF measured under the juniper shrubs at the soil level was between 28 to 62 umoles m^{-2} s^{-1} depending on the density of juniper. This was below the light compensation point of the greenhouse grown bindweed plants. It was also noted that the lower leaves on the bindweed stem under the juniper canopy were mostly abscised or chlorotic. Bindweed stems further from sunlight had longer internodes.

We propose two possible mechanisms to explain the ability of bindweed to become established in these low light levels:

1. The leaves may have adapted to low light, and/or

2. Root reserves were used to support the initial growth stages.

More research is needed to elucidate the mechanisms involved.

Literature Cited

Bjorkman, O., N. K. Boardman, J. M. Anderson, S. W. Thorne, D. J. Goodchild, and N. A. Pyliotis. 1972. Effect of light intensity during growth of Atriplex patula on the capacity of photosynthetic reactions, chloroplast components and structure. Carnegie Inst. Washington Yearb. 71:115-135.

Bjorkman, O. 1981. Responses to different quantum flux densities. In Encyclopedia of Plant Physiology, New Series Volume 12A, Pirson, A. and M. H. Zimmermann, (eds.). Springer-Verlag, Berlin .

Mashhadi, H. R., B. G. Bugbee and J. O. Evans. 1986. The use of direct photosynthetic measurement in herbicide research. Proc. West. Soc. Weed Sci. 39:44-50.

Richards, J. H. 1986. Plant response to grazing. The role of photosynthetic carbon capacity and stored carbon reserves. In Rangelands: A Resource Under Siege; Proceedings of the Second International Rangeland Congress, Joss, P.J., P. W. Lynch and O. B. Williams, (eds.). Austral. Acad. Sci., Canberra.

Richards, J. H. and M. M. Caldwell. 1985. Soluble carbohydrates, concurrent photosynthesis and efficiency in regrowth following defoliation: A field study with Agropyron species. J. Appl. Ecol. 22:907-920.

EFFECT OF PPG-1721, PLANT GROWTH REGULATOR ON GRAPES AND ALMONDS

T.C. DeWitt, W.D. Edson and F.R. Taylor

Abstract. GRAPES--PPG-1721 was applied at prebloom and bloom time to "Flame Seedless" grapes to evaluate the effect on brix and bunch shatter at harvest. Applications were made at a test site near Visalia, California, with a handgun sprayer at the rate of 200 GPA.

PPG-1721 was applied at cane elongation at concentrations of 0, 25, 50 and 100 ppm. Brix data, taken two weeks prior to harvest, indicated that the 25 and 50 ppm concentrations increased sugar significantly over the control. The greatest increase was observed at the 25 ppm concentration level. However, as the concentration increased, brix levels decreased. Bunch shatter information indicated that PPG-1721 reduced bunch shatter significantly over the control. Average shatter reduction was 32% when compared to the control.

Sequential applications of PPG-1721 were applied during bloom and post bloom at concentrations of 12+12 and 25+25 ppm. Both treatments were compared to the standard GA+GA (5 + 40 ppm) treatment. Brix data, taken two weeks prior to harvest, indicated that sugar levels were increased significantly in the PPG-1721 (12+12) and GA+GA treatments. Bunch shatter information indicated that both PPG-1721 treatments showed trends for a reduction of shatter.

Sequential applications of PPG-1721 and GA_3 (PPG-1721/GA and GA/PPG-1721) were made at standard GA_3 timing of bloom and post-bloom stages. PPG-1721 was applied at both stages at a concentration of 12 or 25 ppm and GA_3 at standard commercial rates. Boom-time applications of PPG-1721 followed by GA_3, applied post-bloom, resulted in a significant increase in brix levels compared to the control and the standard GA+GA treatment. A significant reduction of bunch shatter from early application of PPG-1721 was observed at

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[1]PPG Industries, Inc., One PPG Place, Pittsburgh, Pennsylvania 15272

both concentrations. The greatest reduction in bunch shatter was observed from the early application timing when PPG-1721 was applied at 50 ppm. All of the PPG-1721 combinations were better than the standard GA+GA treatment.

ALMONDS--PPG-1721 was evaluated as a bloom-time treatment to mature "Nonparial" almonds to determine the effect on nut set and yield. The treatments were applied at a test site on the Fresno State University Farm with a handgun sprayer at an application rate of 400 GPA. PPG-1721 was applied at pinkbud, popcorn and 30% bloom at concentrations of 0, 12, 25 and 50 ppm.

Nut set data taken after the completion of June drop, showed a significant increase in set at all application concentrations. There were no significant differences between application timings. Increase in set ranged from 15 to 54% over the control depending on the application.

Yields were unusually low in this trial, averaging 470 meat pounds per acre. The highest yield, approximately 32% over the control, was observed at the popcorn application timing of PPG-1721 at the 50 ppm concentration. A significant increase in total nut weight was observed as the concentration increased, regardless of application timing. The average kernel weight increase was 5% over the control.

THE WATER INCORPORATION OF PREEMERGENCE HERBICIDES

Arthur H. Lange and Kurt F. Lange[1]

Abstract. One of the major ways of activating herbicides is with rainfall. The amount and timing of rainfall or sprinkler irrigation after applying a preemergence herbicide is far from an exact science and yet the initial irrigation often makes the difference between selectivity and failure in the use of herbicides. The total effect of moisture after application is not well documented for most herbicides. The initial amount falling on a preemergence herbicide and how soon this water arrives on the scene has proven to be critical with some herbicides like trifluralin {2,6-dinitro N,N-dipropyl-4-(trifluoromethyl)benzenamine}, EPTC {S-ethyl dipropyl carbamothioate}, napropamide {N,N-diethyl-2-)1-naphthalenyloxy)propanamide}, prodiamine {2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine} and norflurazon {4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone}. Herbicides like simazine {6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine} and oryzalin {4-(dipropylamino)-3,5-dinitrobenzenesul fonamide} seem to be affected less by amount and timing than even some related herbicides.

Recent work with metham (methylcarbamodithioic acid), a very soluble herbicide, has demonstrated the importance of the amount and method of applying the water. While most insoluble preemergence herbicides work well applied to the surface followed by the water of incorporation, metham worked best when applied <u>with</u> the water of incorporation. Filling the profile with metham dissolved in water when weed or disease control is needed has been very effective. A limited amount of work applying insoluble herbicides in the water of incorporation suggests this method may also be best for all

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[1]Herbicide Research Institute, Reedley, California

herbicides, soluble and less soluble. More work is needed to prove this hypothesis. The whole area of herbicide movement needs a great deal of study. We have only scratched the surface with a few herbicides.

The current study presented in this poster covers work with two relatively insoluble herbicides floumeturon {N,N-dimethyl-N'[3(trifluoromethyl)-phenyl]urea), alachlor 2-chloro-N-(2,6-diethylphenyl]-N-(methoxymethyl-acetamide}, and one very soluble herbicide, metham. The importance of the initial amount of irrigation on alachlor appeared less striking than on a more insoluble fluometuron. An increased amount of initial irrigation over fluometuron treated soil increased the phytotoxicity to cotton and soybean and reduced the weed control. A decrease in selectivity was also shown but to a lesser extent with alachlor.

The timing of planting crops after metham application was important in the use of metham (ppi). Some initial phytotoxicity appeared as a result of planting three days after application. This disappeared with time and appeared masked by the effect on weed control and other positive growth effects. At the same time the greater interval between application and planting appeared to be less phytotoxic and show less positive growth response. The selectivity of ppi application of metham appeared to be affected by the amount of metham applied and by the amount of water used to incorporate this herbicide. More work is also needed to better describe the effect of water on the movement of metham in several soil types. This will be very important in the control of annual weeds and the growth of subsequently planted crops. Whether the crop is small seeded or large seeded, depth of planting and the condition of the seed as to whether imbibed or dry, all appear to be important. We have shown that transplants are more sensitive to metham than direct seeded crops.

Water, particularly during or after herbicide application, greatly influences the activity and the selectivity of herbicides. The effects are often dramatic and deserving of considerable attention by researchers.

WSWS SURVEY OF COMMON AND TROUBLESOME WEEDS IN TWELVE WESTERN STATES

Larry W. Mitich and Guy B. Kyser[1]

Information solicited from:
Alaska - J.S. Conn
Arizona - E.S. Heathman and P. Ogden
California - D.W. Cudney, C. Elmore, W.B. McHenry, L.W. Mitich, A.H. Lange, and R. Morris
Colorado - K.G. Beck
Hawaii - R.K. Nishimoto and P.S. Motooka
Idaho - R.H. Callihan
Montana - J. Nelson, P. Fay and J. Lacey
New Mexico - R.D. Lee
Oregon - R.D. William, G. Crabtree, R. Wagner and A. Appleby
Utah - S.A. Dewey and J.L. Anderson
Washington - R.H. Callihan
Wyoming - T. Whitson and M. Ferrell

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[1]Weed Scientist and Research Assistant, Cooperative Extension, University of California, Davis 95616

The original intent was to obtain lists of the 10 most common and 10 most troublesome weed species in important crop and vegetation management situations for the 12 western states. Several factors influenced the process of compilation: 1) respondents had varying ideas as to the purpose of the survey, and they supplied weed lists ranging from extremely general (including entire plant classes) to very specific (including local variations of recognized species); 2) common names supplied were difficult to classify, or conversely, botanical nomenclature was given for species without standardized WSSA common names; 3) weed lists were not ranked in order of severity so that lists of more than 10 weeds could not be truncated.

Though responses were inconsistent in format, or incomplete in some cases, the information received yields a fairly clear picture of the current problem weed species. If extra information was included in a response, it was included here (within reason).

Table 1 summarizes the most important weeds of the 12 states surveyed. Weeds are listed in decreasing order of importance; those which appeared to be of comparable importance are listed alphabetically by genus. Weeds were usually grouped generically to gain a better understanding of the problem. Where closely related species were individually significant (e.g., Solanum spp. in dry beans), they were tabulated separately; in other cases (e.g., perennial grasses of different genera in certain crops), genera were grouped to provide a broader picture. Many weeds of the Compositae, though probably similar in growth and reproductive habits, defied grouping; we feel this family is under represented in Table 1.

Another factor which hindered construction of a realistic summary was great interstate variation in weeds of certain situations. The differences between states in weeds of pastures, forests and rangeland, and roadsides and industrial areas probably reflect differences in native species, whereas more ubiquitous weeds of agronomic crops may reflect seed contamination.

Tables 2 and 3 list all weed species found in the agronomic and horticultural crops surveyed; i.e., alfalfa, dry beans, corn, cotton, small grains, sugarbeets, fruits, vegetables, ornamentals, turf, and pasture and hay crops were included in these tables, whereas forest/rangeland weeds and weeds of industrial areas were not. Table 2 lists 198 common weeds, and Table 3 lists 210 troublesome weeds.

Naturally, the weeds of Hawaii differed greatly from those of the continental states; Hawaii thus contributed more than its 'share' to the total species lists (Tables 2 and 3). Even so, the weed problems of this state are inadequately portrayed, as many economically important weeds in Hawaii are found in sugarcane, an important Hawaiian crop not included in the survey.

In Tables 4 and 5 are listed agronomic/horticultural weed species which were unique to either the common weed lists or the troublesome weed lists. There were more unique troublesome weeds than unique common weeds. Similar findings are reported in the Southern Weed Science Society 1984 Research Report 2; as C.D. Elmore states in that publication, "The most troublesome list includes almost all of the common weeds plus those uncommon ones that are hard to control" (p. 193). These "uncommon" weeds doubtless reflect regional variation.

Original responses to the survey are presented in Table 6. Table 7 lists common and scientific names of weeds which are not listed in the WSSA "Composite List of Weeds."

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[2] Southern Weed Science Society Research Report, Volume 37, January 1984, pages 192-198.

Table 1. Overall summary for the 12 western states

ALFALFA

Common	Troublesome
Setaria spp.	_Setaria_ spp.
Bromus spp.	_Bromus_ spp.
Sysimbrium spp.	_Echinochloa_ spp.
Echinochloa spp.	Common dandelion
Quackgrass	Quackgrass
Amaranthus spp.	_Amaranthus_ spp.
Canada thistle	Canada thistle
Common dandelion	Mustards
Mustards	Kochia
Hordeum spp.	Shepherdspurse

DRY BEANS

Common	Troublesome
Amaranthus spp.	_Amaranthus_ spp.
Chenopodium spp.	Hairy nightshade
Hairy nightshade	_Chenopodium_ spp.
Echinochloa spp.	_Echinochloa_ spp.
Kochia	Kochia
Setaria spp.	_Setaria_ spp.
Black nightshade	Black nightshade
Cutleaf nightshade	Cutleaf nightshade
Canada thistle	Canada thistle
Field bindweed	Field bindweed

CORN

Common	Troublesome
Amaranthus spp.	_Setaria_ spp.
Echinochloa spp.	_Amaranthus_ spp.
Setaria spp.	_Echinochloa_ spp.
Kochia	Perennial grasses (johnsongrass, bermudagrass, quackgrass)
Perennial grasses (johnsongrass, bermudagrass, quackgrass)	Field bindweed
Solanum spp.	_Panicum_ spp.
Chenopodium spp.	_Solanum_ spp.
Field bindweed	Nutsedge spp.
Helianthus spp.	Kochia
Panicum spp.	Russian thistle

COTTON

Common	Troublesome
Amaranthus spp.	Perennial grasses (bermudagrass, johnsongrass)
Echinochloa spp.	Morningglory spp.
Perennial grasses (bermudagrass, johnsongrass)	_Amaranthus_ spp.
Cyperus spp.	_Cyperus_ spp.
Morningglory spp.	
Solanum spp.	

SMALL GRAINS

Common	Troublesome
Wild oats	Wild oats
Bromus spp.	_Salsola_ spp.
Salsola spp.	_Bromus_ spp.
Sysimbrium spp.	Field bindweed
Chenopodium spp.	Jointed goatgrass
Polygonum spp.	Kochia
Canada thistle	Canada thistle
Field bindweed	_Descurainia_ spp.
Kochia	_Chenopodium_ spp.
Mustards	Coast fiddleneck

SUGARBEETS

Common	Troublesome
Chenopodium spp.	_Solanum_ spp.
Solanum spp.	_Amaranthus_ spp.
Amaranthus spp.	_Chenopodium_ spp.
Setaria spp.	_Setaria_ spp.
Kochia	Kochia
Echinochloa spp.	_Echinochloa_ spp.
Polygonum spp.	_Polygonum_ spp.
Salsola spp.	_Salsola_ spp.
Volunteer grains	Volunteer grains

FRUITS

Common	Troublesome
Perennial grasses (bermudagrass, johnsongrass, quackgrass)	Perennial grasses (bermudagrass, johnsongrass, quackgrass)
Field bindweed	Field bindweed
Sandbur spp.	_Bromus_ spp.
Mustards	Sandbur spp.
Echinochloa spp.	Common dandelion
Amaranthus spp.	Canada thistle
Canada thistle	_Conyza_ spp.
Common dandelion	_Echinochloa_ spp.
Bromus spp.	Volunteer legumes
Kochia	Mustards

VEGETABLES

Common	Troublesome
Amaranthus spp.	All mustards
Chenopodium spp.	_Cyperus_ spp.
Echinochloa spp.	_Amaranthus_ spp.
Common purslane	_Chenopodium_ spp.
All mustards	Common purslane
Cyperus spp.	Field bindweed
Perennial grasses (johnsongrass, quackgrass)	_Solanum_ spp.
Malva spp.	_Malva_ spp.
Solanum spp.	Perennial grasses (johnsongrass, quackgrass)

ORNAMENTALS

Common	Troublesome
Perennial grasses (bermudagrass, quackgrass)	Perennial grasses
Cyperus spp.	Bluegrass spp.
Bluegrass spp.	_Cyperus_ spp.
Oxalis spp.	_Oxalis_ spp.
Common groundsel	Canada thistle
Sowthistle spp.	Common groundsel
	Spurge spp.
	Sowthistle spp.

continued

Table 1 continued

TURF		PASTURE		FORESTS AND RANGELAND	
Common	**Troublesome**	**Common**	**Troublesome**	**Woody weeds**	**Herbaceous weeds**
Annual bluegrass	Spurge spp.	Cirsium spp.	Barley spp.	Artemisia spp.	Astragalus spp.
Spurge spp.	Annual bluegrass	Barley spp.	Cirsium spp.	Oak spp.	Bromus spp.
Crabgrass spp.	Black medic	Bromus spp.	Perennial grasses	Snakeweed spp.	Cirsium spp.
Common dandelion	Polygonum spp.	Perennial grasses	(bermudagrass,	Juniper spp.	Centaurea spp.
Black medic	Common dandelion	(bermudagrass,	johnsongrass,	Rabbitbrush spp.	Hoary cress
Polygonum spp.	Cyperus spp.	johnsongrass,	quackgrass)	Chamise	Dalmatian toadflax
Chickweed spp.	Bentgrass spp.	quackgrass)	Centaurea spp.	Willow spp.	Lupine spp.
Plantain spp.	Field bindweed	Common dandelion	Dock spp.	Manzanita spp.	
Fescue spp.	Crabgrass spp.	Amaranthus spp.	Bromus spp.	Ceanothus spp.	
Oxalis spp.	Fescue spp.	Kochia	Solanum spp.	Maple spp.	
		Russian thistle	Spurge spp.		
		Setaria spp.	Common dandelion		

ROADSIDES, RIGHTS-OF-WAY, AND INDUSTRIAL AREAS		MOST COSTLY WEEDS	WEEDS OF INCREASING ECONOMIC IMPORTANCE	
Woody weeds	**Herbaceous weeds**			
		Field bindweed	Centaurea spp.	Also -
Artemisia spp.	Russian thistle	Perennial grasses	Leafy spurge	
Rabbitbrush spp.	Canada thistle	(johnsongrass,	Cyperus spp.	Velvetleaf
Willow spp.	Centaurea spp.	quackgrass,	Solanum spp.	Wild oats
Alder spp.	Field bindweed	bermudagrass)	Jointed goatgrass	Bromus spp.
Rose spp.	Mustards	Wild oats	Cirsium spp.	Field bindweed
Pine spp.	(Sinapis,	Bromus spp.	Dyers woad	Proso millet
Atriplex spp.	Brassica,	Kochia		Setaria spp.
Ceanothus spp.	Sysimbrium)	Cyperus spp.		Perennial grasses
	Amaranthus spp.	Setaria spp.		(johnsongrass,
	Helianthus spp.	Artemisia spp.		bermudagrass)
	Kochia	Canada thistle		
	Leafy spurge	Johnsongrass alone		

Table 2. The 198 most common weed species in agronomic and horticultural crops of the 12 western states

Ageratum, tropic	Crabgrass, southern	Kyllinga, green	Salsify, meadow
Alder shrubby spp.	Cress, hoary	Lambsquarters, common	Saltwort, spiny
Alexandergrass	Cupgrass, southwestern	Larkspur spp.	Sandbur, southern
Alfalfa	Dandelion, common	Lettuce, prickly	Sandbur, field
Amaranth, Palmer	Dayflower, spreading	Lettuce, wild	Sandbur, longspine
Amaranth, Powell	Deathcamas spp.	Malie pilau	Sensitiveplant
Amaranth, spiny	Dock, broadleaf	Mallow, common	Shattercane
Anoda, spurred	Dock, curly	Mallow, little	Shepherdspurse
Astragalus spp.	Dodder spp.	Mallow, false	Sida spp.
Balloonplant	Dropseed spp.	Medic, black	Sourgrass
Balsamapple	Elephants-foot	Millet, proso	Sowthistle, annual
Barley, foxtail	Elephants-foot, false	Morninglory, woolly	Sowthistle spp.
Barley, wild	Fescue, tall	Morningglory spp.	Speedwell spp.
Barnyardgrass	Fescue, rattail	Mustard, blue	Sprangletop, Mexican
Bedstraw, Northern	Fiddleneck, coast	Mustard, tumble	Sprangletop spp.
Bedstraw spp.	Filaree, redstem	Mustard, black	Spurge, leafy
Beet, wild	Filaree spp.	Mustard, birdsrape	Spurge, Hyssop
Beggarticks, hairy	Fingergrass spp.	Mustard, wild	Spurge, garden
Bentgrass, colonial	Fireweed	Nightshade, Eastern black	Spurge, prostrate
Bentgrass, creeping	Fleabane, hairy	Nightshade, hairy	Spurge, ground
Bermudagrass	Flixweed	Nightshade, black	Spurge, spotted
Bindweed, field	Foxtail, bristly	Nightshade, cutleaf	Spurry, corn
Bittercress spp.	Foxtail, green	Nightshade, silverleaf	Stargrass
Bluegrass, annual	Foxtail, yellow	Nodeweed	St. Johnswort, common
Bluegrass, Kentucky	Galinsoga, smallflower	Nutsedge, purple	Sunflower, common
Blueweed, Texas	Goatgrass, jointed	Nutsedge, yellow	Sweetclover, yellow
Brome, California	Goosefoot, nettleleaf	Oat, wild	Swinecress
Brome, downy	Goosegrass	Orchardgrass	Tansymustard spp.
Brome, ripgut	Groundcherry, tomatillo	Pansy spp.	Thistle, Russian
Brome, soft	Groundcherry, lanceleaf	Paspalum, sour	Thistle, Canada
Buckwheat, wild	Groundcherry, Wright's	Pearlwort	Thistle, bull
Buffalobur	Groundsel, common	Pennycress, field	Thistle, Scotch
Burdock spp.	Guineagrass	Pennywort, Asiatic	Thistle, musk
Bursage, slimleaf	Hawkbit spp.	Pigweed, redroot	Thunbergia, white
Buttercup, bur	Hawkweed, yellow	Pigweed, prostrate	Velvetgrass spp.
Buttonweed	Henbit	Pigweed, tumble	Velvetleaf
Canarygrass, hood	Horsetail, field	Pigweed, fringed	Vervain, seashore
Canarygrass, littleseed	Horsetail spp.	Pineappleweed	Violet spp.
Carrot, wild	Horseweed	Plantain, broadleaf	Waterhemlock, spotted
Catsear spp.	Houndstongue	Plantain, buckhorn	Wheat, volunteer
Chamomile, mayweed	Hyptis, comb	Puncturevine	Willow spp.
Cheat	Johnsongrass	Purslane, common	Willowweed spp.
Chickweed, common	Junglerice	Quackgrass	Witchgrass
Chickweed, field	Kikuyugrass	Radish, wild	Woodsorrel, creeping
Chickweed, mousear	Knapweed, spotted	Ragwort, tansy	Woodsorrel, yellow
Clover spp.	Knapweed, Russian	Rescuegrass	Yarrow, Western
Clover, rabbitfoot	Knotweed, prostrate	Rocket, London	Yarrow, Northern
Cocklebur, common	Knotweed, silversheath	Rye, volunteer	Yellowcress, marsh
Cocklebur spp.	Kochia	Ryegrass, Italian	
Crabgrass, large	Kyllinga	Sage, lanceleaf	

Table 3. The 210 most troublesome weed species in agronomic and horticultural crops of the 12 western states

Ageratum, tropic	Clover, rabbitfoot	Kikuyugrass	Plantain, buckhorn	Thistle, bull
Alder shrubby spp.	Cocklebur spp.	Knapweed, spotted	Poison-hemlock	Thistle, musk
Alexandergrass	Cocklebur, common	Knapweed, Russian	*Polygonum* spp.	Thunbergia, white
Alfalfa	Crabgrass spp.	Knapweed, diffuse	Potato, hog	Velvetgrass spp.
Amaranth, Palmer	Crabgrass, large	Knotweed, prostrate	Puncturevine	Velvetleaf
Amaranth, spiny	Crabgrass, southern	Knotweed, silversheath	Purslane, common	Vervain, seashore
Anoda, spurred	Cress, hoary	Kochia	Quackgrass	Waterhemlock, spotted
Apera interrupta	Cupgrass, southwestern	Kyllinga	Radish, wild	Wheat, volunteer
Balloonplant	Daisy, English	Kyllinga, green	Ragwort, tansy	Willow spp.
Balsamapple	Dandelion, common	Lambsquarters, common	Rescuegrass	Willowweed spp.
Barley, foxtail	Darnel, Persian	Larkspur spp.	Rocket, London	Woodsorrel, creeping
Barley, volunteer	Dayflower, spreading	Lettuce, prickly	Rose spp.	Yarrow, western
Barley, wild	Deathcamas spp.	Loco spp.	Russian-olive	Yarrow, northern
Barnyardgrass	Dock, curly	Lupine spp.	Rye, volunteer	Yellowcress, marsh
Bedstraw, northern	Dock, broadleaf	Malie pilau	Ryegrass, Italian	
Bedstraw spp.	Dodder spp.	Mallow, common	Sage, lanceleaf	
Beet, wild	Dropseed spp.	Mallow, little	Salsify, meadow	
Beggarticks, hairy	Elephants-foot	Mallow, false	Saltwort, spiny	
Bellflower, creeping	Elephants-foot, false	Medic, black	Sandbur, southern	
Bentgrass, creeping	Fescue, tall	Mesquite spp.	Sandbur, longspine	
Bentgrass, colonial	Fescue, rattail	Milkvetch spp.	Sandbur, field	
Bermudagrass	Fiddleneck, coast	Milkweed, western whorled	Sensitiveplant	
Bindweed, field	Fiddleneck spp.	Milkweed, poison	Shattercane	
Bittercress spp.	Filaree, redsten	Millet, proso	Shepherdspurse	
Blackberry spp.	Filaree spp.	Morningglory, woolly	Sida spp.	
Bluegrass, annual	Fingergrass spp.	Morningglory spp.	Sourgrass	
Bluegrass, Kentucky	Fireweed	Mustard, blue	Sowthistle, annual	
Blueweed, Texas	Fleabane, hairy	Mustard, wild	Sowthistle spp.	
Brome, downy	Fleabane spp.	Mustard, birdsrape	Speedwell, snow	
Brome, ripgut	Flixweed	Nightshade, silverleaf	Speedwell spp.	
Broomrape, hemp	Foxtail, green	Nightshade, black	Sprangletop, Mexican	
Buckwheat, wild	Foxtail, bristly	Nightshade, hairy	Sprangletop, red	
Buffalobur	Foxtail, yellow	Nightshade, cutleaf	Spurge, leafy	
Burdock, common	Galinsoga, smallflower	Nightshade, eastern black	Spurge, prostrate	
Burdock spp.	Goatgrass, jointed	Nodeweed	Spurge, ground	
Bursage, slimleaf	Goosefoot, nettleleaf	Nutsedge, purple	Spurge, spotted	
Buttercup, bur	Goosegrass	Nutsedge, yellow	Spurge, Hyssop	
Buttonweed	Groundcherry, tomatillo	Oat, wild	Spurge, garden	
Canarygrass, littleseed	Groundcherry, Wright's	Orchardgrass	Spurry, corn	
Canarygrass spp.	Groundsel, common	*Oxalis* spp.	Stargrass	
Carrot, wild	Guineagrass	Oxtongue, bristly	Sunflower, common	
Catsear spp.	Henbit	Paspalum, sour	Sweetclover, yellow	
Centaurea spp.	Horsetail, field	Pearlwort	Sweetclover spp.	
Chamomile, mayweed	Horsetail spp.	Pennywort, Asiatic	Swinecress	
Chickweed, field	Horseweed	Pigweed, redroot	Tansy, common	
Chickweed, mouseear	Hyptis, comb	Pigweed, prostrate	Tansymustard spp.	
Chickweed, common	Jimsonweed	Pigweed, tumble	Thistle, Russian	
Chicory	Johnsongrass	Pineappleweed	Thistle, Canada	
Clover, hop	Junglerice	Plantain, broadleaf	Thistle, Scotch	

Table 4. Twenty weed species listed only as 'common' in agronomic and horticultural crops of the western states

Amaranth, Powell	Pansy spp.
Astragalus spp.	Pennycress, field
Brome, California	Canarygrass, hood
Brome, soft	Pigweed, fringed
Groundcherry, Wright's	Houndstongue
Hawkbit spp.	Cheat
Hawkweed, yellow	St. Johnswort, common
Lettuce, wild	Violet spp.
Mustard, tumble	Witchgrass
Mustard, black	Woodsorrel, yellow

Table 5. Thirty-two weed species listed only as 'troublesome' in agronomic and horticultural crops of the 12 western states

Knapweed, diffuse	Fleabane spp.	Milkweed, western whorled
Apera interrupta	*Oxalis* spp.	Fiddleneck spp.
Daisy, English	Milkvetch spp.	Milkweed, poison
Darnel, Persian	*Centaurea* spp.	Blackberry spp.
Barley, volunteer	Jimsonweed	Burdock, common
Loco spp.	Chicory	Broomrape, hemp
Lupine spp.	Clover, hop	Bellflower, creeping
Poison-hemlock	Rose spp.	Speedwell, snow
Polygonum spp.	Russian-olive	Sprangletop, red
Potato, hog	Tansy, common	Oxtongue, bristly
Sweetclover spp.	Mesquite spp.	

Table 6. Survey results as received

MOST COMMON WEEDS OF ALFALFA

ARIZONA (150,000 ac)	CALIFORNIA (1,100,000 ac) Northern	Southern	COLORADO	HAWAII (600 ac)	MONTANA (964,500 ac)
Barnyardgrass	Yellow foxtail	Barnyardgrass	Tansymustard spp.	Goosegrass	Kochia
Junglerice	Barnyardgrass	Yellow foxtail	Blue mustard	Southern sandbur	Wild oats
Bermudagrass	Annual bluegrass	Shepherdspurse	Meadow salsify	Yellow foxtail	Green foxtail
Southwestern cupgrass	Common chickweed	London rocket	Canada thistle	Alexandergrass	Downy brome
Little mallow	Shepherdspurse	Mexican sprangletop	Field bindweed	Guineagrass	Field bindweed
Palmer amaranth	Common groundsel	Flixweed	Foxtail barley	Sourgrass	Canada thistle
London rocket	Coast fiddleneck	Mallow spp.	Yellow foxtail	Balsamapple	Tansymustard spp.
Annual sowthistle	Sowthistle spp.	Common groundsel	Green foxtail	Fingergrass spp.	Common dandelion
Common purslane	Foxtail barley	Curly dock	Downy brome	False mallow	Quackgrass
Purple nutsedge	Annual ryegrass	Dodder spp.	Common dandelion	Nodeweed	Russian thistle

NEW MEXICO (350,000 ac)	OREGON	UTAH (470,000 ac)	WASHINGTON/IDAHO	WYOMING (500,000 ac)
London rocket	Downy brome	Quackgrass	Quackgrass	Downy brome
Tansymustard spp.	Quackgrass	Common dandelion	Kochia	Common dandelion
Flixweed	Barley spp.	Shepherdspurse	Prickly lettuce	Green and yellow foxtail
Yellow foxtail	Shepherdspurse	Flixweed	Common lambsquarters	Redroot pigweed
Rescuegrass	Filaree spp.	Downy brome	Redroot pigweed	Kochia
Downy brome	Barnyardgrass	Green foxtail	Ripgut brome	Common lambsquarters
Field sandbur	Pigweed spp.	Bur buttercup	Canada thistle	Quackgrass
Green foxtail	Tumble mustard	Kochia	Green foxtail	Canada thistle
Palmer amaranth	Canada thistle	Field bindweed	Mustard spp.	Foxtail barley
Common lambsquarters	Common dandelion	Dodder spp.	Dodder spp.	Barnyardgrass

MOST TROUBLESOME WEEDS OF ALFALFA

ARIZONA	CALIFORNIA Northern	Southern	COLORADO	HAWAII
Barnyardgrass	Yellow foxtail	Barnyardgrass	Tansymustard spp.	Goosegrass
Junglerice	Barnyardgrass	Yellow foxtail	Blue mustard	Southern sandbur
Bermudagrass	Annual bluegrass	Bermudagrass	Meadow salsify	Yellow foxtail
Southwestern cupgrass	Common chickweed	Common dandelion	Canada thistle	Alexandergrass
Little mallow	Shepherdspurse	Mexican sprangletop	Field bindweed	Guineagrass
Palmer amaranth	Common groundsel	Flixweed	Foxtail barley	Sourgrass
London rocket	Coast fiddleneck	Mallow spp.	Yellow Foxtail	Balsamapple
Annual sowthistle	Sowthistle spp.	Common groundsel	Green foxtail	Fingergrass spp.
Common purslane	Foxtail barley	Curly dock	Downy brome	False mallow
Purple nutsedge	Annual ryegrass	Dodder spp.	Common dandelion	Nodeweed

continued

Table 6 continued

MONTANA	NEW MEXICO	OREGON	UTAH	WASHINGTON/IDAHO	WYOMING
Kochia	London rocket	Quackgrass	Quackgrass	Quackgrass	Downy brome
Field bindweed	Flixweed	Canada thistle	Common dandelion	Kochia	Common dandelion
Leafy spurge	Tansymustard spp.	Russian knapweed	Shepherdspurse	Prickly lettuce	Green/yellow foxtail
Downy brome	Downy brome	Hoary cress	Flixweed	Common lambsquarters	Redroot pigweed
Common dandelion	Rescuegrass	Barnyardgrass	Downy brome	Redroot pigweed	Kochia
Quackgrass	Yellow foxtail	Pigweed spp.	Green foxtail	Ripgut brome	Common lambsquarters
Common burdock	Green foxtail	Common dandelion	Sandbur spp.	Canada thistle	Quackgrass
Curly dock	Field sandbur	Common groundsel	Kochia	Green foxtail	Canada thistle
Hoary cress			Barnyardgrass	Shepherdspurse	Foxtail barley
Spotted knapweed			Dodder spp.	Dock spp.	Barnyardgrass
				Polygonum spp.	

MOST COMMON WEEDS IN DRY BEANS

CALIFORNIA (213,000 ac)	COLORADO	MONTANA (10,000 ac)	UTAH (9,000 ac)	WASHINGTON/IDAHO	WYOMING (18,000 ac)
Barnyardgrass	Hairy nightshade	Russian thistle	Redroot pigweed	Quackgrass	Hairy nightshade
Yellow nutsedge	Black nightshade	Green foxtail	Common lambsquarters	Kochia	Cutleaf nightshade
Black nightshade	Cutleaf nightshade	Canada thistle	Kochia	Black nightshade	Black nightshade
Hairy nightshade	Buffalobur	Field bindweed	Green foxtail	Common lambsquarters	Kochia
Redroot pigweed	Redroot pigweed	Kochia	Barnyardgrass	Redroot pigweed	Redroot pigweed
Tomatillo groundcherry	Kochia	Wild oats	Field bindweed	Hairy nightshade	Common lambsquarters
Common lambsquarters	Common lambsquarters	Redroot pigweed	Canada thistle	Canada thistle	Wild buckwheat
Field bindweed	Lanceleaf sage	Common lambsquarters	Wild oats	Green foxtail	Barnyardgrass
Johnsongrass	Barnyardgrass	Prostrate pigweed	Hairy nightshade	Barnyardgrass	Green/yellow foxtail
Volunteer cereals	Yellow foxtail	Eastern black nightshade	Cutleaf nightshade	Cutleaf nightshade	Shepherdspurse
Velvetleaf					

MOST TROUBLESOME WEEDS IN DRY BEANS

CALIFORNIA	COLORADO	MONTANA	UTAH	WASHINGTON/IDAHO	WYOMING
Barnyardgrass	Hairy nightshade	Russian thistle	Redroot pigweed	Quackgrass	Hairy nightshade
Yellow nutsedge	Black nightshade	Green foxtail	Common lambsquarters	Kochia	Cutleaf nightshade
Black/hairy nightshade	Cutleaf nightshade	Canada thistle	Kochia	Black nightshade	Black nightshade
Redroot pigweed	Buffalobur	Field bindweed	Green foxtail	Common lambsquarters	Kochia
Tomatillo groundcherry	Redroot pigweed	Kochia	Barnyardgrass	Redroot pigweed	Redroot pigweed
Common lambsquarters	Kochia	Wild oats	Field bindweed	Hairy nightshade	Common lambsquarters
Field bindweed	Common lambsquarters	Redroot pigweed	Canada thistle	Canada thistle	Wild buckwheat
Johnsongrass	Lanceleaf sage	Hairy nightshade	Wild oats	Green foxtail	Barnyardgrass
Volunteer cereals	Barnyardgrass	Prostrate pigweed	Hairy nightshade	Barnyardgrass	Green/yellow foxtail
Velvetleaf	Yellow foxtail	Eastern black nightshade	Cutleaf nightshade	Cutleaf nightshade	Shepherdspurse

continued

Table 6 continued

MOST COMMON WEEDS IN CORN

CALIFORNIA (270,000 ac)	**COLORADO**	**MONTANA** (83,000 ac)	**NEW MEXICO** (78,000 ac)	**UTAH** (80,000 ac)	**WASHINGTON/IDAHO**	**WYOMING** (68,000 ac)
Redroot pigweed	Redroot pigweed	Russian thistle	Johnsongrass	Quackgrass	Hairy nightshade	Kochia
Barnyardgrass	Kochia	Green foxtail	Barnyardgrass	Green foxtail	Quackgrass	Hairy nightshade
Johnsongrass	Cutleaf nightshade	Canada thistle	Junglerice	Barnyardgrass	Canada thistle	Barnyardgrass
Field bindweed	Shattercane	Field bindweed	Palmer amaranth	Witchgrass	Common lambsquarters	Redroot pigweed
Velvetleaf	Proso millet	Kochia	Kochia	Wild oats	Barnyardgrass	Common lambsquarters
Common purslane	Russian thistle	Wild oats	Common sunflower	Redroot pigweed	Green foxtail	Sandbur spp.
Yellow nutsedge	Sandbur spp.	Redroot pigweed	Yellow nutsedge	Common lambsquarters	Redroot pigweed	Green/yellow foxtail
Yellow foxtail	Barnyardgrass	Common lambsquarters	Field bindweed	Field bindweed	Common sunflower	Wild buckwheat
Bermudagrass	Green foxtail	Quackgrass	Texas blueweed	Common sunflower	Witchgrass	Russian thistle
Common cocklebur	Yellow foxtail	Eastern black nightshade	Large crabgrass	Kochia	Proso millet	Black nightshade

MOST TROUBLESOME WEEDS IN CORN

CALIFORNIA	**COLORADO**	**MONTANA**	**NEW MEXICO**	**UTAH**	**WASHINGTON/IDAHO**	**WYOMING**
Redroot pigweed	Redroot pigweed	Russian thistle	Johnsongrass	Quackgrass	Hairy nightshade	Kochia
Barnyardgrass	Kochia	Green foxtail	Barnyardgrass	Green foxtail	Quackgrass	Hairy nightshade
Johnsongrass	Cutleaf nightshade	Canada thistle	Purple nutsedge	Barnyardgrass	Canada thistle	Barnyardgrass
Field bindweed	Shattercane	Field bindweed	Yellow nutsedge	Proso millet	Common lambsquarters	Redroot pigweed
Velvetleaf	Proso millet	Kochia	Palmer amaranth	Velvetleaf	Barnyardgrass	Common lambsquarters
Common purslane	Russian thistle	Wild oats	Field bindweed	Redroot pigweed	Green foxtail	Sandbur spp.
Yellow nutsedge	Sandbur spp.	Redroot pigweed	Texas blueweed	Common lambsquarters	Witchgrass	Green and yellow foxtail
Yellow foxtail	Barnyardgrass	Quackgrass		Yellow nutsedge	Proso millet	Wild buckwheat
Bermudagrass	Green foxtail	Proso millet		Field bindweed	Field bindweed	Russian thistle
Common cocklebur	Yellow foxtail	Eastern black nightshade		Johnsongrass	Common cocklebur	Black nightshade

MOST COMMON WEEDS OF COTTON

ARIZONA (420,000 ac)	**NEW MEXICO** (79,000 ac)	**CALIFORNIA**
Barnyardgrass	Silverleaf nightshade	Barnyardgrass
Junglerice	Kochia	Palmer amaranth
Bermudagrass	Spurred anoda	Bermudagrass
Palmer amaranth	Palmer amaranth	Lanceleaf groundcherry
Common purslane	Russian thistle	Black nightshade
Woolly morningglory	Johnsongrass	Yellow nutsedge
Wright's groundcherry	Yellow nutsedge	Sprangletop spp.
Tumble pigweed	Morningglory spp.	Little mallow
Johnsongrass	Fringed pigweed	London rocket
Hyssop spurge	Barnyardgrass	Tumble pigweed
		Field bindweed

continued

Table 6 continued

MOST TROUBLESOME WEEDS OF COTTON

ARIZONA	NEW MEXICO	CALIFORNIA
Barnyardgrass	Purple nutsedge	Black nightshade
Junglerice	Bermudagrass	Ivyleaf morningglory
Bermudagrass	Yellow nutsedge	Bermudagrass
Palmer amaranth	Johnsongrass	Palmer amaranth
Common purslane	Spurred anoda	Common cocklebur
Woolly morningglory	Morningglory spp.	Yellow nutsedge
Wright's groundcherry		Hairy nightshade
Tumble pigweed		Field bindweed
Johnsongrass		Purple nutsedge
Hyssop spurge		Tumble pigweed

MOST COMMON WEEDS IN FRUITS

ARIZONA (40,000 ac)	CALIFORNIA (1,500,000 ac)	COLORADO	HAWAII (25,400 ac)	MONTANA (1,200 ac)	NEW MEXICO (22,000 ac)
Bermudagrass	Bermudagrass	Field bindweed	Guineagrass	Quackgrass	London rocket
Palmer amaranth	Spurge spp.	Tansymustard spp.	Spreading dayflower	Canada thistle	Flixweed
Wright's groundcherry	Yellow nutsedge	Kochia	Morningglory spp.	Field bindweed	Tansymustard spp.
Prickly lettuce	Hairy fleabane	Common dandelion	Sour paspalum	Spotted knapweed	Johnsongrass
Barnyardgrass	Horseweed	Sandbur spp.	Garden spurge	Downy brome	Yellow nutsedge
Junglerice	Johnsongrass	Barnyardgrass	Purple nutsedge	Mustard spp.	Field bindweed
Horseweed	Pigweed spp.	Bermudagrass	Buttonweed	Mayweed chamomile	Kochia
Field sandbur	Common lambsquarters	Orchardgrass	Comb hyptis	Common dandelion	Field sandbur
Yellow sweetclover	Mustard spp.		Malie pilau	Prostrate pigweed	Bermudagrass
London rocket	Barnyardgrass		White thunbergia	Common chickweed	Russian thistle

OREGON	UTAH	WASHINGTON/IDAHO
Field bindweed	Quackgrass	Quackgrass
Catsear spp.	Field bindweed	Field horsetail
Canada thistle	Common thistle	Ripgut brome
Common dandelion	Canada thistle	Common dandelion
Hawkbit spp.	Kochia	Yellow foxtail
Quackgrass	Redroot pigweed	Field bindweed
Sowthistle spp.	Puncturevine	Canada thistle
Prostrate knotweed	Sandbur spp.	Barnyardgrass
Filaree spp.	Blue mustard	Alfalfa
Common groundsel	Downy brome	Longspine sandbur

continued

Table 6 continued

MOST TROUBLESOME WEEDS IN FRUITS

ARIZONA	CALIFORNIA	COLORADO	HAWAII	MONTANA	NEW MEXICO
Bermudagrass	Bermudagrass	Field bindweed	Guineagrass	Quackgrass	Southwestern cupgrass
Palmer amaranth	Yellow nutsedge	Tansymustard spp.	Spreading dayflower	Canada thistle	Red sprangletop
Wright's groundcherry	Johnsongrass	Kochia	Morningglory spp.	Field bindweed	Purple nutsedge
Prickly lettuce	Field bindweed	Common dandelion	Sour paspalum	Spotted knapweed	Rescuegrass
Barnyardgrass	Hairy fleabane	Sandbur spp.	Garden spurge	Downy brome	Hog potato
Junglerice	Horseweed	Barnyardgrass	Purple nutsedge	Mustard spp.	Horseweed
Horseweed	Black nightshade	Bermudagrass	Buttonweed	Mayweed chamomile	
Field sandbur	Common purslane	Orchardgrass	Comb hyptis	Common dandelion	
Yellow sweetclover	Sweetclover spp.		Malie pilau	Prostrate pigweed	
London rocket	Purple nutsedge		White thunbergia	Common chickweed	

OREGON	UTAH	WASHINGTON/IDAHO
Field bindweed	Quackgrass	Quackgrass
Quackgrass	Field bindweed	Field horsetail
Horsetail spp.	Chicory	Ripgut brome
Blackberry spp.	Canada thistle	Common dandelion
Velvetgrass spp.	Cocklebur spp.	Yellow foxtail
Mesquite spp.	Prickly lettuce	Field bindweed
Catsear spp.	Puncturevine	Canada thistle
Common dandelion	Sandbur spp.	Barnyardgrass
	Johnsongrass	Alfalfa
	Downy brome	Longspine sandbur

MOST COMMON WEEDS OF SMALL GRAINS

ALASKA (50,000 ac)	ARIZONA (190,000 ac)	CALIFORNIA (1,860,000 ac) Northern	Southern	COLORADO	MONTANA (6,430,000 ac)
Common lambsquarters	London rocket	Wild oats	Barnyardgrass	Russian thistle	Wild oats
Prostrate knotweed	Silversheath knotweed	Italian ryegrass	Common lambsquarters	Kochia	Downy brome
Chickweed	Littleseed canarygrass	Wild mustard	Sowthistle spp.	Jointed goatgrass	Canada thistle
Pineappleweed	Nettleleaf goosefoot	Wild radish	London rocket	Canada thistle	Kochia
Corn spurry	Russian thistle	Littleseed/hood canarygrass	Volunteer cereals	Field bindweed	Russian thistle
Wild buckwheat	Common lambsquarters	Coast fiddleneck	Canarygrass	Wild oats	Field pennycress
Shepherdspurse	Wild oats	Common chickweed	Knotweed	Yellow foxtail	Tansymustard spp.
Quackgrass	Annual sowthistle	Field bindweed	Common purslane	Green foxtail	Green foxtail
Wild oats	Prickly lettuce	Shepherdspurse	Wild beet	Volunteer rye	Wild buckwheat
Flixweed	Common sunflower		Mallow spp.	Wild buckwheat	Redroot pigweed
Marsh yellowcress					

continued

Table 6 continued

NEW MEXICO (480,000 ac)	UTAH (403,000 ac)	OREGON	WASHINGTON/IDAHO	WYOMING (470,000 ac)
Kochia	Common sunflower	Italian ryegrass	Wild oats	Wild oats
Palmer amaranth	Tumble mustard	Wild oats	Ripgut brome	Downy brome
Field bindweed	Downy brome	Tumble mustard	Common lambsquarters	Common lambsquarters
Cheat	Prickly lettuce	Field bindweed	Redroot pigweed	Redroot pigweed
Tansymustard spp.	Russian thistle	Bromes - California, soft, ripgut, downy	Canada thistle	Tansymustard
Flixweed	Wild oats	Birdsrape mustard	Prickly lettuce	Flixweed
London rocket	Field bindweed	Wild radish	Mayweed chamomile	Shepherdspurse
Russian thistle	Bur buttercup	Coast fiddleneck	Henbit	Russian thistle
Jointed goatgrass	Black mustard	Canada thistle	Tumble mustard	Canada thistle
Johnsongrass	Kochia	Annual bluegrass	Spiny saltwort	Green and yellow foxtail
			Kochia	

MOST TROUBLESOME WEEDS OF SMALL GRAINS

ALASKA	ARIZONA	CALIFORNIA Northern	Southern	COLORADO	MONTANA
Common lambsquarters	London rocket	Wild oats	Wild radish	Russian thistle	Wild oats
Prostrate knotweed	Silversheath knotweed	Italian ryegrass	Wild oats	Kochia	Downy brome
Chickweed	Littleseed canarygrass	Wild mustard	Canarygrass spp.	Jointed goatgrass	Canada thistle
Pineappleweed	Nettleleaf goosefoot	Wild radish	Coast fiddleneck	Canada thistle	Kochia
Corn spurry	Russian thistle	Littleseed and hood canarygrass	Common groundsel	Field bindweed	Russian thistle
Wild buckwheat	Common lambsquarters	Coast fiddleneck	London rocket	Wild oats	Field bindweed
Shepherdspurse	Wild oats	Common chickweed	Shepherdspurse	Yellow foxtail	Tansymustard spp.
Quackgrass	Annual sowthistle	Field bindweed	Common lambsquarters	Green foxtail	Persian darnel
Wild oats	Prickly lettuce	Shepherdspurse	Downy brome	Volunteer rye	Wild buckwheat
Flixweed	Common sunflower		Sowthistle spp.	Wild buckwheat	Jointed goatgrass
Marsh yellowcress					

NEW MEXICO	UTAH	OREGON	WASHINGTON/IDAHO	WYOMING
Jointed goatgrass	Common sunflower	Field bindweed	Kochia	Wild oats
Johnsongrass	Jointed goatgrass	Bedstraw spp.	Canada thistle	Downy brome
Russian thistle	Downy brome	Brome spp.	Italian ryegrass	Common lambsquarters
Field bindweed	Prickly lettuce	Wild oats	Spiny saltwort	Redroot pigweed
Texas blueweed	Russian thistle	Canada thistle	Wild oats	Tansymustard
Palmer amaranth	Snow speedwell	Speedwell spp.	Field bindweed	Flixweed
Kochia	Field bindweed	Jointed goatgrass	Fiddleneck spp.	Shepherdspurse
Flixweed	Bur buttercup	Annual bluegrass	Ripgut brome	Russian thistle
Tansymustard spp.	Cereal rye	Quackgrass	Jointed goatgrass	Canada thistle
London rocket	Kochia	Coast fiddleneck	Apera interrupta	Green and yellow foxtail
		Canada thistle		Kochia

continued

Table 6 continued

MOST COMMON WEEDS IN ORNAMENTAL CROPS

ARIZONA (40,000 ac)	CALIFORNIA	NEW MEXICO	OREGON	WASHINGTON/IDAHO
Bermudagrass	Common groundsel	Field bindweed	Bittercress spp.	Quackgrass
Purple nutsedge	Prostrate spurge	Yellow nutsedge	Common groundsel	Clover spp.
Yellow nutsedge	Creeping woodsorrel	Silverleaf nightshade	Willowweed spp.	Kentucky bluegrass
Ground spurge	Sowthistle spp.	Bermudagrass	Pearlwort	Annual bluegrass
London rocket	Common chickweed	Field sandbur	Sowthistle spp.	Common dandelion
Annual sowthistle	Barnyardgrass	Rescuegrass/downy brome	Annual bluegrass	Plantain spp.
Prickly lettuce	Crabgrass spp.	Annual morningglory	Velvetgrass spp.	Canada thistle
Yellow sweetclover	Wild lettuce	Palmer amaranth	Oxalis spp.	Common groundsel
Creeping woodsorrel	Bermudagrass	Common lambsquarters	Horsetail spp.	Field chickweed
Annual bluegrass	Nutsedge spp.	Mustards - tansymustard, flixweed, London rocket	Canada thistle	Field bindweed

MOST TROUBLESOME WEEDS IN ORNAMENTAL CROPS

ARIZONA	CALIFORNIA	NEW MEXICO	OREGON	WASHINGTON/IDAHO
Bermudagrass	Common groundsel	Purple nutsedge	Bittercress spp.	Quackgrass
Purple nutsedge	Prostrate spurge	Rescuegrass	Common groundsel	Clover spp.
Yellow nutsedge	Creeping woodsorrel	Johnsongrass	Willowweed spp.	Kentucky bluegrass
Ground spurge	Nutsedge spp.	Annual bluegrass	Pearlwort	Annual bluegrass
London rocket	Clover spp.	Bermudagrass	Sowthistle spp.	Common dandelion
Annual sowthistle	Horseweed	Field bindweed	Annual bluegrass	Plantain spp.
Prickly lettuce	Fleabane spp.	Palmer amaranth	Velvetgrass spp.	Canada thistle
Yellow sweetclover	Bristly oxtongue		Oxalis spp.	Hop clover
Creeping woodsorrel	Bermudagrass		Horsetail spp.	Field chickweed
Annual bluegrass	Kikuyugrass		Canada thistle	Field bindweed

MOST COMMON WEEDS IN SUGARBEETS

CALIFORNIA	COLORADO	MONTANA (44,000 ac)	OREGON	WASHINGTON/IDAHO	WYOMING (32,100 ac)
Barnyardgrass	Hairy nightshade	Russian thistle	Pigweed spp.	Kochia	Wild buckwheat
Common lambsquarters	Wild buckwheat	Green foxtail	Common lambsquarters	Shepherdspurse	Kochia
Sowthistle spp.	Cutleaf nightshade	Canada thistle	Barnyardgrass	Common lambsquarters	Hairy nightshade
London rocket	Volunteer small grains	Field bindweed	Green foxtail	Canada thistle	Green/yellow foxtail
Volunteer cereals	Redroot pigweed	Kochia	Kochia	Quackgrass	Redroot pigweed
Canarygrass spp.	Kochia	Wild oats	Russian thistle	Hairy nightshade	Common lambsquarters
Knotweed spp.	Common lambsquarters	Redroot pigweed	Hairy nightshade	Cutleaf nightshade	Barnyardgrass
Common purslane	Green foxtail	Common lambsquarters	Bedstraw spp.	Barnyardgrass	Russian thistle
Wild beet	Barnyardgrass	Prostrate pigweed	Birdsrape mustard	Redroot pigweed	Downy brome
Mallow spp.	Yellow foxtail	Eastern black nightshade	Volunteer wheat	Green foxtail	Shepherdspurse

continued

Table 6 continued

MOST TROUBLESOME WEEDS IN SUGARBEETS

CALIFORNIA	COLORADO	MONTANA	OREGON	WASHINGTON/IDAHO	WYOMING
Wild beet	Hairy nightshade	Russian thistle	Pigweed spp.	Kochia	Wild buckwheat
Sowthistle spp.	Wild buckwheat	Green foxtail	Common lambsquarters	Shepherdspurse	Kochia
Canarygrass spp.	Cutleaf nightshade	Canada thistle	Barnyardgrass	Common lambsquarters	Hairy nightshade
Volunteer cereals	Volunteer small grains	Field bindweed	Green foxtail	Canada thistle	Green/yellow foxtail
Knotweed spp.	Redroot pigweed	Kochia	Kochia	Quackgrass	Redroot pigweed
Nightshade spp.	Kochia	Wild oats	Russian thistle	Hairy nightshade	Common lambsquarters
London rocket	Common lambsquarters	Redroot pigweed	Hairy nightshade	Cutleaf nightshade	Barnyardgrass
Common lambsquarters	Green foxtail	Common lambsquarters	Bedstraw spp.	Barnyardgrass	Russian thistle
Redroot pigweed	Barnyardgrass	Prostrate pigweed	Birdsrape mustard	Redroot pigweed	Downy brome
Barnyardgrass	Yellow foxtail	Eastern black nightshade	Volunteer wheat	Green foxtail	Shepherdspurse

MOST COMMON WEEDS OF VEGETABLES

ALASKA	ARIZONA (65,000 ac)	CALIFORNIA (400,000 ac)	HAWAII (5,300 ac)	NEW MEXICO (24,000 ac)
Chickweed spp.	Common purslane	Common groundsel	Smallflower galinsoga	Yellow nutsedge
Common lambsquarters	Prickly lettuce	Shepherdspurse	Little mallow	Barnyardgrass
Pineappleweed	Annual sowthistle	Little mallow	Hairy beggarticks	Junglerice
Corn spurry	Common lambsquarters	Common purslane	Purple nutsedge	Johnsongrass
Shepherdspurse	Nettleleaf goosefoot	Black nightshade	Goosegrass	Russian thistle
Quackgrass	Littleseed canarygrass	Hairy nightshade	Amaranthus spp.	Common lambsquarters
Flixweed	Wright's groundcherry	Yellow nutsedge	Common purslane	Palmer amaranth
Marsh yellowcress	London rocket	Common lambsquarters	Bristly foxtail	Mexican morningglory
Prostrate knotweed	Palmer amaranth	Pigweed spp.	Crabgrass spp.	
	Junglerice	Barnyardgrass	Swinecress	

OREGON	UTAH	WASHINGTON/IDAHO
Common lambsquarters	Hairy nightshade	Field bindweed
Powell amaranth	Barnyardgrass	Redroot pigweed
Barnyardgrass	Redroot pigweed	Quackgrass
Shepherdspurse	Common lambsquarters	Canada thistle
Common groundsel	Yellow foxtail	Henbit
Canada thistle	Common purslane	Common purslane
Volunteer wheat	Common mallow	Wild oats
Wild radish	Field bindweed	Pineappleweed
Quackgrass	Puncturevine	Corn spurry
Nutsedge spp.		Speedwell spp.

continued

Table 6 continued

MOST TROUBLESOME WEEDS OF VEGETABLES

ALASKA	ARIZONA	CALIFORNIA	HAWAII	NEW MEXICO
Chickweed spp.	Common purslane	Common groundsel	Smallflower galinsoga	Purple nutsedge
Common lambsquarters	Prickly lettuce	Field bindweed	Little mallow	Yellow nutsedge
Pineappleweed	Annual sowthistle	Little mallow	Hairy beggarticks	Volunteer barley
Corn spurry	Common lambsquarters	Dodder spp.	Purple nutsedge	Johnsongrass
Shepherdspurse	Nettleleaf goosefoot	Black nightshade	Goosegrass	Wright's groundcherry
Quackgrass	Littleseed canarygrass	Hemp broomrape	Amaranthus spp.	Jimsonweed
Flixweed	Wright's groundcherry	Yellow nutsedge	Common purslane	Spurred anoda
Marsh yellowcress	London rocket	Sweetclover	Bristly foxtail	London rocket
Prostrate knotweed	Palmer amaranth	Purple nutsedge	Crabgrass spp.	Silverleaf nightshade
	Junglerice	Spurge spp.	Swinecress	

OREGON	UTAH	WASHINGTON/IDAHO
Canada thistle	Hairy nightshade	Field bindweed
Field bindweed	Barnyardgrass	Redroot pigweed
Horsetail spp.	Redroot pigweed	Quackgrass
Yellow nutsedge	Common lambsquarters	Canada thistle
Wild radish	Yellow foxtail	Henbit
Shepherdspurse	Common purslane	Common purslane
	Common mallow	Wild oats
	Field bindweed	Pineappleweed
	Puncturevine	Corn spurry
		Speedwell spp.

MOST COMMON WEEDS IN TURF AND LANDSCAPE

ARIZONA (120,000 ac)	CALIFORNIA	COLORADO	HAWAII	NEW MEXICO
Ground spurge	Annual bluegrass	Common dandelion	Goosegrass	Annual bluegrass
Spotted spurge	Prostrate spurge	Broadleaf plantain	Purple nutsedge	Prostrate/spotted spurge
London rocket	Creeping woodsorrel	Buckhorn plantain	Green kyllinga	Black medic
Annual bluegrass	Crabgrass spp.	Prostrate knotweed	Southern crabgrass	Yellow woodsorrel
Russian thistle	Kikuyugrass	Spotted spurge	Prostrate spurge	Yellow nutsedge
Yellow sweetclover	Bermudagrass	Black medic	Creeping woodsorrel	Common dandelion
Little mallow	Common chickweed	Quackgrass	Sour paspalum	Knotweed (prostrate or silversheath)
Redstem filaree	Common groundsel	Creeping bentgrass	Stargrass	Field sandbur
Southwestern cupgrass	Sowthistle spp.	Annual bluegrass	Kyllinga	Large crabgrass
Silversheath knotweed	Curly dock	Fescue spp.	Dropseed spp.	

continued

Table 6 continued

MONTANA	UTAH	WASHINGTON/IDAHO
Common dandelion	Common dandelion	Annual bluegrass
Canada thistle	Black medic	Plantain spp.
Quackgrass	Prostrate spurge	Common dandelion
Knotweed spp.	Crabgrass spp.	Italian ryegrass
Common chickweed	Field bindweed	Tall fescue
Large crabgrass	Tall fescue	Black medic
Buckhorn plantain	Annual bluegrass	Colonial bentgrass
Green foxtail	Mouseear chickweed	Mouseear chickweed
Annual bluegrass	Common mallow	Rabbitfoot clover
Western yarrow	Violet and pansy spp.	
Mustards		

MOST TROUBLESOME WEEDS IN TURF AND LANDSCAPE

ARIZONA	CALIFORNIA	COLORADO	HAWAII	MONTANA
Ground spurge	Prostrate spurge	Common dandelion	Goosegrass	Common dandelion
Spotted spurge	Bermudagrass	Broadleaf plantain	Purple nutsedge	Canada thistle
London rocket	Creeping woodsorrel	Buckhorn plantain	Green kyllinga	Quackgrass
Annual bluegrass	Annual bluegrass	Prostrate knotweed	Southern crabgrass	Knotweed spp.
Russian thistle	Nutsedge spp.	Spotted spurge	Prostrate spurge	Black medic
Yellow sweetclover	Kikuyugrass	Black medic	Creeping woodsorrel	Large crabgrass
Little mallow	Common chickweed	Quackgrass	Sour paspalum	Creeping bellflower
Redstem filaree	Common groundsel	Creeping bentgrass	Stargrass	Field bindweed
Southwestern cupgrass	English daisy	Annual bluegrass	Kyllinga	Annual bluegrass
Silversheath knotweed	Goosegrass	Fescue spp.	Dropseed spp.	Western yarrow

NEW MEXICO	UTAH	WASHINGTON/IDAHO
Rescuegrass	Creeping bentgrass	Annual bluegrass
Field sandbur	Black medic	Plantain spp.
Yellow nutsedge	Prostrate spurge	Common dandelion
Prostrate and spotted spurge	Crabgrass spp.	Italian ryegrass
Common dandelion	Field bindweed	Tall fescue
Puncturevine	Tall fescue	Black medic
Common purslane	Annual bluegrass	Colonial bentgrass
	Prostrate knotweed	Mouseear chickweed
	Common mallow	Rabbitfoot clover
		Field bindweed

continued

Table 6 continued

MOST COMMON WEEDS IN PASTURE AND HAYCROPS

ALASKA (60,000 ac)	ARIZONA (25,000 ac)	CALIFORNIA	COLORADO	HAWAII (1,680,000 ac)	MONTANA (1,050,000 ac)
Foxtail barley	Silverleaf nightshade	Barnyardgrass	Field bindweed	Sida spp.	Canada thistle
Northern yarrow	Johnsongrass	Mexican sprangletop	Canada thistle	Tropic ageratum	Downy brome
Field horsetail	Palmer amaranth	Nutsedge spp.	Foxtail barley	Spiny amaranth	Leafy spurge
Broadleaf plantain	Common purslane	Bermudagrass	Yellow foxtail	Seashore vervain	Field pennycress
Common dandelion	Barnyardgrass	Field bindweed	Green foxtail	Sensitiveplant	Kochia
Alder shrubby spp.	Common sunflower	Shepherdspurse	Kochia	Asiatic pennywort	Russian thistle
Fireweed	Puncturevine	Wild barley	Russian thistle	Elephants-foot	Common dandelion
Northern bedstraw	Buffalobur	Common groundsel	Larkspur spp.	Balloon plant	Quackgrass
Willow spp.	Slimleaf bursage	Mallow spp.	*Astragalus* spp.	False mallow	Wild oats
	Mexican sprangletop	London rocket		False elephants-foot	Foxtail barley

NEW MEXICO (90,000 ac)	OREGON	UTAH	WASHINGTON/IDAHO	WYOMING (680,000 ac)
Field sandbur	Bull thistle	Quackgrass	Thistle spp.	Downy brome
Palmer amaranth	Canada thistle	Bull thistle	Quackgrass	Quackgrass
Cocklebur spp.	Tansy ragwort	Canada thistle	Shepherdspurse	Russian knapweed
Bull thistle	Curly dock	Curly dock	Ripgut brome	Canada thistle
Plantain spp.	Broadleaf dock	Foxtail barley	Yellow hawkweed	Leafy spurge
Downy brome	Wild carrot	Common dandelion	Spotted knapweed	Foxtail barley
Rescuegrass	Scotch thistle	Horsetail spp.	Buttercup spp.	Spotted waterhemlock
Common lambsquarters	Barley spp.	Hoary cress	Common dandelion	Deathcamas spp.
Common dandelion	Downy brome	Houndstongue	Flixweed	Green and yellow foxtail
Russian thistle	Musk thistle	Burdock spp.	Common St. Johnswort	Kochia
	Rattail fescue			

MOST TROUBLESOME WEEDS IN PASTURE AND HAYCROPS

ALASKA	ARIZONA	CALIFORNIA	COLORADO	HAWAII	MONTANA
Foxtail barley	Silverleaf nightshade	Nutsedge spp.	Field bindweed	Sida spp.	Canada thistle
Northern yarrow	Johnsongrass	Johnsongrass	Canada thistle	Tropic ageratum	Russian knapweed
Field horsetail	Palmer amaranth	Bermudagrass	Foxtail barley	Spiny amaranth	Leafy spurge
Broadleaf plantain	Common purslane	Wild barley	Yellow foxtail	Seashore vervain	Spotted knapweed
Common dandelion	Barnyardgrass	Field bindweed	Green foxtail	Sensitiveplant	Common dandelion
Alder shrubby spp.	Common sunflower	Nightshade spp.	Kochia	Asiatic pennywort	Hoary cress
Fireweed	Puncturevine	Common groundsel	Russian thistle	Elephants-foot	Diffuse knapweed
Northern bedstraw	Buffalobur	Mallow spp.	Larkspur spp.	Balloon plant	Kochia
Willow spp.	Slimleaf bursage	Redroot pigweed	Loco spp.	False mallow	Downy brome
	Mexican sprangletop	Barnyardgrass	Milkvetch spp.	False elephants-foot	Foxtail barley

continued

Table 6 continued

NEW MEXICO	OREGON	UTAH	WASHINGTON/IDAHO	WYOMING
Johnsongrass	Bull thistle	Willow spp.	_Centaurea_ spp.	Downy brome
Bermudagrass	Canada thistle	Bull thistle	Mustard spp.	Quackgrass
Western whorled milkweed	Tansy ragwort	Canada thistle	Quackgrass	Russian knapweed
Poison milkweed	Curly dock	Curly dock	Leafy spurge	Canada thistle
Chicory	Broadleaf dock	Foxtail barley	Lupine spp.	Leafy spurge
Filaree spp.	Wild carrot	Common dandelion	Dock spp.	Foxtail barley
Hoary cress	Scotch thistle	Russian-olive	Poison-hemlock	Spotted waterhemlock
Silverleaf nightshade	Barley spp.	Hoary cress	Thistle spp.	Deathcamas spp.
	Downy brome	Rose spp.	Common tansy	Green and yellow foxtail
	Musk thistle	Burdock spp.	_Polygonum_ spp.	Kochia
	Rattail fescue			

WOODY WEEDS IN FORESTS AND RANGELANDS

ALASKA	ARIZONA	CALIFORNIA	MONTANA Common	MONTANA Troublesome	HAWAII
White spruce	Mesquite spp.	Greenleaf manzanita	Big sagebrush	Big sagebrush	Brazilian peppertree
Black spruce	Snakeweed spp.	Snowbrush ceanothus	Silver sagebrush	Silver sagebrush	Largeleaf lantana
Aspen spp.	Burroweed	Big sagebrush	Ponderosa pine	Ponderosa pine	Banks melastoma
Paper birch	Sagebrush spp.	Mountain whitethorn	Prairie wild/ Woods rose	Prairie wild/ Woods rose	Downy rosemyrtle
American green alder	Saltcedar	Tanoak	Broom snakeweed	Broom snakeweed	Blackberry spp.
Willow spp.	Prickly pear/ cholla spp.	Beargrass	Cottonwood spp.	Shrubby cinquefoil	Clidemia
Labrador tea	Turbinella oak	White sage	Western snowberry	Western snowberry	Firebush
High bush cranberry	Wait-a-bit	Chamise (greasewood)	Willow spp.	Creeping juniper	_Passiflora mollissima_
Bird vetch	Juniper spp.	Whiteleaf manzanita	Fringed sagebrush	Fringed sagebrush	Apple guava
	New Mexican locust	Interior live oak	Plains pricklypear	Plains pricklypear	Strawberry guava

NEW MEXICO	OREGON, WASHINGTON (in reforestation projects) Common	Troublesome	UTAH	WYOMING (60,000,000 ac)
Mesquite spp.	Salmonberry	Bigleaf maple	Big sagebrush	Chamise (greasewood)
Creosote bush	Western thimbleberry	Red alder	Rabbitbrush	Big sagebrush
Acacia spp.	Red alder	Scotch broom	Juniper spp.	Chokecherry spp.
Shinnery oak	Bigleaf maple	Salal	Gamble oak	Grey rabbitbrush
Big sagebrush	Vine maple	Snowbrush ceanothus	Chamise (greasewood)	Douglas rabbitbrush
Sand sagebrush	Red elderberry	Manzanita spp.	Snakeweed	Pine spp.
Rubber rabbitbrush	Bitter cherry	Poisonoak	Willow	Sagebrush (silver)
Scrub oak	Western hazel	Golden chinkapin	Bit-toothed maple	Western snowberry
Broom snakeweed	Brackenfern	Tanoak	Russian-olive	Juniper spp.
Pinion juniper	Grasses, other herbaceous weeds	Canyon live oak	Tamarisk spp.	Broom snakeweed

continued

Table 6 continued

HERBACEOUS WEEDS OF FORESTS AND RANGELANDS

ALASKA	ARIZONA	CALIFORNIA	HAWAII	MONTANA Common	MONTANA Troublesome
Bluejoint reed bentgrass	Loco spp.	Needlegrass spp.	Bull thistle	Spotted knapweed	Spotted knapweed
Foxtail barley	Cocklebur spp.	Squirreltail	Common dandelion	Milkvetch spp.	Leafy spurge
Bluebell	Russian thistle	Bull thistle	Telegraphplant	Downy brome	Downy brome
Sedge spp.	Foxtail brome	Anderson's lupine	Brackenfern	Common dandelion	Canada thistle
Bunchberry	Horseweed	Western brackenfern	Dodder spp.	Scarlet globemallow	Houndstongue
Field horsetail	Annual goldeneye	Downy brome	Malie pilau	Erigeron spp.	Russian knapweed
Alaska chickweed	Iris	Medusahead	Balloon plant	Lupine spp.	Diffuse knapweed
	Poison milkweed	Red brome	Cream ginger	Hairy goldaster	Common St. Johnswort
	White horehound	Yellow starthistle	White ginger	Cinquefoil spp.	Hoary cress
	White horsenettle	Italian thistle	Cocklebur	Western yarrow	Dalmatian toadflax

NEW MEXICO	UTAH	WYOMING
Flixweed	Dyers woad	Leafy spurge
Tansymustard spp.	Musk thistle	Canada thistle
Wooly loco	Halogeton	Russian knapweed
Whitepoint locoweed	Downy brome	Hoary cress
Common sunflower	Tall larkspur	Dalmatian toadflax
Threadleaf groundsel	Hoary cress	Plains pricklypear
Silverleaf nightshade	Loco/milkvetch spp.	Downy brome
Lupine spp.	Diffuse knapweed	Common burdock
Pingue	Scotch thistle	Larkspur spp.
	Dalmatian toadflax	Loco spp.

WOODY WEEDS OF ROADSIDES, RIGHTS-OF-WAY, AND INDUSTRIAL AREAS

ALASKA	ARIZONA	CALIFORNIA	COLORADO	HAWAII	MONTANA
White spruce	Mesquite spp.	Coyotebrush	Wild rose	Largeleaf lantana	Big sagebrush
Black spruce	Mexican palo-verde	Red alder	Big sagebrush	Brazilian peppertree	Silver sagebrush
Aspen spp.	Burroweed	Deerbrush	Sand sagebrush	Australian-pine	Ponderosa pine
Paper birch	Desertbroom	Wedgeleaf ceanothus	Chamise (greasewood)	Sea hibiscus	Prairie wild rose
American green alder	Sagebrush spp.	Mountain alder	Gambel oak	Strawberry guava	Woods rose
Willow spp.	Saltbush spp.	Greenleaf manzanita	Rabbitbrush	Apple guava	Lodgepole pine
Labrador tea	Pricklypear spp.	Pacific poison-oak	Saltcedar	Java plum	Cottonwood spp.
High bush cranberry	Creosotebush	Whiteleaf manzanita	Snakeweed	Silk oak	Western snowberry
Bird vetch	Brittlebush	Yerba santa spp.		Ekoa (white popinac)	Willow spp.
	Juniper spp.	California buckwheat		Sourbush	Fringed sagebrush
					Quaking aspen

continued

Table 6 continued

NEW MEXICO	UTAH	WASHINGTON/IDAHO	WYOMING
Fourwing saltbrush	Rose spp.	*Ceanothus* spp.	Chamise (greasewood)
Rubber rabbitbrush	Willow spp.	Maple spp.	Big sagebrush
Shinnery oak	Big sagebrush	Oregon boxwood	Chokecherry spp.
Apache plume	Rabbitbrush spp.	Rabbitbrush spp.	Gray rabbitbrush
Creosote bush	Curly dock	Willow spp.	Douglas rabbitbrush
Cactus spp.	Foxtail barley	Alder spp.	Willow spp.
Mesquite spp.	Common dandelion	Poison ivy, oak, and sumacs	Pine spp.
Broom snakeweed	Russian-olive	Mallow ninebark	Sagebrush (silver)
Yucca	Hoary cress	Big sagebrush	Gambel oak
Shadscale	Burdock spp.	Gymnosperm spp.	Western snowberry

HERBACEOUS WEEDS OF ROADSIDES, RIGHTS-OF-WAY, AND INDUSTRIAL AREAS

ALASKA	ARIZONA	CALIFORNIA	COLORADO	HAWAII
Common dandelion	Russian thistle	Prickly lettuce	Yellow sweetclover	Spiny amaranth
Yarrow spp.	Common mullein	Redstem filaree	Tansymustard	Broadleaf plantain
Astragalus spp.	Common sunflower	Coast fiddleneck	Puncturevine	Beggarticks spp.
Sweetvetch spp.	Camphorweed	Telegraphplant	Field bindweed	Purple nutsedge
	Crownbeard	Yellow starthistle	Canada thistle	Tropic ageratum
	White horehound	Curlycup gumweed	Leafy spurge	Sensitiveplant
	Buffalobur	Field bindweed	Russian thistle	Creeping beggarweed
	London rocket	Russian thistle	Russian knapweed	Morningglory spp.
	Little mallow	Wild mustard	Diffuse knapweed	Flora's paintbrush
	Wild radish	Common groundsel	Curly dock	Vervain spp.

MONTANA Common	MONTANA Troublesome	NEW MEXICO	UTAH	WASHINGTON/IDAHO	WYOMING
Leafy spurge	Leafy spurge	Kochia	Dyers woad	Canada thistle	Kochia
Spotted knapweed	Spotted knapweed	Russian thistle	Musk thistle	Halogeton	Redroot pigweed
Russian thistle	Russian thistle	Field bindweed	Quackgrass	Brackenfern spp.	Yellow sweetclover
Redroot pigweed	Diffuse knapweed	Silverleaf nightshade	Canada thistle	Leafy spurge complex	Russian thistle
Canada thistle	Canada thistle	Texas blueweed	Curly dock	Lupine spp.	Common lambsquarters
Field bindweed	Field bindweed	Bluestem pricklepoppy	Foxtail barley	*Centaurea* spp.	Annual marshelder
Curlycup gumweed	Poison hemlock	Flixweed	Common dandelion	Yellow hawkweed	Canada thistle
Common mullein	Common mullein	Tansymustard spp.	Horsetail spp.	Common St. Johnswort	Common sunflower
Kochia	Kochia	Puncturevine	Hoary cress	Rush skeletonweed	Halogeton
Mustard spp.	Russian knapweed	Globemallow spp.	Houndstongue	Common yarrow	Thistle spp.

continued

Table 6 continued

MOST COSTLY WEEDS

ALASKA	ARIZONA	CALIFORNIA Northern	CALIFORNIA Southern	COLORADO	HAWAII
Wild oats	Purple nutsedge	Yellow nutsedge	Johnsongrass	Canada thistle	Guineagrass
Quackgrass	Yellow nutsedge	Johnsongrass	Yellow and purple nutsedge	Leafy spurge	Alexandergrass
Foxtail barley	Field bindweed	Field bindweed	Field bindweed	Field bindweed	Paragrass
Chickweed spp.	Johnsongrass	Bermudagrass	Bermudagrass	Kochia	Sprangletop
Wild buckwheat	Bermudagrass	Wild oats	Nightshade spp.	Russian thistle	Brazilian peppertree
Corn spurry	Morningglory spp.	Barnyardgrass	Yellow foxtail	Larkspur spp.	Largeleaf lantana
Common lambsquarters	White horsenettle	Sago pondweed	Barnyardgrass	Redroot pigweed	Morningglory spp.
Pineappleweed	Field sandbur	Medusahead	Pigweed spp.	Green foxtail	Swollen fingergrass
Willow spp.	Junglerice	Greenleaf manzanita	Sowthistle spp.	Wild oats	*Eupatorium riparium*
Alder spp.	Juniper spp.	Chamise spp.	Wild oats	Gambel oak	Apple guava

MONTANA	NEW MEXICO	UTAH	WASHINGTON/IDAHO	WYOMING
Leafy spurge	Broom snakeweed	Field bindweed	Canada thistle	Leafy spurge
Spotted knapweed	Field bindweed	Quackgrass	Field bindweed	Canada thistle
Wild oats	Yellow nutsedge	Canada thistle	Quackgrass	Russian knapweed
Downy brome	Johnsongrass	Downy brome	Ripgut brome	Musk thistle
Green foxtail	Kochia	Dyers woad	Spiny saltwort	Hoary cress
Kochia	Purple nutsedge	Wild oats	Common dandelion	Downy brome
Field bindweed	*Amaranthus* spp.	Hoary cress	Wild oats	Big sagebrush
Tansymustard spp.	Shinnery oak	Musk thistle	*Centaurea* spp.	Field bindweed
Russian thistle	Rescuegrass	Kochia	*Artemisia* spp.	Kochia
Big sagebrush	Downy brome	Big sagebrush	Alder spp.	Green and yellow foxtail
	Mustards – tansymustard, flixweed, London rocket			

WEEDS INCREASING IN ECONOMIC IMPORTANCE

ALASKA	ARIZONA	CALIFORNIA Northern		CALIFORNIA Southern	COLORADO
Foxtail barley	Purple nutsedge	Velvetleaf	Bermudagrass	Nightshade spp.	Canada thistle
Wild oats	Yellow nutsedge	Black nightshade	Yellow nutsedge	Yellow/green foxtail	Leafy spurge
Wild buckwheat	White horsenettle	Hairy nightshade	Cudweed spp.	Southwestern cupgrass	Field bindweed
	Juniper spp.	Dodder spp.	Yellow sweetclover		Russian knapweed
	Snakeweed spp.	Hydrilla	Common purslane		Johnsongrass
		Medusahead	Little mallow		Jointed goatgrass
		Chamise	Cattail spp.		Proso millet
		Pampas grass	Horseweed		Velvetleaf
		Hairy fleabane			Jimsonweed
					Shattercane

continued

Table 6 continued

HAWAII	MONTANA	NEW MEXICO	OREGON	UTAH
Gorse	Leafy spurge	Jointed goatgrass	Yellow nutsedge	Leafy spurge
Hairy beggarticks	Spotted knapweed	Broom snakeweed	Proso millet	Wild oats
Swollen fingergrass	Dyers woad	Spotted knapweed	Bedstraw spp.	Johnsongrass
Firebush	Diffuse knapweed	Musk thistle	Yellow starthistle	Yellow nutsedge
<u>Passiflora</u> <u>mollissima</u>	Dalmatian toadflax	Rescuegrass		Velvetleaf
	Cutleaf nightshade	Wright's groundcherry		Diffuse knapweed
	Green foxtail	Field bindweed		Spotted knapweed
	Downy brome	African rue		Yellow starthistle
	Persian darnel			Canada thistle
	Cowcockle			Sandbur spp.
				Jointed goatgrass
				Dyers woad

WASHINGTON/IDAHO		WYOMING	
Ventenata	Dyers woad	Common dandelion	Spotted/diffuse knapweed
Yellow hawkweed	Common tansy	Downy brome	Dyers woad
Spotted knapweed	Medusahead	Wild buckwheat	Black henbane
Diffuse knapweed	Hedgeparsley	Foxtail barley	Houndstongue
Yellow starthistle	Tansy ragwort	Deathcamas spp.	Field sandbur
Globe centaurea	Sulfur cinquefoil	Spotted water hemlock	Kochia
Mouseear chickweed	Evening primrose	Russian knapweed	Hairy nightshade
Rush skeletonweed	Orange hawkweed	Canada thistle	
Scotch thistle	Plumeless thistle	Leafy spurge	
Scentless chamomile	Field bindweed	Wild oats	
Indigobush	Hedgehog dogtailgrass	Hoary cress	
White bryony	<u>Lepyrodiclis</u> <u>holosteoides</u>	Halogeton	
<u>Apera</u> <u>interrupta</u>	Kochia	Dalmatian toadflax	
Jointed goatgrass	Garden rocket	Nightshade spp.	
Corn buttercup	Small-flowered gaura	Foxtail spp.	
Field violet	Eurasian watermillfoil	Barnyardgrass	
Leafy spurge		Proso millet	

Table 7. **Weeds not listed in the WSSA "Composite List of Weeds" (alphabetically by common name)**

Alder, mountain	Alnus tenuifolia
Alder, red	Alnus rubra
Alder shrubby spp.	Alnus crispa, A. sinuata
Apache plume	Fallugia paradoxa
Aspen spp.	Populus spp.
Aspen, quaking	Populus tremuloides
Balloon plant	Gomphocarpus physocarpus
Beargrass	Nolina spp.
Bentgrass	Apera interrupta
Bentgrass, bluejoint reed	Calamagrostis canadensis
Birch, paper	Betula papyrifera
Bluebell	Martensia paniculata
Boxwood, Oregon	Pachystyma spp.
Brittlebush	Encelia farinosa
Brush, ceanothus spp.	Ceanothus spp.
Buckwheat, California	Eriogonum fasciculatum
Bunchberry	Cornus canadensis
Buttonweed	Borreria laevis
Ceanothus, snowbrush	Ceanothus velutinus
Ceanothus, wedgeleaf	Ceanothus cuneatus
Centaurea, globe	Centaurea macrocephala
Chamise (greasewood)	Adenostoma fasciculatum
Cherry, bitter	Prunus emarginata
Chickweed, Alaska	Stellaria laeta
Chinkapin, golden	Castanopsis chrysophylla
Clidemia	Clidemia hirta
Cottonwood spp.	Poplar spp.
Cranberry, high bush	Viburnum edule
Deerbrush	Ceanothus integerrimus
Dropseed	Sporobolus spp.
Elephants-foot	Elephantopus mollis
Elephants-foot, false	Pseudoelephantopus spicatus
Elderberry, red	Sambucus racemosa
Evening primrose	Oenothera strigosa
Fingergrass spp.	Chloris spp.
Fingergrass, swollen	Chloris inflata
Firebush	Myrica faya
Flora's paintbrush	Emilia javanica
Small-flowered gaura	Gaura parviflora
Ginger, cream	Hedychium flavescens
Ginger, White (butterflylily)	Hedychium coronarium
Groundcherry, Wright's	Physalis wrightii
Guava, apple	Psidium guajava
Guava, strawberry	Psidium cattleianum
Hazel, western	Corylus cornuta
Horsenettle, white	Solanum elaegnifolium
Hyptis, comb	Hyptis pectinata
Java plum	Eugenia cuminii
Kyllinga	Cyperus kyllinga
Laborador tea	Ledum palustre
Larkspur spp.	Delphinium spp.
Locust, New Mexican	Robinia neomexicana
Lupine, Anderson's	Lupinus andersonii
Maile pilau	Paederia foetida
Mallow, false	Malvastrum coromandelianum
Manzanita, greenleaf	Arctostaphylus patula
Manzanita, whiteleaf	Arctostaphylus viscida
Maple, bigleaf	Acer macrophyllum
Maple, bit-toothed	Acer grandidentatum
Maple spp.	Acer spp.
Maple, vine	Acer circinatum
Milkweed, poison	Asclepias subverticillata
Mist-flower g.	Eupatorium riparium
Ninebark, mallow	Physocarpus malvaceus
Nodeweed	Synedrella nodiflora
Oak, canyon live	Quercus chrysolepis
Oak, gambel	Quercus gambellii
Oak, interior live	Quercus wislizenii
Oak, silk	Grevillea robusta
Pampas grass	Cortaderia jubata
Passion flower g.	Passiflora mollissima
Rue, African	Peganum harmala
Rye, cereal	Secale cereale
Sage, white	Salvia apiana
Sagebrush, silver	Artemisia cana
Salal	Gaultheria shallon
Salmonberry	Rubus spectabilis
Sedge spp.	Carex spp.
Sourbush	Pluchea odorata
Speedwell, snow	Veronica campylopoda
Spruce, black	Picea mariana
Spruce, white	Picea glauca
Stargrass	Chloris divaricata
Tanoak	Lithocarpus densiflora
Thunbergia, white	Thunbergia fragrans
Ventenata	Ventenata dubia
Vervain spp.	Stachytarpheta spp.
Vetch, bird	Vicia cracca
Wait-a-bit	Mimosa biuncifera
Whitethorn, mountain	Ceanothus cordulatus
Yarrow, northern	Achillea borealis
Yerba santa spp.	Eriodictyon spp.

UNNAMED WEEDS

Apera interrupta	Bentgrass genus
Eupatorium riparium	Mist-flower genus
Lepyrodiclis holosteoides	(new species)
Passiflora mollissima	Passionflower genus

NOXIOUS WEED TRUST FUND PROMOTES COOPERATIVE WEED CONTROL EFFORT

Celestine A. Lacy[1]

Landowners, extension specialists, researchers and other agricultural officials are continuously striving to find more effective ways to control noxious weeds. New herbicide technology, application equipment and research in biological control of weeds have improved weed control practices. However, the key to any weed management effort is the development of long-term public education and cooperative weed control programs.

The value of cooperative weed action groups involving private, county, state and federal land managers has been proven during the early 1980's in Montana. Because of the success of these cooperative efforts and the magnitude of Montana's weed problem, the 1985 legislature passed the Noxious Weed Trust Fund Act. The purpose of the act is two-fold: (1) To provide technical and financial assistance to cooperative weed management projects; and (2) To establish a permanent trust fund for continuation of the weed management effort.

Program: The Noxious Weed Trust Fund is administered through the State Department of Agriculture. Funding for the Trust Fund was a one million dollar grant through Montana's Resource Indemnity Trust Fund (RIT). Half of the grant was used to establish the permanent trust account, and half was used to fund top-ranked weed proposals submitted under the RIT program.

The Trust Fund and Weed Management program is perpetuated by a one percent herbicide surcharge. This surcharge generates about $250,000 annually, half of which builds the permanent trust account and half funds grant requests for cooperative weed management projects. Within 10 years, the permanent trust fund is expected to reach $2.5 million. The interest income generated from this fund, in addition to the herbicide surcharge, will provide an estimated $500,000 annually to help fund weed education and control programs in the state.

The trust fund is designed to provide incentive for the establishment of cooperative weed management programs. Money is issued on a cost-share basis to counties or community action groups that submit grant requests. All requests are reviewed by the Noxious Weed Advisory Council. This council is composed of eight members representing various interests in the state. The Director of Department of Agriculture serves as chairman of the committee.

How effective has the program been over the past year? Nine projects received funding in 1985 and twelve additional cooperative efforts were approved in 1986. The projects include cooperative weed control projects on leafy spurge and spotted knapweed; a statewide eradication program on dyers woad; research and field studies on biological control of weeds; educational programs including tours, publication of brochures, posters and programs that involve youth; and intensive weed mapping projects.

Summary: Montana's cooperative weed management effort has controlled noxious weed and increased public awareness and education concerning noxious weeds. Thus, the first year results suggest that Montana's Noxious Weed Trust Fund Act may develop into an effective weapon against weeds. However, the continued success of this program is dependent upon the support and cooperation of all entities concerned with weed control in the state.

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[1]State Weed Coordinator, Department of Agriculture, Capitol Station, Helena, Montana 59620.

MAPPING LEAFY SPURGE WITH COLOR VIDEO AND MICRO-COMPUTER IMAGE PROCESSING

Roland Elliston and Lee D. Miller[1]

Crook County is located in the far Northeast corner of Wyoming and is very concerned about their leafy spurge (Euphorbia esula L.) problem. In Wyoming we have a program that helps the land owner financially with this problem. Where the program is supported by landowners, county tax and state funds, a need to have an accurate accounting of the acres infested has been sought after for many years.

The geographic location of the county is in the Black Hills, which has made ground locating and mapping a financial impossibility. By having accurate maps we can make better managerial decisions as to budgeting, application, justifying needs for tax revenues and monitoring our successes or failures.

We did some research work into the different possible methods of mapping the county's infestation. We found a firm in Great Falls, Montana, Rocky Mountain Mapping, that had done some work along these lines. They were contracted to fly one full township, 36-square miles, 23,040 acres at approximately 40 cents per acre. Rocky Mountain Mapping flew the area at approximately 6,000 feet, video taping and shooting 70 mm color IR film of the area. From these they prepared maps showing locations of heavy, light and no infestation of leafy spurge with a high degree of accuracy.

The Crook County Weed and Pest District sharing the cost with Dow Chemical Company now has maps of a larger part of our leafy spurge infested area. We realized the system was new and that changes and improvements needed to be done. That's what brought us to contact Dr. Lee Miller, at Lincoln, Nebraska. Mr. Miller is with the Geology Department at the University of Nebraska. Dr. Miller along with his associates have developed the software that makes it possible to use a system of mapping, analysis by the end user.

The OWL OVERVIEW image analysis software uses an IBM PC compatible microcomputer equipped with an AT&T Image Capture Board (ICB), RGB analog monitor and a Micro-soft compatible mouse. The image to be processed may be extracted from color video, color film or prints or satellite image data tapes. The AT&T ICB is capable of presenting a full-color image of 240 by 256 picture elements in 32,000 colors. Simultaneous color video frame grabbing or digitizing is directly supported by the ICB using a standard color or color infrared video camera or the output of a home video recorder. An optimal PHOTOMASTER color slide scanner from Howtek, Inc. can be used to scan positive or negative 35 mm film with up to a 6x zooming and convert it to color video for input to the ICB. One, two or three variables of satellite or other images originating on magnetic tape can be subset and read from appropriately formatted floppy disks using the standard Truevision Image File Format (TIFF) supported by many other PC DOS-based color paint and image display programs. Three variables can be selected, subset and read from a complete multispectral satellite image stored on a write-once optical disk drive using an appropriate add-on external drive. Down loading services are available to format and create a floppy disk or an optical disk image from your open reel image tapes.

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[1]Crook County Weed and Pest Control Board, Sundance, Wyoming and University of Nebraska, Lincoln, Nebraska

The OWL OVERVIEW software is designed for the display, analysis and measurement of one, two or three variable images. It is operational in nature, allowing the reading, display and analysis of an image in less than five minutes. No experience with IBM PC DOS is required as you work directly off the disk supplied. Neither a user's manual nor extensive training or experience is required, as the program uses a simple menu and mouse selection and drawing procedure. You will be productively using this program within one or two hours after experimenting with its procedures. The analyses may be easily performed by a technician or professional who is not trained in image processing or computer use and has never touched a computer keyboard or mouse.

Two processing activities are currently performed by OWL OVERVIEW. Both allow you to process the entire display screen or draw around a subarea, no matter how complex and select it for analysis. The subarea is then mapped into up to 10 categories based on three colors or multispectral variables using a combination of cluster analysis and direct on-screen feature labeling via the mouse. Several methods are available to calibrate the ground size of the individual display cell so that features mapped are reported in percent, acres or some other convenient area measurement unit. When a color-infrared image is available, the area selected (e.g., a single agricultural field) can be computed into a 10-step green vegetation canopy density (green biomass) map, color-coded and displayed with appropriate areas for the 10 levels. The simplest use of the OWL OVERVIEW is to calibrate the size of the cells displayed and use the mouse to draw around and measure features directly interpreted from the high quality image being displayed. Good quality color hardcopy of anything displayed on the screen can be printed using one of several optional color ink jet printers or a video 35 mm color film recorder.

The most unique feature of the OWL OVERVIEW is that the software is but paid for as information is extracted. Floppy disks sealed in plastic envelopes are purchased at $200 each and are used to process a number of images depending upon the number of display elements and color hardcopy prints produced. Typically the processing of 40 images where half the area of the display screen is selected for processing would exhaust the disk. You are not charged for any of the data access, drawing or other processing support, functions as charges are deducted only when a final product is computed and displayed or printed.

The OWL OVERVIEW has been designed for end user, point of transaction image processing for people who currently don't even know what image processing or why they need it. These end users may be farmers, ranchers, agricultural fertilizer salesmen, chemical company salesmen, agricultural consultants, crop or cattle insurers, district foresters, wildlife habitat managers, etc. Remote sensing and image processing will never be very useful until it makes an impact on the day-to-day on-site management of our agricultural and natural resources. This cannot be accomplished until we put the necessary tools in the hands of the person on the site who actually makes the management decisions and who chooses to use them because they are cost effective. Several components must fall into place before we can succeed in the face of so many past failures to achieve this utopia.

1. We must be able to collect useful images in an economical and timely fashion.
2. Move the images to the user in a timely fashion and a useful format.

3. The end user must be able to carefully correlate the images with his ground site and extract useful information which can then be combined with his intimate knowledge of his resources.
4. The end user must be convinced that money can be made or saved using this new information.

I am looking at the program as a tool, to help our county landowners become as efficient and effective as possible in their treatment of leafy spurge, putting an end to the old method of search and treat types of programs that cause a lot if misapplication, unnecessary travel over fragile pasture lands and a general poor management of crews' time.

Along with helping to define areas of leafy spurge, there are many other uses that could be developed from the system, such as: locating Canada thistle [Cirsium arvense (L) Scop.] infestation, measuring prairie dog towns, along with an almost unlimited number of other uses.

USE OF REFINED LEAFY SPURGE POPULATION SIMULATION MODEL TO IDENTIFY HYPOTHESES AND DEVELOP CONTROL STRATEGIES

Bruce P. Maxwell, Mark V. Wilson, Steven R. Radosevich[1]

Abstract. Plant population models can serve as a framework upon which weed biology information can be organized and unified in a manner which will facilitate development of weed control strategies. The proposed approach is focused on the development of models as tools to identify information gaps, set research priorities, develop hypotheses pertinent to weed population regulation and suggest control tactics. A population simulation model of leafy spurge (Euphorbia esula L.) is used to demonstrate, that through a process of adding detail to the model, hypotheses can be generated that relate to the mechanisms which influence population growth. Sensitivity analysis on a first generation leafy spurge model indicated that (1) transition from root buds to vegetative shoots during the germination stage of development, (2) survival of vegetative shoots at maturation and (3) survival of root buds over winter are important parameters that influence population growth of leafy spurge. Hypotheses were generated on mechanisms that influence the transition from root buds to vegetative shoots. Hypothetical intra-specific density effects on root bud transition and production have been included in the model to demonstrate the refinement process and development of a second generation model. Four control strategies, including the use of herbicides and biological control agents, were implemented in a refined model to demonstrate the potential of models for developing viable weed management strategies.

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[1]Oregon State University, Corvallis, Oregon

A COMPARISON OF DIFFERENT HERBICIDES AND APPLICATION TECHNIQUES FOR THE CONTROL OF LEAFY SPURGE

John L. Baker and Donald L. Kosteff[1]

Leafy spurge (Euphorbia esula L.) was first identified in Fremont County, Wyoming, in the late 1940's and by the mid 1950's was noticed as a threat to livestock production in the Lander area. Fremont County Weed and Pest Control District encouraged control of this weed with a 75% cost share program for many years, but we watched leafy spurge spread, especially on State and Federal land where we were frustrated in our efforts by lack of interest of the agencies involved. In 1978, the State of Wyoming passed the State Leafy Spurge Act which funded the effort on state lands and gave added leverage for dealing with the federally owned lands as well. One area that demanded immediate attention was the Sinks Canyon State Park, located about five miles south of Lander, Wyoming, on the Popo Agie River.

The park consists of 600 acres of steep canyon and cliffs where the Popo Agie River pours into a cave, The Sinks, and disappears from sight, reappearing at a spring a half mile down the canyon. The park is well developed with camp grounds and picnic sites, a visitors' center, and spurge was becoming wide spread along the river and at the lower boundary of the park where two irrigation projects took water. It was obvious that any successful control effort would have to eliminate the seed production along the irrigation systems and at the head waters. Park officials agreed to the program in principal but were reluctant to participate due to the use of herbicides that would injure non-target species and effect the overall appearance of the park. We promised to minimize herbicide use where at all possible and restrict vehicles to established roads. At that time, 1978, we estimated that leafy spurge infested 30 acres of the park but found there was a lot more once we went to work.

Our program in the Sinks Canyon State Park began in 1979 and continues today. The records of our activity for the past eight years are the core of this presentation. It should be noted from the start that this work was not undertaken to evaluate different application techniques nor to compare herbicide performance, but to kill as much leafy spurge as possible for the funds available. The data is affected by the many variables present like weather, crew performance and timing of treatment, that are better controlled during scientific investigation. However, when combined with our experience and observations, I hope that they are meaningful. Ultimately, the data represents a real on-going treatment program over a period of eight years at the same location. We have had to contend with reluctant managers, inadequate funding, non-target damage, heavy work loads, equipment breakdowns and less than hoped for performance of the herbicides used. All of this combined has lead us toward some conclusions about our program, and we hope these conclusions will be of help to others working on leafy spurge.

During the last eight years, we have used both liquid and granular formulations of Banvel and Tordon. The rates of active ingredient have remained consistent from year to year at two pounds of picloram or six pounds of dicamba per acre, regardless of the formulation or application technique. These are really maximum rates and were selected because they produce the

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[1]Fremont County Weed and Pest Control District, County Court House, Lander, Wyoming

FREMONT COUNTY WEED AND PEST CONTROL DISTRICT, LANDER, WYOMING
SINKS CANYON STATE PARK, LEAFY SPURGE CONTROL PROGRAM

YEAR	1979	1980	1981	1982	1983	1984	1985	1986
APPLICATION METHOD	TMHG & SB	HG & SB	HG & SB	BP & SB	BP	BP	BP	LH & HG
NUMBER OF TREATMENTS	ONE	ONE	ONE	ONE	ONE	ONE	TWO	TWO
DATE OF TREATMENT	JULY	JULY	JULY	JULY	JULY	JULY	JUNE & SEPT	JUNE & SEPT
TORDON 22K (GAL)	5.25						7.54	5.25
TORDON 2K (LBS)	1025.00							
BANVEL 4L (GAL)	0.50	12.00	4.50	0.03	11.44	16.50	4.00	
BANVEL 5G (LBS)		600.00	600.00					
BANVEL 10G (LBS)				550.00				
HERBICIDE COST	$1,191.81	$882.00	$618.00	$837.08	$497.75	$707.05	$773.76	$409.50
HOURS LABOR	40.25	20.00	25.00	4.92	17.69	26.50	44.00	31.75
LABOR RATE	$18.00	$20.00	$20.00	$25.00	$25.00	$25.00	$25.00	$30.00
LABOR COST	$724.50	$400.00	$500.00	$122.92	$442.25	$662.50	$1,100.00	$952.50
TOTAL COST	$1,916.31	$1,282.00	$1,118.00	$940.00	$940.00	$1,369.55	$1,873.76	$1,362.00
ACRES TREATED	16.00	11.75	6.75	6.88	5.75	9.20	10.20	5.25
ACRES WORKED	54.00	50.00	40.00	26.00	32.00	47.00	122.00	130.00
ACRES INFESTED	54.00	54.00	54.00	54.00	54.00	56.00	61.00	65.00
STAND DENSITY(AT/AW)	29.63%	23.50%	16.88%	26.46%	17.97%	19.57%	8.36%	4.04%
ACRES THREATENED	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
ADJUSTED CHEMICAL AND LABOR COSTS FOR ALL YEARS TO EQUAL 1986 PRICES								
HERBICIDE	$1,291.75	$1,152.00	$780.00	$1,020.00	$572.00	$825.00	$788.00	$409.50
LABOR	$1,207.50	$600.00	$750.00	$147.60	$530.70	$795.00	$1,320.00	$952.50
TOTAL	$2,499.25	$1,752.00	$1,530.00	$1,167.60	$1,102.70	$1,620.00	$2,108.00	$1,362.00
COST/ACRE TREATED	$156.20	$149.11	$226.67	$169.71	$191.77	$176.09	$206.67	$259.43
COST/ACRE WORKED	46.28	35.04	38.25	44.91	34.46	34.47	17.28	10.48
COST/ACRE INFESTED	$46.28	$32.44	$28.33	$21.62	$20.42	$28.93	$34.56	$20.95
COST/ACRE AFFECTED	$4.17	$2.92	$2.55	$1.95	$1.84	$2.70	$3.51	$2.27
REMARKS	TREATMENT COMPLETED	TREATMENT INCOMPLETE	TREATMENT INCOMPLETE	TREATMENT INCOMPLETE	TREATMENT INCOMPLETE	TREATMENT INCOMPLETE	TREATMENT COMPLETED	TREATMENT COMPLETED

HG = HANDGUN, TM = TRUCK MOUNTED, SB = SEYMOUR BEADER, BP = BACKPACK, LH = LONG HOSE best reduction in stand from a single treatment. With high labor costs per acre, rapid stand reduction saves money in the long run. Because of the restraints placed upon us by the park, spot treatment was the only way to protect non-target plants and broadcast applications were never considered.

Our observations at this site and similar low moisture rangeland areas, suggest that Tordon is the better product because it reduces the stand faster and has better selectivity. Banvel consistently allows greater recovery of spurge within a year of treatment, which increases retreatment costs in following years, and at these heavy rates the impact on native grasses is significant. Downy brome (Bromus tectorum L.) has rapidly increased in the areas treated with Banvel, creating a fire hazard that contributed to a wild fire in the Park which burned over 100 acres of trees and brush. Some impacts of a treatment program go beyond herbicide residual. The granular formulations tend to out perform the liquid formulations for both products due to treatment beyond the edge of the infestation and less photodegradua-tion of the herbicide which increases soil concentrations. In spite of the disadvantages of Banvel at this site, its reputation of environmental safety and a well contamination problem with Tordon in 1980, forced its selection for the next five years.

Of greater interest than the performance of the herbicides is the evolution of the method of application. For five of the eight years, funding was less than needed to completely treat the whole park--partly due to our underestimating the infestation and over-estimating the results of the treatments and the rest due to resistance toward the program by park offi-cials who saw too much damage and not enough dead spurge. After the first year, the funding allowed only follow-up work in those areas closest to the roads, along the river and at the irrigation diversions. Each year, as the level of control in those areas increased, we moved a little higher on the hill and beyond the reach of our hoses, but never were able to cover the whole park until better funding came through in 1985. During those years, the leafy spurge moved into new areas, and by 1986, it had spread over an additional twelve acres, an increase of twenty-two percent. While the park looked clean to the casual observer after the third year, a careful examina-tion showed that the leafy spurge was still there but in a suppressed state and not obvious.

Our early application technique was based on a four-wheel drive truck with a tank and two, two-hundred foot reels of hose with handguns. Our standard procedure was to drive as close to the weeds as we could and fight hose as little as possible. The crews were calibrated to deliver one hundred gallons of spray per acre. When the hose would not reach, granular formula-tions were used in preference to backpack sprayers. The backpack requires that twice as much weight be carried to the weeds than is needed with granules and is slow to empty. The granules go on fast and in 1982, using Banvel 10G, labor amounted to thirteen percent of the total program cost. While the labor component was drastically cut, the per-acre cost was still high due to the cost of the material, but worse we covered less ground each year. The amount of injury to brush seemed to increase as well, and park officials were becoming increasingly dissatisfied with our efforts.

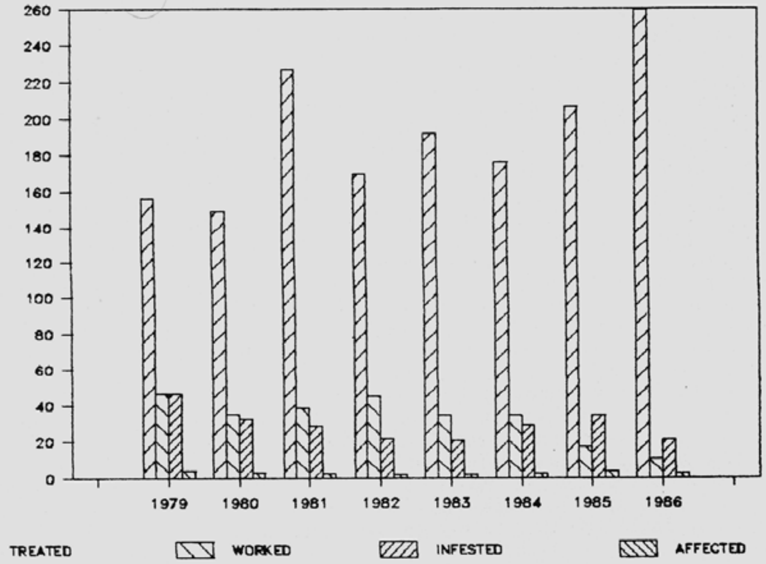
At this time I would like to define some terms and explain why they are needed. The use of the cost per-acre to determine the value of a particular herbicide or application technique contains a pitfall. When a piece of land is treated on a broadcast basis, the number of acres treated is easy to determine, but when spot treatment is used, the acres treated are often estimated as a percent of the total acres infested or is based on the amount of herbicide used. If the stand of weeds was solid, there would be no difference but that is not the case in nature where diversity is the rule and even leafy spurge does not totally dominate any site. The cost of the broadcast treatment is spread out over all the acres, and even though many of those acres have no weeds, they are still treated. Broadcast treatment makes no allowance for density of stand or distribution of the weeds but instead is governed by the equipment used. Spot treatment treats all the weeds, but not all the acres, even though many acres are walked in search of weeds. Thus, spot treatment always costs more than broadcast on a per-acre basis and appears unattractive as a control method. Today I would like to define an acre treated as the weeds treated with one acre's worth of herbicide and all of the treated acres in this study are calculated from the amount of herbicide used. The term acres worked is the area that was actually covered in search of weeds and is estimated from maps. The acres infested is the sum of all acres in the treatment area in which weeds can be found, again estimated from maps. And the acres affected would be the entire area that the weed could impact if control were not established. I think you can see from this graph that cost-per-acre treated continues to grow to the high of $260 last year, but the cost per-acre worked, infested and affected, is falling. the over-all cost of the program in the park is about $11,000 for the eight years and a broadcast treatment repeated several times to maintain control would easily exceed that figure. The real problem with aircraft at this site, aside from the environmental impact, is that many more acres would be treated than are infested just to reach the weeds.

As we contemplated this situation, we began to wonder if backpacks might not allow us to decrease the herbicide cost enough to work more ground even though the labor cost would go up. In 1983, we used backpacks, applying twenty-five gallons of spray per acre and decreased the acres treated. This could happen even with an increase in stand because the backpack delivered a fine spray to the foliage of the plant, while the granules were scattered on the ground all around the weeds. Because the amount of herbicide used went down, so did the weeds treated. The cost per-acre treated went up, but the acres worked increased and the cost per-acre worked dropped by twenty percent. There was a real net gain in the amount of spurge treated for the money. State park officials were, for the first time, interested in the program because they could see hope for controlling the spurge short of destroying all the trees and brush in the park. They increased the funding, and more acres were treated and worked in 1984. They were so impressed with the ability to treat very close to trees without injury that they decided to allow part of the park to be treated with Tordon in 1985 as a test. The safety factor was the same as Banvel and control was more definite. We used Tordon exclusively in 1986.

Let's go back a moment to where I noted that backpacking was more work than spreading granules. The park people were excited about the change in application method and so was I, but the guys packing the backpacks were not. It really was a lot of work, and I would have caused a mutiny if I had suggested that they use backpacks much more than they were. With both Bavel 10G and Tordon 2K leaving the market, a replacement needs to be found...if such a thing is possible. My Assistant Supervisor, Don Kosteff, set out to at least reduce our consumption so that our stock would last longer. For several years, the crews under his direction, had coupled hoses together to reach areas just a little way beyond the end of the hose. It seemed to make good sense to lengthen the hose since the many was almost there. In one or two places, hoses had spanned rivers or reached the bottom of a canyon easier

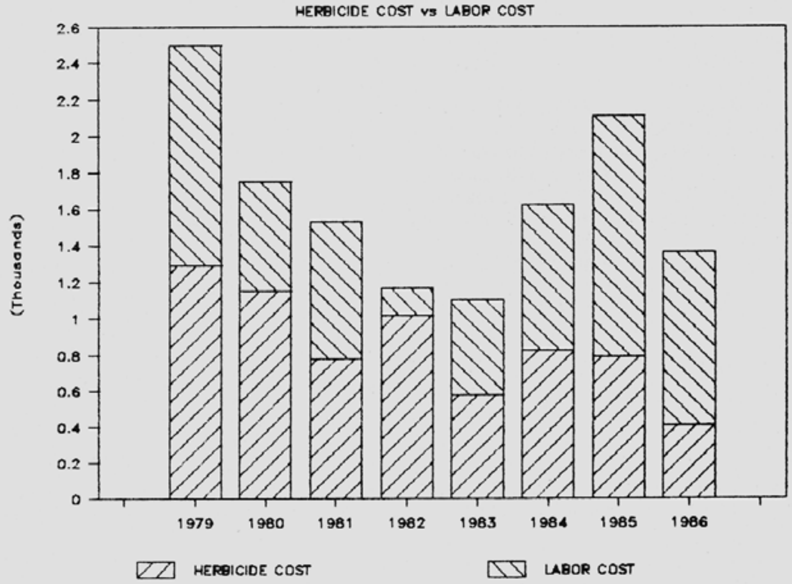
SINKS CANYON STATE PARK

COST/ACRE COMPARISONS



SINKS CANYON STATE PARK

HERBICIDE COST vs LABOR COST



than we could have carried granules or backpacks. Don reasoned that the hose and handgun could duplicate backpack performance if the regular tip was replaced with a small flat fan nozzle and the pressure was reduced. We replaced the two hundred feet of half-inch hose with three hundred feet of three-eighths and used quick disconnecting swivel-type hydraulic fittings, all minor alterations of existing equipment. Since that time we have used as much as 1,200 feet of hose in the some locations.

I found it hard to believe that one man spraying and three or four men holding onto the hose could be as productive as the same number of men with backpacks, but the results in the state park last year showed that more acres were covered in less time than the year before, with a decrease of total cost, as well as the cost per-acre worked. The cost per-acre treated rose to $260 and will keep going up in the future, but the cost per-acre worked hit $10.48, and that is a reasonable cost of treatment.

When our crews arrive at the site for the day's work, they are mixed for a twenty gallon per-acre rate and spread out. Each truck works all the spurge they can out to three hundred feet, which really is most of it. Then they link hoses and move to the hill. To avoid tangling the hose in brush, the gun man works a long narrow zone, spraying up one side and down the other. As he goes up, the hose men follow, paying out hose as they go. As the gun man comes down, the hose is pulled back down the hill in front of him until the gun man can start a new zone. This way each man moves only a few hundred feet up and down the hill with a light load, and the gun man sprays all the time. In backpacking, each man would have to walk to the weeds with a forty-pound load, spray it out and walk back. In practice, backpacking is 98% walking back and forth. Last year it took about five hours using this technique to treat all the spurge in the park, a decrease of several hours. In 1986, these three crews spot treated over one thousand acres of leafy spurge with handguns at an average cost of $50 per acre treated. They covered over thirty thousand acres of land in the process.

In summary then, the data collected from eight years of work at Sinks Canyon State Park leads to these conclusions:

1) Using the cost per-acre worked provides a better comparison of treatment methods than does the cost per acre treated;

2) Spot treatment is no more expensive than broadcast treatment for scattered infestations on rough sites;

3) Careful directed sprays from a backpack will reduce treatment costs and environmental damage from herbicides, allowing a variety of products to be used safely in sensitive areas;

4) Long hoses and handguns can reduce treatment cost over granular formulations or backpacks with comparable results, and in many cases, may be able to satisfactorily replace the discontinued granular formulations;

5) Spot treatment is labor intensive but savings from reduced consumption of expensive herbicides more than compensates. A side benefit is that labor dollars are returned to the community in wages paid which has important political consequences.

The operations of Fremont County Weed and Pest Control District have been changed for the better as a result of the ingenuity of our crews, and I hope that the long hose, low pressure, directed spray techniques just described, might help others to overcome environmental concerns, reduce treatment costs and replace the discontinued granular formulations to some degree.

EVALUATION OF 2,4-D AMINE TIMING ON LEAFY SPURGE SEED PRODUCTION AND VIABILITY

Gamal S. Heneidi, Stephen D. Miller and Mark A. Ferrell[1]

Abstract. Leafy spurge (*Euphorbia esula* L.) is a troublesome weed that infests considerable areas of range and pastureland in the western United States. The successful spread of leafy spurge is due in part to its capability to reproduce by both seeds and underground roots. Spread of leafy spurge by seed occurs naturally. Expulsion of leafy spurge seed from the capsules can propel the seed up to 15 to 20 ft from the mother plant.

The purpose of this experiment was to evaluate the effect of 2,4-D {(2,4-dichlorophenoxy)acetic acid} amine spray timing on leafy spurge seed viability. The dimethyl amine formulation of 2,4-D (2 lb ai/A) was applied initially at the pre-bud to bud stage and at seven-day intervals thereafter, until the seeds started dehissing from the seed capsules.

The experiment was conducted at Lander, Wyoming, in 1985, and consisted of six timing treatments plus a non-treated check. Seeds were collected in nylon netting which was wrapped around the top of the leafy spurge plants. Treatments were replicated ten times in a randomized complete block design.

Data collected included seed counts per plant, percent viable seed, viable seeds per plant, percent seed germination in water and GA_3, (Gibberellic acid), percent seed abnormality in water and GA_3 and number of seed with broken seedcoat.

Seed production, seed viability, seed germination and seed abnormalities were influenced by timing of 2,4-D amine applications. 2,4-D amine applications 0 and 7 days after bud initiation were most effective in eliminating viable seed production. However, 2,4-D applications 35 days after bud initiation caused the greatest number of abnormal leafy spurge radicals when germinated in both water and GA3. Leafy spurge seed germination tended to be higher in GA_3 than in H_2O regardless of 2,4-D timing.

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[1]Plant Science Department, University of Wyoming, Laramie, Wyoming 82071

SULFOMETURON - A SULFONYLUREA HERBICIDE PHYTOTOXIC TO LEAFY SPURGE

Rodney G. Lym and Calvin G. Messersmith[1]

Abstract. Sulfometuron {2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]sulfonyl]-benzoic acid} is among a group of sulfonylurea herbicides currently being marketed for industrial weed control. These herbicides are analogs of chlorsulfuron {2-chloro-*N*-[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide} but they have less soil residual and different weed control spectrums than chlorsulfuron. Sulfometuron is the only sulfonylurea herbicide that has shown herbicidal activity on leafy spurge (*Euphorbia esula*

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[1]Department of Agronomy, North Dakota State University, Fargo, North Dakota

L.), at least within the range of economic application rates. Leafy spurge growth stopped following application of sulfometuron at 0.5 to 2.0 oz ai/A, but leaves and stems remained green. However, sulfometuron directly affected root bud growth. Root buds were either inhibited completely or only a few grew but were white and short compared to numerous pink elongated buds on untreated plants. Sulfometuron at 0.5 to 1 oz/A plus an auxin herbicide provided better leafy spurge control than sulfometuron alone and long-term control was better when sulfometuron was mixed with picloram (4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid) than with 2,4-D (2,4-dichlorophenoxy)-acetic acid) or dicamba (3,6-dichloro-2-methoxybenzoic acid) (Table). Leafy spurge control with sulfometuron tended to be better as a spring compared to a fall application whether applied alone or with an auxin herbicide. Sulfometuron inhibits growth of many grass species, but application after the major growth period of most grass species may allow its use on pasture and rangeland. Also, enhanced grass growth after eliminating leafy spurge competition may compensate for the direct suppression of forage production by chlorsulfuron. The optimum herbicide application rates and date and the effectiveness of various retreatments and combination treatments with auxin herbicides still must be determined.

		Application and evaluation dates				
		June 27,1985			September 4 , 1985	
Treatment	Rate	August 21, 1985	May 29, 1986	August 18, 1986	May 29, 1986	August 18, 1986
	(oz/A)	----------------------	----------------(% control)	----------------	----------------	----------------
Sulfometuron	0.5	---	---	---	16	0
Sulfometuron	1	0	6	0	95	7
Sulfometuron	1.5	0	63	25	---	---
Sulfometuron	2	0	36	6	---	---
Sulfometuron+2,4-D	1+16	95	76	26	99	17
Sulfometuron+dicamba	1+32	96	85	40	97	23
Sulfometuron+picloram	1+8	70	96	59	99	74
Sulfometuron+2,4-D	0.5+16	---	---	---	95	24
Sulfometuron+dicamba	0.5+32	---	---	---	97	51
Sulfometuron+picloram	0.5+8	---	---	---	99	40
Sulfometuron+metsulfuron	2+0.5	0	60	24	88	13
DPX-L5300	1	---	---	---	44	6
LSD (0.05)		25	22	26	26	30

EVALUATION OF CURLYCUP GUMWEED CONTROL WITH SPRING VS. FALL HERBICIDE APPLICATIONS

Mark A. Farrell and Thomas D. Whitson[1]

Abstract. Curlycup gumweed (*Gindelia squarrosa* (Pursh) Dunal) is a warm season, biennial or short-lived perennial native forb found in waste places, along roadways and depleted rangelands. It is an invader and has little forage value. This experiment was established to evaluate the effectiveness of late summer herbicide applications compared with spring herbicide applications for the control of curlycup gumweed.

The study was established August 8, 1985, when the curlycup gumweed was in full flower and 4 to 6 inches in height and was repeated June 18, 1986, when the curlycup gumweed was in the prebud stage-of-growth. Liquid formulations were applied with a 9 by 30 ft arranged in a randomized complete block design with four replications. The soil was a sandy loam (73% sand, 10% silt and 17% clay) with 1.2% organic matter and a 7.1 pH.

Visual estimates of curlycup gumweed control were made August 1986. There was considerable difference in control based on time of application. The June 1986 application gave better control than did the August 1985 application. Metsulfuron {2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-amino]carbonyl]amino]sulfonyl]benzoic acid} at 0.0438 lb ai/A, 2,4-D amine {(2,4-dichlorophenoxy)acetic acid} at 3.0 lb ai/A, dicamba {3,6-dichloro-2-methoxybenzoic acid} at 0.5 lb ai/A plus 2,4-D amine at 1.5 lb ai/A, metsulfuron at 0.0109 lb ai/A plus 2,4-DLVE at 0.5 lb ai/A all gave 95% or better control when applied in June of 1986, whereas all treatments applied in August of 1985 gave less than 90% control when evaluated one year after application. Metsulfuron gave the best control at both application timings, giving 99% control when applied in June 1986 and 87% control when applied in August 1985. The data indicate that spring applications of the herbicides evaluated are better for control of curlycup gumweed than are late summer applications (Table 1).

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[1]Plant Science Department, University of Wyoming, Laramie, Wyoming

Table 1 Curlycup gumweed control

Treatment	Rate lb ai/A	[1]Percent control Date applied 8/14/85	6/18/86
clopyralid	0.25	76	60
clopyralid	0.50	70	89
fluroxypyr	0.25	0	0
fluroxypyr	1.00	0	0
metsulfuron	0.0109	76	90
metsulfuron	0.0438	87	99
dicamba	0.50	71	86
2,4-DLVE	1.50	71	93
MCPA amine	3.0	68	90
2,4-D amine	3.0	79	96
triclopyr	0.75	40	55
picloram	0.25	66	81
dicamba + 2,4-DA	0.50 + 1.50	78	96
triclopyr + 2,4-DLV	0.25 + 0.50	65	88
metsulfuron + bromoxynil	0.0109 + 0.50	79	92
metsulfuron + dicamba	0.0109 + 0.50	84	97
metsulfuron + 2,4-DLVE	0.0109 + 0.50	81	95
LSD (0.05) =		16	10
CV =		18	9

[1]Visual control evaluations August 21, 1986.

TEACHING WEED IDENTIFICATION

J.L. Lindquist, P.K. Fay, J.E. Nelson[1]

Abstract: A survey of agricultural universities was conducted to determine the methods and techniques used to teach undergraduate level weed identification. Few universities had separate courses, and most incorporated weed identification into introductory weed science courses. The number of weed species taught ranged from 50 to more than 200. A number of institutions depend heavily upon single teaching methods or devices such as plant mounts, field trips, greenhouse-grown plants or slides for information delivery. Weed identification courses and methods vary greatly from institution to institution.

[1]Montana State University, Bozeman, Montana

SULFONYLUREA HERBICIDES ON TWO SOILS IN KANSAS

P.W. Stahlman[1]

Abstract. Studies were conducted for three years near Hays, Kansas, to determine the effects of chlorsulfuron {2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide} and metsulfuron {2-[[[[(4-methoxy-6-methyl-1,3,5,-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoic acid} carryover to grain sorghum (Sorghum bicolor L. Moench 'Dekalb DK46') planted 7.5 to 9.5 months after application. The herbicides were applied individually to Harney silt loam (pH 6.6) and Armo loam (pH 7.8) soils at the rates of 0, 12, 18, 23 or 26 g/ha in late September, 1983, mid-October, 1984, and mid-November,1985, and grain sorghum was planted the following June. Chlorsulfuron and metsulfuron injured grain sorghum all years, but crop stand was not reduced by any treatment any year. Injury generally increased as herbicide rate increased and was more severe on the Armo loam than on the Harney silt loam. Grain sorghum flowering was delayed slightly one of three years on the Harney silt loam and all years on the Armo loam; flowering delay was severe in 1986. Despite injury, neither herbicide reduced grain sorghum yield significantly on either soil in 1984 or 1985. In 1986 there was a trend of increasing crop yield on the Harney silt loam as the rate of both herbicides increased, but corp yields on the Armo loam were reduced significantly, partly because grain sorghum on treated plots did not mature before a killing freeze occurred.

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[1]Fort Hays Branch, Kansas Agric. Exp. Station, Hays, Kansas 67601

THE DEGRADATION RATE OF AC 222,293

E.S. Davis, G.M. Fellows and P.K. Fay[1]

Abstract. AC 222,293 {Methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate and methyl 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate}, a new herbicide for the control of wild oat (Avena fatua L.) in wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) persists in soil which may limit its use in certain areas. A greenhouse study was conducted to determine the rate of degradation of AC 222,293 in eight Montana soils. AC 222,293 was applied to soil at rates of 0, 1, and 2 ppm (w/w) and stored at 4.5 and 18 C for 0, 1, 2, 4, 8, 12 and 16 weeks. A soil bioassay was devised using oats (Avena sativa L. 'Otana') as an indicator species. The half life of AC 222,293 was determined for each soil and varied by soil type and temperature.

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[1]Montana State University, Bozeman, Montana

THE RATE OF DISSIPATION OF FMC 570202 FROM SOIL

E.R. Gallandt, P.K. Fay and E.S. Davis[1]

Abstract. Field and greenhouse experiments were designed to examine the rate of dissipation from soil and weed control potential of FMC 57020 {2-(2-chlorophenyl)methyl-4,4-dimethyl-3-isoxazolidinone}, a promising herbicide for chemical fallow in Montana. The herbicide was applied at 0, 0.5, 1.1 and 2.2 kg/ha at two locations in March 1985. Following application, soil samples were removed to a depth of 8 cm at monthly intervals for seven months. Seven months after application, soil samples were taken from 0-8 cm, 8-16 cm and 16-24 cm soil depths. A greenhouse bioassay using oats (*Avena sativa* L.) and a field bioassay using winter wheat (*Triticum aestivum* L.), were developed to determine residual activity. Field bioassay results indicate a significant reduction in winter wheat dry weight from plots originally treated with 1.1 and 2.2 kg/ha.

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[1]Montana State University, Bozeman, Montana

PERSISTANCE OF CLOPYRALID IN SOIL

K. Tanphiphat and L.C. Burrill[1]

Abstract. Field studies were conducted in 1984 to determine the soil persistance of clopyralid {3,6-dichloropicolinic acid} under cropping situation. Two fields with identical clopyralid treatments were established. Clopyralid was sprayed on bare soil at 0.14 kgae/ha in the spring and on the same plots at 0.56 kgae/ha in the summer. Winter wheat (*Triticum aestivum* L. 'Stephen') was seeded in one field in the fall of 1984. Safflower (*Carthamus tinctorios* L.), a crop sensitive to clopyralid, was planted in the other field in the spring of 1985. Wheat and safflower yields were not affected by clopyralid treatments.

Greenhouse bioassays were conducted on soil samples periodically collected from plots treated with clopyralid at 0.56 or 1.12 kgae/ha in the fall of 1984. Soil samples were collected from two depths, 0 to 10 cm, and 10 to 20 cm. Lentil (*Lentilla lens* L.), safflower and peas (*Pisum sativum* L.) were used as indicator plants. Clopyralid disappeared faster in the second sampling depth (10 to 20 cm) than in the first sampling depth (0 to 10 cm). No herbicide was detected in the second sampling depth 220 days after treatment but in the first sampling depth there was sufficient herbicide to cause growth reduction in all indicator species. In soil sampled 287 days after applying either 0.56 or 1.12 kgae/ha, enough herbicide remained in the first depth to produce slight symptoms on lentil. Adding 2,4-D {(2,4-dichlorophenoxy)acetic acid} did not affect clopyralid persistence. Clopyralid and XRM-3785 (clopyralid + 2,4-D) at the same dosage of clopyralid disappeared from the soil at approximately the same time.

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[1]Department of Crop Science, Oregon State University, Corvallis, Oregon

DPX-R9674 IN THE PACIFIC NORTHWEST

G.E. Cook and D.T. Ferguson[1]

Abstract. "Matrix" (formerly DPX-R9674) {2:1 ratio methyl 3-[[(4-methoxy-6-methyl-1,3,5-triazin-2yl)amino=carbonyl]amino sulfonyl]-2-thiohene carbonylate + methyl 2-[[[[[3-(4-methoxy-6-methyl-1,3,5-triazin-2yl)N-methyl]amino]-carbonyl]amino]sulfonyl]benzoate] is a sulfonylurea herbicide (2:1 mixture of DPX-M6316 to DPX-L5300) that is characterized by having a very short residual in the soil. This herbicide has been tested in the Pacific Northwest for the last four years by university, private, commercial and DuPont investigators in over 150 trials. The weed spectrum and mode of action of "Matrix" is similar to that of chlorsulfuron {2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide}; however, it must be used as postemergence herbicide. In annual recroppping areas broadleaf crops, such as peas and lentils, can be grown 60 days after application. "Matrix" is an exciting cereal herbicide that demonstrates good crop tolerance, broad spectrum weed control and crop rotation flexibility.

[1]E.I. DuPont de Nemours & Co., Inc., Menlo Park, California

AN INTRODUCTION OF RE-45601, A NEW POSTEMERGENCE HERBICIDE

M.J. Ansolabehere[1]

Abstract. RE-45601 {(E,E)-(+1-)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]-propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one} is a new selective postemergence grass herbicide under development by Chevron Chemical Company, Agricultural Chemicals Division. In the herbicidal class, cyclohexanedione-oxime, RE-45601 has shown to be effective against a wide range of annual and perennial grasses, with little or no activity against broadleaf weeds and sedges. All broadleaf crops tested, including soybeans, cotton, peanuts, sugarbeets, potatoes, alfalfa and most vegetable crops, have shown excellent crop tolerance. Preemergence activity for annual grass control has been observed from application rates of from 0.125 to 0.50 lb. active per acre when applied preemergence or preplant incorporated to many broadleaf crops. Best results from RE-45601 applications have been obtained when grass species are actively growing and are 2 to 8 inches in height. An oil concentrate at 1.0 qt. per acre is recommended with all postemergence applications.

[1]Chevron Chemical Company, Fresno, California 93711

OXYFLUORFEN/GLYPHOSATE AND OXYFLUORFEN/PARAQUAT COMBINATIONS FOR POSTEMERGENCE WEED CONTROL OF WINTER ANNUAL WEEDS

R.W. Falconer, R.L. Smith and T.C. Tillett[1]

Abstract. Five trials were established during the 1985-86 winter season to evaluate tank mix combinations of oxyfluorfen {2-chloro-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene} (0.037 to 0.25 lb ai/A) with either glyphosate {N-(phosphonomethyl)glycine} (0.125 to 0.50 lb ai/A) or paraquat {1,1'-dimethyl-4,4'-bipyridinium ion} (0.125 lb ai/A) for optimum postemergence control of the winter weed spectrum common to the Central San Joaquin Valley.

The first experiment design was a randomized complete block with four replications. Treatments were applied at 10 gpa and 40 psi using a CO_2 backpack sprayer. Weed size ranged from 4 to 8 inches in height. Evaluations were made at 7, 14 and 28 days after applications.

Results indicate that tank mix combinations of oxyfluorfen with paraquat or glyphosate resulted in comparable or improved postemergence weed control as compared to either product alone. Tank mixtures that provided the best overall weed control were: oxyfluorfen + paraquat (0.25 + 0.125 lb ai/A) and oxyfluorfen + glyphosate (0.20 + 0.50, 0.25 + 0.50 lb ai/A). Weeds controlled by redmaids (*Calandrinia caulescens*), fiddleneck (*Amsinckia spp*) and redstem filaree (*Erodium botrys*). These tank mix combinations provided more consistent and efficacious results as compared to reduced rate tank mixtures of oxyfluorfen plus glyphosate (0.037 + 0.38, 0.037 + 0.50 lb ai/A).

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[1]Rohm and Haas Company, Fresno California

DPX-L5300 - A NEW CEREAL HERBICIDE[1]

C.W. Kral and D.T. Ferguson

Abstract. "Express" (formerly DPX-L5300 {methyl 2 [[[[N-(4-methoxy-6-methyl-1,3,5-triazin-2-yl) methylamino]carbonyl]amino]sulfonyl]benzoate} cereal herbicide controls a wide arrange of annual broadleaf weeds and Canada thistle (*Cirsium arvense*) when applied as a postemergence spray to actively growing weeds. Use rates of 0.125 - 0.375 oz ai/acre provide good crop tolerance to such cereals as winter wheat, spring wheat and barley. Broadleaf crops such as potatoes, alfalfa, sugarbeets and onions can be planted within the normal rotational interval. Rotational crop studies indicate any crop may be planted 60 days after application because "Express" is rapidly inactivated in soil by chemical hydrolysis.

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[1]E.I. DuPont de Nemours & Co., Inc., Menlo Park, California

FACTORS AFFECTING VOLUNTEER CEREAL RYE (SECALE spp.) CONTROL IN WINTER WHEAT WITH ETHYL-METRIBUZIN

P.R. Diener, D.J. Rydrych and A.P. Appleby

Abstract. Ethyl-metribuzin {4-amino-6-(1,1-dimethylethyl-3-(methylthio)-1,2,4-triazin-5(4H)-one] is selective in winter wheat (*Triticum aestivum* L. 'Stephens') for the control of volunteer cereal rye. Field trials were conducted in eastern Oregon in 1985 to 1986 to evaluate the combination of ethyl-metribuzin and metribuzin {4-amino-6-(1,1-dimethylethyl-3-(ethylthio)-1,2,4-triazin-5(4H)-one} at various rates and timings. Nutrient solution bioassays were conducted in the greenhouse to determine if the difference in sensitivity between wheat and cereal rye to ethyl-metribuzin is due to physiological factors.

Greatest control of cereal rye was achieved when treated at the 2- to 3-leaf stage. The combination of ethyl-metribuzin at 2.2 kg ai/ha and metribuzin at 0.14 kg ai/ha gave 90% control, whereas ethylmetribuzin at 1.7 kg ai/ha and metribuzin at 0.14 kg ai/ha reduced control to 80%. Solution bioassay results showed Stephens winter wheat to be 6X more tolerant to ethyl-metribuzin than cereal rye. This suggests that Stephens winter wheat possesses greater physiological tolerance to ethyl-metribuzin.

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[1]Oregon State University, Corvallis, Oregon

NITRATE AND SOLUBLE OXALATE ACCUMULATION IN KIKUYUGRASS (PENNISETUM CLANDESTINUM)

M.C. Williams[1]

Abstract. Kikuyugrass (*Pennisetum clandestinum* Hochst. ex Chiov.), a native to eastern Africa, is cultivated in a pasture grass in tropical and subtropical areas of the world. While the grass can be safely grazed under most conditions, it may accumulate toxic concentrations of nitrates and soluble oxalates and may contain a third unknown toxic compound. Three syndromes of poisoning are observed: 1) osteodystrophia fibrosa, observed primarily in horses and caused by chronic oxalate poisoning; 2) nitrate poisoning; and 3) an often fatal inflammation and necrosis of the alimentary tract. To test the capacity of kikuyugrass to form and accumulate nitrates and soluble oxalates, the grass was grown in nutrient solution superimposed with NaCl, KCl (0.001 M and 0.01 M) and with NH_4NO_3 (100 $mmol \cdot l^{-1}$). Na and K often enhance the formation of oxalate salts and adequate N is required for the accumulation of nitrates.

The concentration of soluble oxalates and nitrates was not significantly affected when Na, K or N were added to the nutrient solution. Plants from the controls and treatments averaged 2.0% nitrates (as KNO_3) and 3.0% soluble oxalates. A level of 1.5% nitrates in plants is considered a toxic level for

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[1]USDA/ARS, Logan, Utah

livestock and 0.3 to 0.4% soluble oxalates in kikuyugrass has caused osteodystrophia fibrosa in horses that grazed the plant over several months. The formation of soluble oxalates in kikuyugrass is largely genetic and is not affected by the presence of Na or the addition of K beyond the normal nutritional requirements of the plant. Therefore, if kikuyugrass grows on fertile soil in which K and N are not limiting, the plant may accumulate toxic concentrations of both nitrates and soluble oxalates.

METSULFURON DRIFT WITH AERIAL APPLICATION

J.M. Lish, D.C. Thill and S.P. Yenne[1]

Introduction

Conditions conducive to high drift, swath displacement, downwind or extended airborne displacement include high air temperature, low relative humidity, high wind velocity, inversion, small spray droplets, low spray volume and nozzle wind shear. Part of the date required by the Environmental Protection Agency for overall environmental risk assessment to register a herbicide may include an aerial drift study. Generally, an aerial drift study is required if a herbicide is toxic to nontarget organisms and the product is used in a manner whereby it may be carried off-target by air currents (1). The protocol requires that the studies simulate a worse case scenario, maximum drift conditions.

Aerial drift data were required for registration of metsulfuron {methyl 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-benzoate]. The objectives of this study were: 1) to obtain metsulfuron drift information that fulfilled the requirement for the Environmental Protection Agency's registration protocol and 2) to compare metsulfuron drift under low and high drift conditions.

Materials and Methods

Metsulfuron (60% dry flowable) was applied to a 14 by 450 m spray strip with a Cessna Spray Wagon at 14 g ai/ha in four passes for a total of 56 g ai/ha. The spray strip was perpendicular to wind direction. Samples were collected from three vectors perpendicular to the spray strip and one vector 45^{o} off the end of the spray strip (Figure). Samples were collected upwind at -7, -12, -17, -32 and -37 m and downwind at 7, 12, 17, 22, 37, 82, 157, 307 and 457 m on the perpendicular vectors and the downwind diagonal vector. Samples were collected on four, 697 cm^2 Mylar sheets placed at the top of the plant canopy at each sampling station. Mylar sheets were collected 0.5 to 1 h after application and each was placed in a 0.95 L glass jar, which was then sealed with a tight fitting screw-top lid. Collection order was from -37 to 457 m. Samples were sent to E.I. DuPont de Nemours and Co. for liquid chromatography analysis[2].

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[1]Res. Assoc., Assoc. Prof., and former Res. Grad. Asst., respectively, Plant Soil and Ent. Sci. Dept., Univ. of Idaho, Moscow, ID 83843
[2]Saladini, J.L., personal communication, 1986

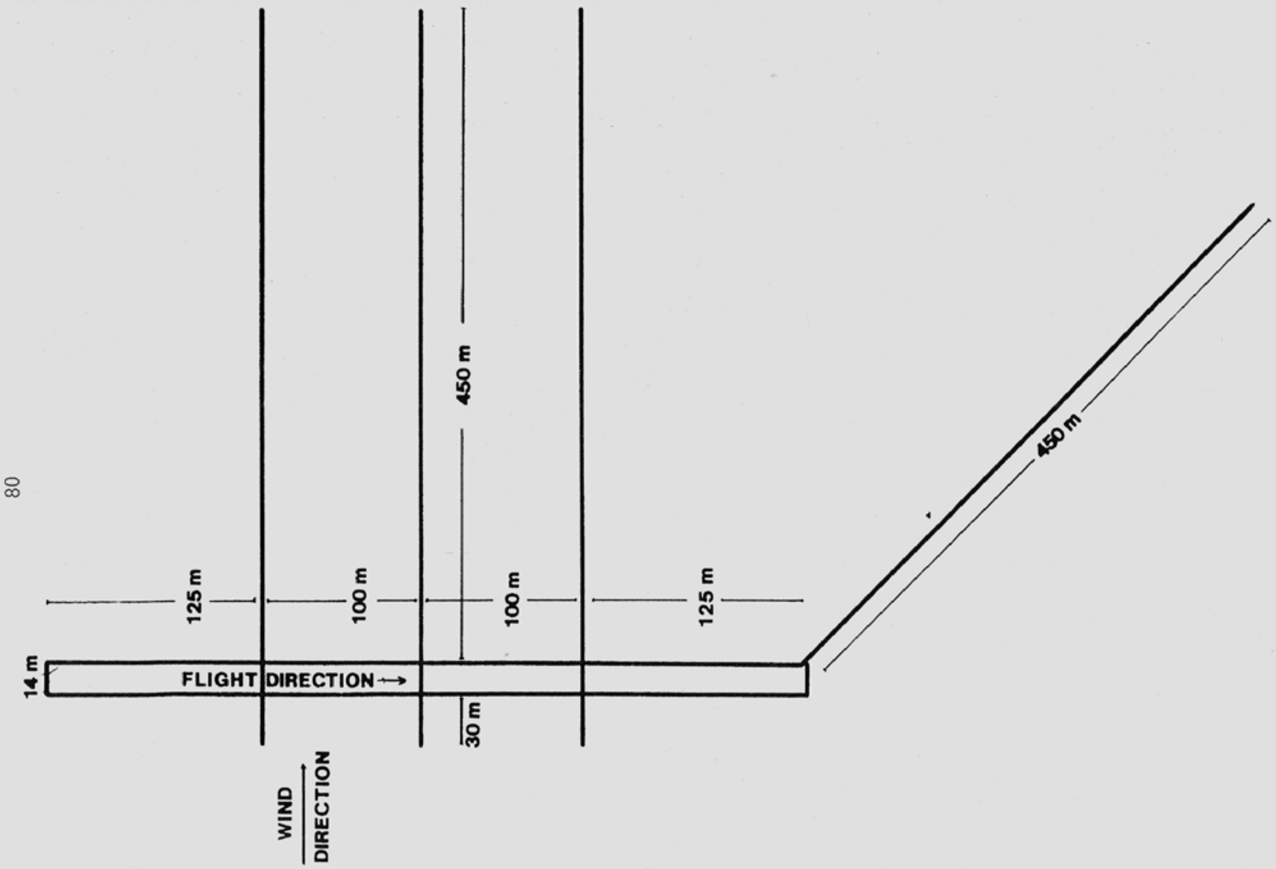

Figure. Pattern of metsulfuron application and collection surface placement for aerial drift study.

Conditions at the time of application were selected to obtain a low and high off-target drift situation on June 14, 1984, and May 16, 1985, respectively. D6 nozzles with number 46 whirlplates were oriented at a 0^{0} shear and spray volume was 28 L/ha applied at 161 km/h with a 4.4 km/h crosswind for the low drift condition. D4 nozzles with number 46 whirlplates were oriented at a 90^{0} shear (turned perpendicular to line of flight) and total spray volume was 9.4 L/ha applied at 177 km/h with a 13 km/h crosswind for the high drift condition. Air temperature at 1 m, relative humidity and time of application were 27 and 26 C, 33 and 30% and 1800 and 800 h PDT, respectively. The ground cover was 15 to 46 cm tall flixweed (*Descurania sophia* (L.) Webb), hedgeparsley (*Torilis arvensis* (Huds.) Link) and downy brome (*Brome tectorum* L.) at the low drift site and 20 to 25 cm tall wheat (*Triticum aestivum* L.) at the high drift site. Data were analyzed with analysis of variance using least squares procedures and Fisher's protected least significant difference (LSD) at the 0.05 probability level was used for mean separation (2).

Results and Discussion

Data were combined over vectors because there was no difference between vectors. Deposition was shifted approximately 7 and 12 m downwind from the center of the flight line with the low and high drift conditions, respectively (Table). Deposition rate was greater at -12 to 22 m from the center of the flight line under low drift conditions compared to high drift conditions. There was a trend for deposition rate to decrease as the distance increased from 37 to 457 m under high drift conditions but for deposition rate to remain static under low drift conditions.

Table. Metsulfuron deposition rate for high and low drift conditions to off-target sites.

Distance from flight line	Drift condition High	Drift condition Low
(m)	----(g/ha)-----	
-37	0.004	0.007
-32	0.002	0.019
-17	0.001	0.038
-12	0.005	1.843
- 7	0.023	7.130
7	6.633	9.253
12	8.061	6.724
17	5.851	2.059
22	2.215	1.432
37	0.351	0.171
82	0.039	0.019
157	0.017	0.019
307	0.014	0.021
457	0.013	0.022
LSD (0.05)	0.765	

Literature Cited

1. Holst, R.W. and T.C. Ellwanger. 1984. Pesticide Assessment Guidelines, Subdivision R. Pesticide Spray Drift Evaluation, EPA-540/9-84-002. U.S. Environmental Protection Agency, Office of Pesticide Program. Washington, D.C. 19 pp.
2. Steel, R.G.D. and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., Inc. New York. 481 pp.

EFFECTS OF DENSITY AND PROPORTION ON SPRING WHEAT AND ITALIAN RYEGRASS (LOLIUM MULTIFLORUM)

J. Concannon and Dr. S. Radosevich[1]

Abstract. An experiment was established to investigate competition between Italian ryegrass and two spring wheat varieties in western Oregon. Six densities of wheat and six densities of ryegrass were combined in a systematic design to obtain six proportions in an ascending addition series. The addition series was incorporated into a split-plot design using wheat variety as the main plot. This approach facilitated the analysis of intraspecific and interspecific competition by separating the effects of plant density and species proportion on crop and weed biomass. The reciprocal of average plant biomass for each species was regressed against the independent variables of density and species proportion. Multiple linear regression was used to estimate the competition between the two plant species when grown in monocultures and mixtures. Although wheat was always the superior competitor, the competitive ability of each species was influenced by both the density and the proportion.

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[1]Oregon State University, Corvallis, Oregon

INTERFERENCE OF ANNUAL WEEDS IN SEEDLING ALFALFA (MEDICAGO SATIVA)

Albert J. Fischer[1], Jean H. Dawson[2] and Arnold P. Appleby[1]

Abstract. Two summer annual weeds, barnyardgrass (*Echinochloa crus-galli*) (L.) Beauv. #[3] ECHCG) and pigweeds (mixture of *Amaranthus retroflexus*) L. # AMARE and *A. powellii* S. Wats. #AMAPO) seeded separately with alfalfa

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[1]Grad. Res. Asst. and Professor, respectively, Dep. of Crop Sci., Oregon State Univ., Corvallis, Oregon 97331.
[2]Res. Agron., Agric. Res. Serv., U.S. Dep. Agric., Irrigated Agric. Res. and Ext. Center, Prosser, Washington 99350.
[3]Letters following this symbol are the WSSA-approved computer code from Composite List of Weeds, Weed Sci. 32, Suppl. 2. Available from WSSA, 309 West Clark St., Champaign, IL 61820.

(Medicago sativa L.) in mid August suppressed alfalfa severely. Although frost killed the summer annuals in October and November, interference from barnyardgrass killed 30% of the alfalfa seedlings and interference from bothspecies reduced the yield of alfalfa forage in each of three harvests the following year. The summer annuals did not harm alfalfa seeded in mid-September. Two winter annuals, downy brome (Bromus tectorum L. # BROTE) and tumble mustard (Sisymbrium altissimum L. # SSYAL), suppressed alfalfa seeded in August or September. They reduced alfalfa stands, suppressed fall and spring growth of alfalfa, and yield of alfalfa forage in each of three harvests the following year. Alfalfa seeded 27 August and allowed to compete with a mixture of the above weed species for various periods was injured most by weeds that emerged with the alfalfa and remained uncontrolled until forage harvest in May. These weeds did not reduce alfalfa yields if removed by 36 days after alfalfa emergence; thereafter, yield suppression increased as period of weed interference increased. The early tolerance to the presence of weeds allows the farmer flexibility in timing and selecting the first weed control measure. This initial month of tolerance to weeds also indicated that in this system, interference was not significant until competition for light began after weeds grew taller than the crop. Interference was most damaging in early spring, when growth of winter annual weeds was rapid and vigorous. Interference from weeds seeded 65 or more days after alfalfa emergence had little or no impact on alfalfa yields, but these weeds sometimes produced enough undesirable biomass to reduce the quality of the first cutting alfalfa hay.

Additional index words. Amaranthus retroflexus, A. powellii, Bromus tectorum, Echinochloa crus-galli, Sisymbrium altissimum, competition, AMAPO, AMARE, BROTE, ECHCG, SSYAL.

SUMMER GRASS CONTROL IN ALFALFA

Carl E. Bell[1]

Abstract. Summer grasses are a serious problem in alfalfa production in the Imperial Valley of California. These grasses invade weakened fields and reduce alfalfa quality. Experiments were conducted to evaluate several alternative systems of controlling these weeds.

Experiment 1 compared EPTC (S-ethyl dipropyl carbomothioate) when applied at 3 lb ai/A in the irrigation water to an untreated control. The EPTC was applied three times to five acre blocks of three fields for four months starting in March, 1986. Weed control was determined by making counts of seedlings of prairie cupgrass (Eriochloa contracta Hitchc.) in June, July and August of 1986 in the treated and contiguous untreated 5 acre blocks. Phytotoxicity was evaluated at the same time by measuring the height of the alfalfa in treated and untreated blocks. Twenty 1/4 square meter areas were sampled each month from each block. For data analysis, a log transformation

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[1]Farm Advisor, University of California Cooperative Extension El Centro, California 92243.

was done on the raw counts because of the variability of the numbers and the large number of samples with no weeds. Analysis of variance on these data (Table 1) show that there are several significant sources of variation. Of these, the effect of treatment is not very significant (11.6%). However, the effect of field is highly significant, as is the interactions of field and treatment and month and treatment. Further analysis of these data when partitioned by month and by field are shown in Table 2 and Table 3.

Table 1. Analysis of Variance (all data included)

Source of Variation	df	F Value	Probability
Field	2	50.35	.000
Month	2	0.73	
Field x month	4	8.17	.000
Treatment	1	2.48	.116
Field x treatment	2	9.41	.000
Month x treatment	2	8.32	.000
Field x month x treatment	4	2.49	.043

Table 2. Analysis of Variance by Month

Source of Variation	df	F Value	Probability
June			
Field	2	14.99	.000
Treatment	1	5.32	.022
Field x treatment	2	2.72	.070
July			
Field	2	47.08	.000
Treatment	1	11.14	.001
Field x treatment	2	6.55	.002
August			
Field	2	9.34	.000
Treatment	1	3.57	.061
Field x treatment	2	5.37	.005

Table 3. Analysis of Variance by Field

Source of Variation	df	F Value	Probability
Field 1			
Month	2	3.15	.046
Treatment	1	18.32	.000
Month x treatment	2	6.88	.001
Field 2			
Month	2	9.66	.000
Treatment	1	1.60	.207
Month x treatment	2	4.61	.011
Field 3			
Month	2	2.05	.132
Treatment	1	0.07	-
Month x treatment	2	0.24	-

The data in Table 3 show that the herbicide treatment had a significant effect on numbers of weeds only on field one. Variation in the number of weeds apparently results more from field and seasonal differences than from the herbicide.

Experiment 2 compared several preemergence herbicide treatments applied in March, 1986, compared to an untreated control for control of summer grasses. These herbicides were applied to two fields in small plots (10' x 20') with four replications in a randomized complete block design. The herbicides applied to field one were: trifluralin 10% granules {2,6-dinitro-N,N-dipropyl-4-(trifluormethyl)benzenamine} at 1 and 2 lb ai/A, pendamethalin {N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine} at 1 and 2 lb ai/A, prodiamine {2,4-dinitro-N^3,N^3,-dipropyl-6-(triflouromethyl)-1,3-benzenediamine} at 1 and 2 lb ai/A, and RE-45601 {(E,E)-2-[1-[[(3-chloro-2-propenyl-oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one} at 0.1 and 0.2 lb ai/A. The treatments for field two were the same with the exception of the 0.1 lb ai/A rate of RE-45601 was replaced with a granular product containing 12% EPTC and 2% trifluralin. This EPTC/trifluralin granule was applied at 3.0 lb ai/A EPTC and .5 lb ai/A trifluralin to each plot in March and April (total of 6 lb ai/A EPTC and 1.0 lb ai/A trifluralin). Field one was treated on March 10, 1986, and field two on March 12, 1986. Field one did not have any weeds, therefore results are not presented. However, on March 30, 1986, some plots in this trial appeared stunted. These plots were measured for height and averaged 28 cm compared to 41 cm for the other plots and the area outside the experiment. The stunted plots were pendimethalin at 2.0 lb ai/A. Table 4 shows the results of this experiment on field 2.

Table 4. Evaluation of data for field 2.
Percent Weed Control

Treatment	Rate	5/27	PC	LEFUN	CYDNA
Trifluralin	1.0	42 abc	99 a	50 abc	0 b
Trifluralin	2.0	35 abc	99.9 a	70 ab	0 b
Pendimethalin	1.0	8 bc	83 ab	2 cd	0 b
Pendimethalin	2.0	85 ab	98 ab	15 bcd	0 b
Prodiamine	1.0	25 bc	79 b	47 abcd	25 ab
Prodiamine	2.0	58 abc	97 ab	35 abcd	0 b
EPTC/Trif.	6.0+1.0	99.9 a	99 ab	95 a	62 a
RE-45601	0.2	2 c	2 c	0 d	0 b
Untreated Control		0 c	0 c	0 d	0 b

PC = prairie cupgrass, LEFUN = mexican sprangletop (Leptochloa uninervia (Presl.)Hitchc. & Chase) and CYNDA = bermudagrass (Cynodon dactylon (L.)Pers.). These three weeds were evaluated on 8/13/86, the 5/27 evaluation was on all weeds present. Numbers followed by the same letter are not significantly different at the 5% level according to DMRT.

Trifluralin, pendimethalin and prodiamine at 2.0 lb ai/A provided good control of prairie cupgrass but not mexican sprangletop or bermudagrass. The only treatment to provide good season-long control was the EPTC/trifluralin granules.

Experiment 3 tested several postemergence grass herbicides on two fields against an untreated control. The herbicides were: sethoxydim {2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one} at .3 and .5 lb ai/A, BAS 517 (not available) at .075 and .15 lb ai/A, fluazifop-P-butyl {butyl (R)-2[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoate) at methyl)-2-pyridinyl]oxy]phenoxy]propanoic acid} at .15 and .3 lb ai/A, DPX-Y6202 {2-[4-(6-chloro-2-quinoxalinyl)oxy)phenoxy]propionic acid, ethyl exter} at .15 and .3 lb ai/A and RE-45601 that was 8-10 inches tall and mexican sprangletop that was 10-12 inches tall. Both grasses were flowering. In field two the grass was prairie cupgrass that was 6-8 inches tall, but not flowering. Field one was treated on July 23, 1986, with a CO_2 pressurized sprayer at 14 GPA. Field two was treated with the same sprayer and spray volume on July 25, 1986. All treatments had 1 quart per acre crop oil surfactant in each mix. Plot size was 10' by 15' in a randomized complete block design. Evaluation of both trials was made on August 11, 1986 using a visual rating system. Results are presented below in Table 5 as percent control.

Table 5. Percent Grass Control with Postemergence Herbicides

Treatment	Rate	Field One PC	Field One LEFUN	Field Two PC
Sethoxydim	0.3	91 abc	70 abc	77 bc
Sethoxydim	0.5	89 abc	62 bc	79 abc
BAS 517	0.075	83 bc	58 c	66 cd
BAS 517	0.15	98 a	91 a	89 ab
Fluazifop-P-butyl	0.3	93 abc	85 ab	66 cd
Fluazifop-P-butyl	0.5	97 ab	89 a	77 bc
Haloxyfop-methyl	0.15	95 ab	89 a	79 abc
Haloxyfop-methyl	0.3	97 ab	91 a	73 c
DPX-Y6202	0.15	77 c	70 abc	55 d
DPX-Y6202	0.3	91 abc	83 abc	55 d
RE-45601	0.15	95 ab	79 abc	79 abc
RE-45601	0.3	98 a	91 a	91 a
Untreated Control		0 d	0 d	0 e

PC = prairie cupgrass, LEFUN = mexican sprangletop. Numbers followed by the same letter are not significantly different at the 5% level according to DMRT.

CONTROL OF SUMMER ANNUAL GRASS IN ARIZONA ALFALFA

E.S. Heathman[1], B.R. Tickes[2] and J.P. Chernicky[3]

Summer annual grass weeds are the most widespread weed problem in Arizona alfalfa fields. Tests were conducted during 1986 with two principal objectives:

(1.) Observe the emergence of summer annual grass weeds during the summer growing season to determine when they first become established and if they emerge all season long.

(2.) Evaluate the effectiveness of trifluralin {2.6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine} 10% granules under varied field conditions for the control summer annual grass weeds using various rates and one or two application dates.

Summer Annual Grass Emergence

At the Yuma Valley Agricultural Center a two-year-old stand of alfalfa with a known heavy infestation of summer annual grass *Echinochloa* sp. and *Erichloa* sp., was selected to observe the pattern of grass seedling emergence. Plot size was 20 x 20 ft replicated 3 times. After grass seedlings began to emerge, an application of sethoxydim {2-[1-ethoxyimino)butyl]-5-[2-

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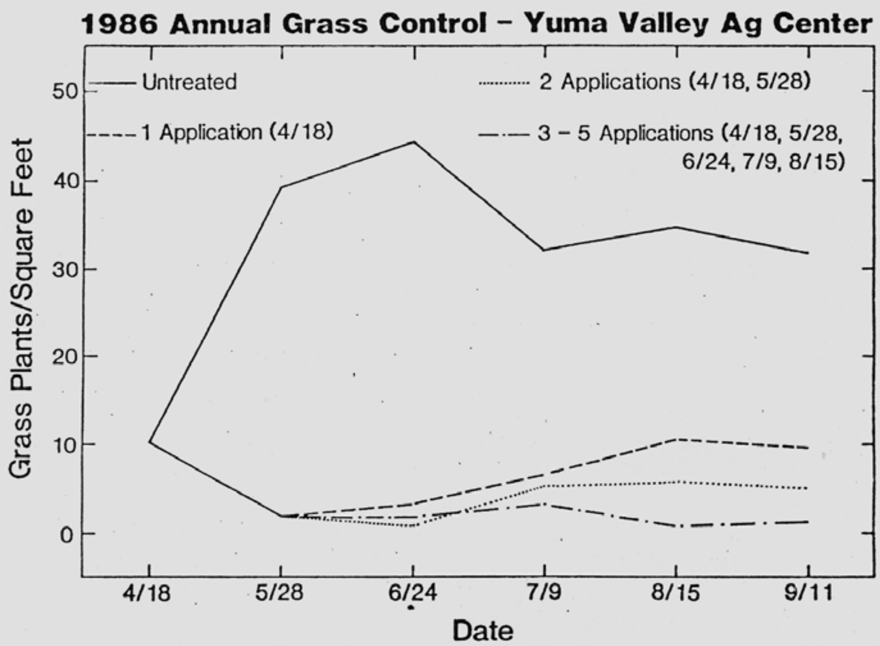
[1]Cooperative Extension Service, University of Arizona, Tucson, Arizona
[2]Cooperative Extension Service, University of Arizona, Yuma, Arizona
[3]Department of Plant Science, University of Arizona, Casa Grande, Arizona

(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) at 0.5 lb/A plus 1% crop oil was applied following each irrigation following harvest. Application dates were April 18, May 28, June 24, July 9 and August 15. Treatments were either 0, 1, 2, 3, 4, or 5 successive applications of sethoxydim. The sethoxydim was applied to control the emerged seedling weeds so that those weeds emerging following the next harvest could be identified. Weeds were counted in each treatment at two locations using a 1 sq. ft. quadrant after each harvest.

Graph 1



Seedling annual grass weeds emerged in April and at every cutting through August. Summer annual grass weeds peaked in numbers in the untreated check by June (44 per sq ft). The greatest flush of weeds was from April to June. Weeds emerging after the July cutting were relatively few in numbers (less than 1 per sq ft). Annual grass weeds emerged after five successive applications of sethoxydim at 0.5 lb/A. These results suggest that summer annual grass weeds emerge from April through August. To provide acceptable season long control of these summer weeds, control must extend through the June harvest. Grass weeds emerging in July and August were low in numbers and would be a doubtful economic threat to forage quality and crop competition.

Preemergence Control with Trifluralin 10% Granules

Trifluralin 10% granules were applied to the soil at five locations in 4 counties in the lower desert valleys of Arizona. The non-dormant alfalfa at each location was in the 2nd or 3rd year after planting. Alfalfa stands under desert conditions are normally replanted following the 3rd or 4th season. These locations were expected to have infestations of summer annual grass weeds. Soil type ranged from a sandy loam to a clay loam. All fields were irrigated with border irrigation with approximately two irrigations between harvests. The granules were applied using a Velmar air blast unit, 16.5 ft wide. A 16.5 ft swath was applied the length of the field leaving a 4 ft untreated swath between each replication. There were three or four replications of each treatment. Herbicides were applied in February at 1, 2 and 3 lb/A for preemergence control of summer annual grass weeds. In three locations a supplemental application was made in June of 1 or 2 lb/A to one half of the February applications of 1 or 2 lb/A. Weed species were primarily _Echinochloa_ sp., _Erichloa_ sp., and _Leptochloa_ sp.

Table 1. Percent control of summer annual grass weeds in June and August following applications of Trifluralin granules in February and June at 5 locations.

Date of Appl.		Percent Control of Annual Grass**									
Feb	Jun	Yuma		Bruce Church		Wakimoto		Lakin		CRIT	
lb/Aai	lb/Aai	Jun	Aug*	Jun	Aug	Jun	Aug	Jun	Aug	Jun	Aug
1	-	92a	62 b	98a	10 b	72 b	30 c	96a	63 b	97a	75a
2	-	96a	82a	99a	73a	93a	59 b	99a	80a	93a	85a
3	-	97a	88a	99a	88a	99a	63 b	100a	90a	98a	95a
1	1	89a	67 b	98a	92a	67 b	93a	-	-	-	-
2	1	93a	90a	85a	83a	98a	94a	-	-	-	-
1	2	90a	63b	-	-	-	-	-	-	-	-
2	2	99a	93a	-	-	-	-	-	-	-	-
Untreated		o c	o c	o b	o b	o c	o d	o b	o c	o b	o b

*Means in columns followed by the same letter are not significantly different at the 5% level using Duncan's multiple range test.

**Estimates of annual grass control include only those areas where some stand of alfalfa was maintained. There was no control of weeds in August with any treatment where alfalfa stands were lost.

June Evaluation: All treatments resulted in satisfactory control through June except at the Wakimoto location. The 1 lb/A rate was not satisfactory. At this location, a marginal stand of alfalfa was left in production so that this test could be conducted.

August Evaluation: Control of summer annual grass weeds in alfalfa season long was achieved only where adequate stands were maintained. Low spots in the field where irrigation water ponded, reduced alfalfa stands and probably encouraged the rapid anerobic degradation of trifluralin. Excessive wheel traffic or any other field condition that reduced alfalfa stands also effected weed control.

Where alfalfa stands were maintained, trifluralin at 2 lb/A gave adequate control season long. The 1 lb/A rate failed to control weeds past June. The 3 lb/A rate gave consistently higher control but never significantly greater control than 2 lb/A. Split applications, particularly those using 2 lb/A in February, were also effective but were not significantly better than one application of 2 or 3 lb/A. What appeared to be most important for season long control was the maintenance of cultural practices that promoted the growth and competitive ability of the alfalfa. Trifluralin granules were only effective where adequate alfalfa stands were maintained.

The results of the grass emergence test appears to conflict with the data from the preemergence test. Satisfactory grass control in June did not insure adequate control in August. The lack of grass control in late summer in Arizona alfalfa fields may be due to the seasonal decline in alfalfa vigor and stand. By July and August alfalfa has been subjected to five or six repeated harvests. Night time temperatures seldom fall below 90°F. Growing conditions are better for summer annual grass weeds than for alfalfa. Herbicides can only supplement cultural practices that help maintain a competitive stand of alfalfa.

POSTEMERGENCE HERBICIDE TREATMENTS FOR SUMMER GRASS CONTROL IN ALFALFA

B.R. Tickes, E.S. Heathman and J.P. Chernicky[1]

Introduction

Alfalfa is grown in all 15 Arizona counties from sea level to near 5,000 feet elevation. Seventy-six percent of the states production occurs in the central and southwestern regions where non-dormant varieties are intensively irrigated and managed. Seven to ten cuttings are made annually in this region to produce average yields of 8 tons per acre. Mild winter climatic conditions allow weeds to compete with alfalfa year round, and weeds are the major pest of alfalfa grown in this region.

Grasses are the major weed pests in alfalfa from April to October when the bulk of production occurs. Annual and perennial grasses commonly reduce forage quality and stand vigor. The major summer annual grass weeds in alfalfa in this region are *Echinochloa colonum* (Junglerice), *Echinochloa crusgalli* (Barnyardgrass), *Erichloa contracta* (Prairie cupgrass), *Erichloa gracills* (Southwestern cupgrass), *Leptochloa filiformis* (Red sprangletop) and *Leptochloa univervia* (Mexican sprangletop).

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[1]University of Arizona, Tucson, Arizona

Preemergence herbicides and cultural practices have been the primary methods of controlling summer annual grasses in alfalfa in central and western Arizona. The development of postemergence foliar applied grass herbicides offers an additional tool to supplement these practices. The purpose of this test was to evaluate various rates and times of application of four postemergence grass herbicides in alfalfa.

Materials and Methods

Research plots were established in 1986 on a two-year-old stand of non-dormant (CUF101) alfalfa. Ten-foot square plots were established at the University of Arizona Yuma Valley Agricultural Center on silty clay loam soil. Summer annual grass weeds were barnyardgrass, junglerice and prairie cupgrass at an infestation of 30 to 40 per square foot. Treatments included two rates of four herbicides including sethoxydim {2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one}, fluazifop {(±)-2-[4[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid}, DPX-Y6202 {2-[4-(6-chloro-2-quinoxyalinyl)oxy)phenoxy}propionic acid, ethyl exter} and BAS 517 {2-[1-(ethoxyimino) butyl]-3-hydroxy-5-(2H-tetrahydrothiopyran-3-yl)-2-clohexen-1-one}. Both rates of each herbicide were applied either 1) once on May 28; 2) once on July 10; or 3) twice on May 28 and on July 10. One percent non ionic crop oil was included with each treatment. A total of 25 treatments including an untreated check were applied and replicated four times. All treatments were applied soon after the removal of hay bales and following the first postcutting irrigation when the alfalfa was 4 to 8 inches in height. Grass weeds were from seedling to tillering at the May 28 application and from seedling to 6 inches in height with some heading at the July 10 application. All treatments were applied in a 30 gallon per acre spray volume with a compressed air backpack sprayer. Visual evaluations of control were made on June 25 and August 21.

From Graphs 1 and 2:

Sethoxydim achieved marginal levels of control (65%) at the 0.125 lbs/A rate and better but still marginal levels (73%) of control at the 0.25 lb. rate when evaluated on June 25, twenty-eight days following application. When evaluated on August 21, eighty-four days following application, both treatments had dropped by 10 to 12% to marginal levels of control (63% and 53%).

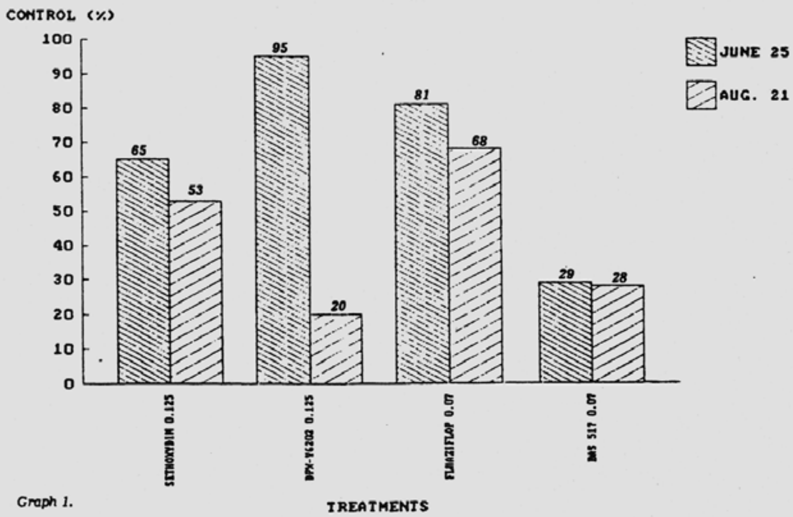
DPX-Y6202 achieved excellent control at both the 0.125 and 0.25 rates when evaluated on June 25, twenty-eight days following application. The 0.25 rate was no more effective (95%) than the 0.125 rate. When evaluated eighty-four days later on August 21, both rates had dropped to negligible levels of control (20 to 21%).

Fluazifop achieved good control (81%) at the 0.07 rate and excellent control (95%) at the 0.15 rate when evaluated on June 25. Both treatments were reduced to 68% when evaluated eighty-four days later.

BAS 517 achieved negligible levels of control (29%) at the 0.07 rate and excellent levels of control (95%) at the 0.15 rate when evaluated on June 25. The 0.15 treatment had dropped to 50 percent control levels eighty-four days following treatment.

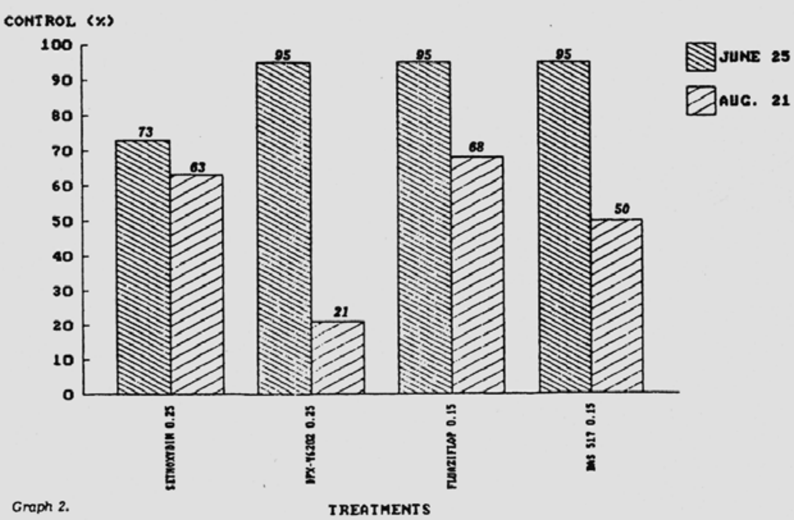
Results

% CONTROL OF ANNUAL GRASS FROM ONE APPLICATION
MAY 28
LOW RATES

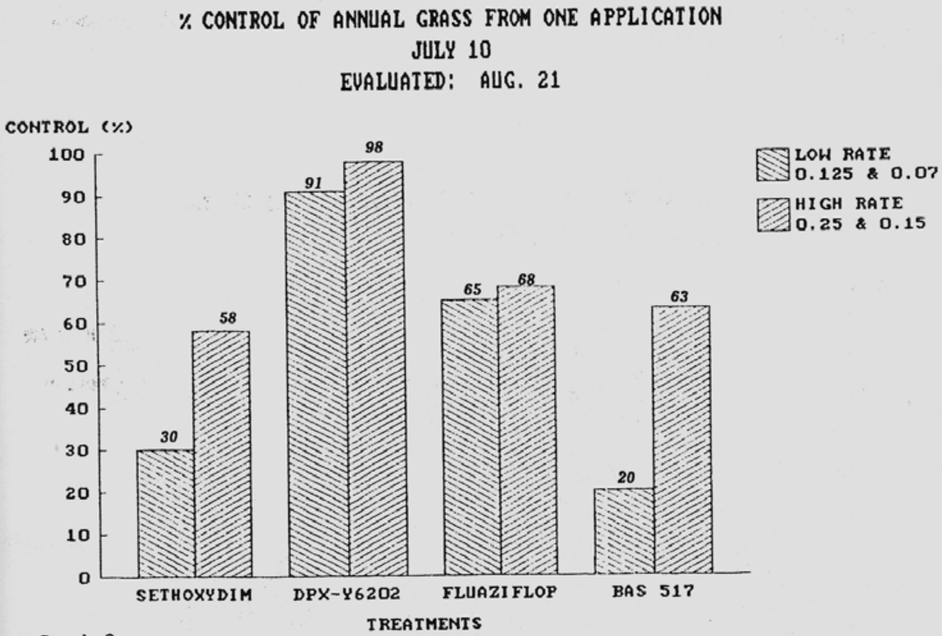


Graph 1.

% CONTROL OF ANNUAL GRASS FROM ONE APPLICATION
MAY 28
HIGH RATES



Graph 2.



Graph 3.

From Graph 3:

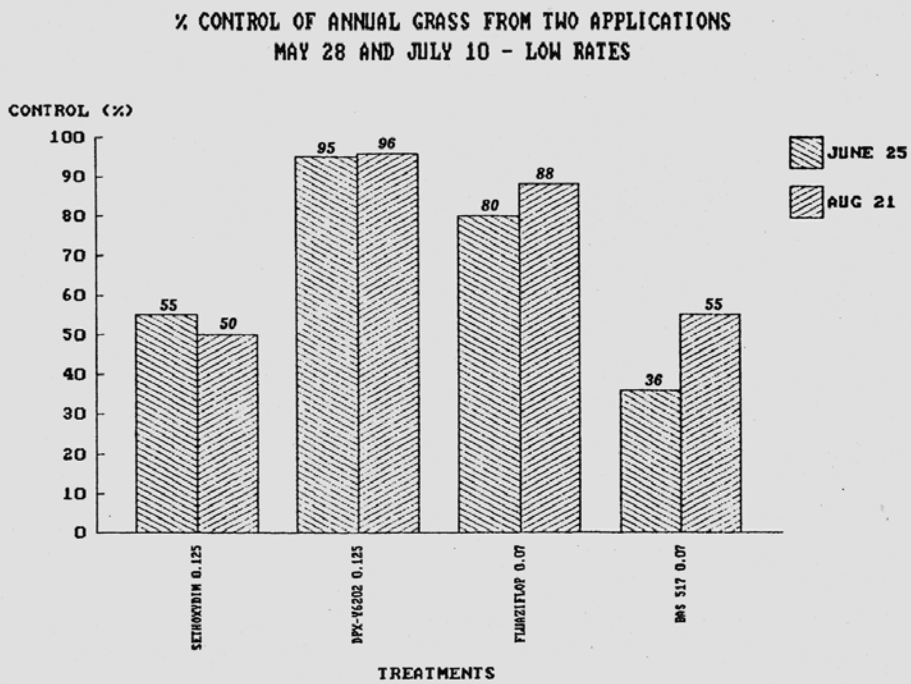
By July 10 grass seeds were seedling to 6 inches in height, some were heading, alfalfa hay quality had been reduced and the alfalfa stand had been reduced through weed competition from 30 to 40 per square foot.

Sethoxydim, fluazifop and BAS 517 produced unacceptable levels of control when applied late in the season.

DPX-Y6202 produced 91 to 98% control when applied on this date.

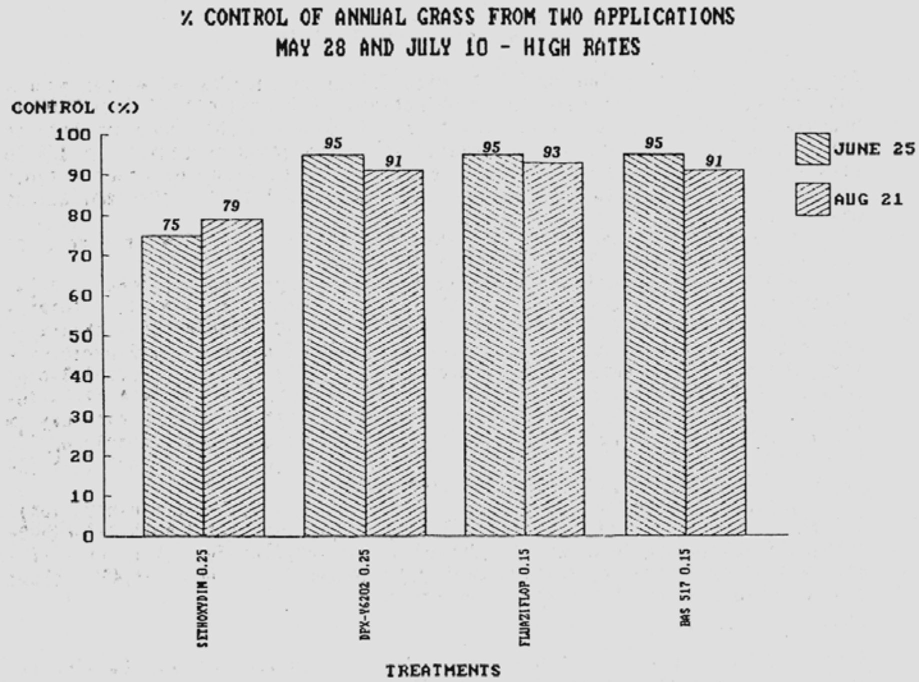
From Graphs 4 and 5:

*Control from each rate was maintained throughout the season at the same level by two applications.



Graph 4.

Graph 5.



Conclusions

*Two applications were necessary to achieve acceptable season long control of junglerice, barnyardgrass and prairie cupgrass with the herbicides tested.

*All of the herbicides tested, except DPX-Y6202 were more effective when applied to smaller weeds (seedling to tillering) than when applied at advanced growth stages (6 inches in height). DPX-Y6202 was as effective on these grasses at an advanced growth stage as on smaller weeds.

*Rates: Sethoxydim was better at the 0.25 lb/A rate than at the 0.125 rate although only marginal (73%) levels of control were achieved. The need for higher rates was indicated. DPX-Y6202 was effective at all rates tested. Fluazifop was a little different at the 0.15 lb/A rate than at the 0.07 lb rate. BAS 517 produced excellent control at the 0.15 lb/A rate but negligible control at the 0.07 lb/A rate.

BROAD-SPECTRUM CONTROL OF WEEDS IN ALFALFA WITHOUT PERCEPTIBLE INJURY

Harold M. Kempen and Joe Voth[1]

Abstract. Studies during 1984-1986 with foliar herbicides on winter plantings of alfalfa showed that the combinations of bromoxynil {3,5-dibromo-4-hydroxy benzonitrile} at 1/4 lb ai/A or 2,4DB {4-(2,4-dichlorophenoxy)butyric acid} at 3/4 lb ai/A plus any of several selective grass herbicides at 1/4 lb ai/A plus crop oil concentrate were effective on an array of weeds without perceptible alfalfa retardation. The results suggest that such combinations would control most weeds found.

These studies were conducted when winter fog was often present, on seedling alfalfa at the 2-5 trifoliate leaf stage.

Selective grass herbicides included were haloxyfop-methyl {methyl 2-[4-[[3-chloro-5-(triflouro=methyl)-2-pyridinyl]oxy]phenoxy]propanate}, fluazifop-p-dibutyl {butyl(R)-2[4-[[5-(trifluoro-methyl)-2-pyridinyl]oxy]phenoxy]-propanate}, fluazifop-butyl {(±)butyl-2-[4[[5-(trifluoromethyl)-2-pyridinyl-]oxy]phenoxy]propanoate}, fenoxaprop-ethyl {(RS)-2-[4-(6-chloro-1,3-benzoxazol-2-yloxy)phenoxy]propionic acid, ethyl exter}, DPX-Y6202-14 {2-[4-(6-chloro-2-quinoxalinyl)oxy)phenoxy}propionic acid, ethyl exter}, cloproxydim {(E,E)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cylcohexen-1-one} and sethoxydim {2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one}.

Comparisons were made to paraquat {1,1'-dimethyl-4,4'-bipyridinium ion}, 2,4,DB, bromoxynil, AC 263,499 {5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid} (Pursuit) and oxyfluorfen {2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene}. AC 263,499 shows considerable promise, but oxyflurofen did not.

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[1]Farm Advisor and Technician, respectively, University of California, Cooperative Extension, Bakersfield, CA 93303.

WEED CONTROL IN ALFALFA WITH OXYFLUORFEN PLUS PARAQUAT

L.D. West, M.F. Jehle and R.C. Hildreth[1]

Oxyfluorfen {2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)-benzene} is an effective herbicide for preemergence and/or postemergence broadleaf weed control in many perennial crops. Since 1984, oxyfluorfen (alone and in tankmix combinations with paraquat {1,1'-dimethyl-4,4'-bipyridinium ion} has been evaluated for weed control in seedling and established alfalfa.

In California, the winter weed spectrum in alfalfa includes annual bluegrass (Poa annua), common chickweed (Stellaria media), shepherdspurse (Capsella bursa-pastoris) and whitestem filaree (Erodium moschalum). The tank mix combination of oxyfluorfen and paraquat provided effective control

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[1]Rohm & Haas Co., Fresno, California

(90% or better) of the winter annual weed spectrum. However, crop response (leaf necrosis and height reduction) was enhanced when compared to either compound alone. In trials established on first year alfalfa ranging from 6 to 20 trifoliates, initial stand reduction was noted with the combinations, although yields were not affected. The best overall performance (acceptable weed control with minimal crop injury) was provided by tankmix combinations of oxyfluorfen at 0.28 to 0.42 kg ai/ha with paraquat at 0.13 kg ai/ha. No effect on alfalfa quality (% protein and TDN) was observed with any of the treatments evaluated.

UPDATE: SUMMARY OF ANNUAL WEED CONTROL IN ESTABLISHED ALFALFA WITH PRODIAMINE HERBICIDE

J.M. Fenderson, M.C. Boyles and S.J. Bowe[1]

Abstract. Prodiamine {2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine} has been evaluated since 1984 for annual grass control in established alfalfa. Results of studies conducted in the central plains and western U.S. indicate that prodiamine is an excellent herbicide for full season residual summer annual grass control. Prodiamine was applied during the winter and early spring to dormant or semi-dormant stands of established alfalfa. All treatments were surface applied and activated by rainfall or irrigation. Plots were established in a randomized complete block design with 3 or 4 replications.

Prodiamine was applied at 0.25 - 4.0 lbs./A to established stands of alfalfa (greater than one year old). Prodiamine treatments resulted in no injury at any rate tested. Effective annual grass control has been noted at 0.38 lbs/A, but effective full season control required 0.5 - 1.0 lb/A depending on weed specie. Effective full season crabgrass (Digitaria sanguinalis) control has been achieved at 0.5 lbs/A. Yellow foxtail (Setaria lutescens) was more difficult to control and required 0.75 - 1.0 lbs/A for acceptable (85%) full season foxtail control. Excellent full season control (90%) of green foxtail (Setaria viridis), barnyardgrass (Echinchloa crusgalli), cupgrass (Erichloa spp.) and sprangletop (Leptochloa fascicularis) was accomplished when 0.75 lbs/A of prodiamine was applied. Control of broadleaf weeds has also been noted. Prodiamine at 0.5 lbs/A or greater has provided full season (99%) pigweed control.

Following season evaluations of alfalfa indicate the prodiamine's residual activity will provide fall and second season annual grass and broadleaf control. Prodiamine at 0.5 - 1.5 lbs/A has provided chickweed (67-88%) and shepherdspurse (Capsella bursa-pastoris (L.) Medic.) (49-83%) control the following fall. Prodiamine at 0.5 - 1.5 lbs/A has given fair to excellent second season crabgrass control. Crabgrass control prior to August 1 of the second growing season ranged from 65-96%. Control of crabgrass following August 1 resulted in crabgrass control ranged from 47-81% at 0.5-1.5 lbs/A respectively.

Crude protein analysis and forage yields were evaluated from mid and late summer alfalfa harvests. Prodiamine applied at 0.75 lbs/A increased

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[1]Sandoz Crop Protection Corporation, Chicago, Illinois

crude protein 4.2% versus the untreated check. Correspondingly, prodiamine at 0.75 lbs/A increased alfalfa dry matter production by 579 lbs/A.

Prodiamine's effectiveness for increasing alfalfa forage production and quality make it an excellent herbicide candidate for established alfalfa.

CONTROL OF DODDER IN ALFALFA WITH DINITROANILINE HERBICIDES

Steve B. Orloff and David W. Cudney[1]

Introduction

Dodder (Cuscuta spp.) is a serious problem in forage and seed alfalfa fields. The high desert area of California is severely infested with dodder; it is present in over 90 percent of the alfalfa fields. Control practices have included contact treatments (burning or dinoseb) or preemergence CIPC applications. These practices have been both ineffective and costly.

The results of preliminary field studies in 1985 showed promise of dodder control with a preemergence application of trifluralin {α,α,α-tri-fluoro-2,6-dinitro-N-N-dipropyl-p-toluidine} granules. Three trials were established in Lancaster, California, in 1986, with the following objectives: 1) to augment the understanding of dodder biology in the high desert, 2) to evaluate the effectiveness of trifluralin and other dinitroaniline herbicides, and 3) to determine the proper rates and time(s) to maximize the length of dodder control.

Materials and Methods

The first trial was conducted to determine the persistance of dinitro-aniline herbicides for dodder control. Dodder was overseeded on February 11, 1986, at 175 lb/A into plots three by six feet in size. Seeds were lightly covered with soil using a hand rake. The alfalfa stand in the plot area was uniform and in its third year of production. Trifluralin, pendimethalin {N-(1-ethylpropyl)-3,4 dimethyl-2,6 dinitrobenzenamide), and prodiamine {2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoremethyl)-1,3-benzenediamine} were applied at three rates (2,4, and 6 lb/A) on 3/6/86. Trifluralin granules were applied by hand with a shaker jar. Pendimethalin and prodiamine were applied with a CO_2 backpack sprayer at a pressure of 30 psi with a spray volume of 30 gallons per acre. The plots were mowed at three-week intervals for the duration of the summer to maximize light penetration for dodder growth. Dodder control was evaluated by counting and removing dodder seedlings at weekly intervals as they became attached. After dodder emergence had nearly ceased in June, half of each plot was reseeded with an additional 175 lbs/A of dodder seed to evaluate residual dodder control with the herbicides tested.

The second trial compared the effectiveness of three dinitroaniline herbicides applied in single and split applications. Trifluralin, pen-dimethalin, and prodiamine were applied at 2,4 and a split application of 2+2 lb/A in an alfalfa hay field known to be heavily infested with dodder. Plot

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[1]University of California, Lancaster and Riverside, California

size was 25 by 25 feet. Applications were made on 3/9/86 and 5/22/86. Dodder control, based on counts, was calculated after each alfalfa harvest.

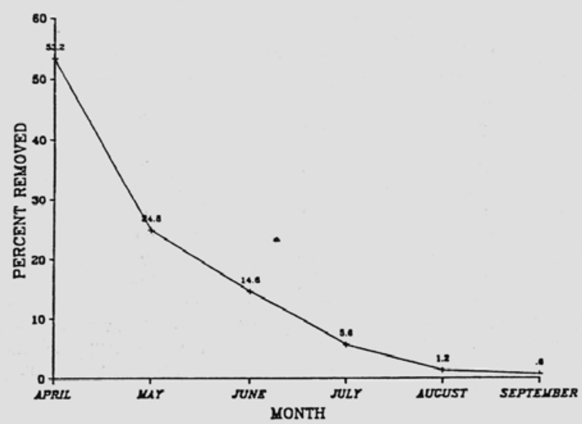
Different rates and time of application were investigated in the third trial in an attempt to maximize the length of dodder control with trifluralin. The plots were 25 by 220 feet long. Trifluralin was applied at 2 and 4 lb/A on March 14, the same rates after first cutting (May 22), and as split applications of 2+2. The split applications included an initial application in March followed by an application after first cutting (May), a March application followed by an application after second cutting (June 20), and an application after first and second cuttings. Dodder control was evaluated after each cutting and percent control was calculated based on counts of dodder colonies. Dodder colonies were classified as mature or immature on the September 10 evaluation. This classification was based on the presence or absence of reproductive organs.

A randomized complete block experimental design with four replications was used in all three trials.

Results and Discussion

Dodder emergence commenced on March 20 in Trial One and continued for the remainder of the season. Dodder attachment to alfalfa occurred approximately one week after emergence. After an initial heavy flush of dodder emergence and attachment in the spring, the number of attached dodder declined as the season progressed (Figure 1). Seventy-eight percent of the total attached dodder for the growing season occurred during April and May.

Figure 1. Seasonal distribution of attached dodder seedlings.



The dinitroaniline herbicides appeared to reduce dodder attachment in two ways. First, there was a reduction in emergence and secondly, those plants that did emerge, exhibited reduced growth (Table 1). All the dinitroaniline herbicides tested reduced dodder seedling growth from 46 to 64 percent.

Table 1. The effect of dinitroaniline herbicides on dodder seedling growth.

Treatment	Rate lb/A	Length (mm)	Percent Reduction
Trifluralin	2	15	46
	4	13	54
	6	11	61
Pendimethalin	2	10	64
	4	12	57
	6	11	61
Prodiamine	2	12	57
	4	12	57
	6	11	61
Check	0	28	0
LSD .05		3	11

The initial control of dodder with all three dinitroaniline herbicides was excellent (Table 2). Control declined as the season progressed. The decline in control was greatest for the lower rates of application. Among the three herbicides, prodiamine maintained the highest level of control throughout the season.

Table 2. Residual dodder control from three dinitroaniline herbicides.

		Percent Control 1/		
Treatment	Rate lbs/A	Apr-May	Jun-Jul	Aug-Sep
Trifluralin	2	96	76	40
	4	100	77	65
	6	98	88	80
Pendimethalin	2	98	70	47
	4	99	73	55
	6	99	90	58
Prodiamine	2	100	84	80
	4	99	92	89
	6	98	93	97

1/ Percent control was calculated using the total number of attached dodder plants in the four replications of the untreated control plots. For each time period the total was: April-May, 255; June-July, 114; and August-September, 67.

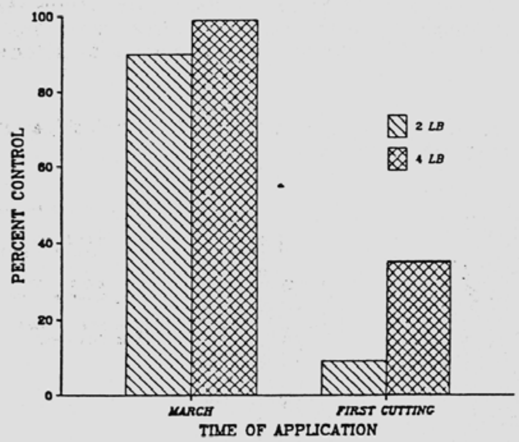
Similar results were observed in the larger second trial (Table 3). Dodder control diminished at the end of the growing season. Again, prodiamine provided the longest period of control. There was a trend toward longer control with the 4 lb rate and the split application.

Table 3. Residual dodder control from single versus split applications of dinitroaniline herbicides.

Treatment	Rate lbs/A	Percent Control 5/22	6/20	8/8	9/10
Trifluralin	2	95	98	72	30
	4	99	99	85	30
	2 + 2	96	98	87	45
Pendimethalin	2	100	100	83	22
	4	100	100	93	67
	2 + 2	100	100	93	65
Prodiamine	2	100	100	95	80
	4	100	100	97	79
	2 + 2	100	100	99	94
Check		0	0	0	0
LSD .05		24	19	24	25

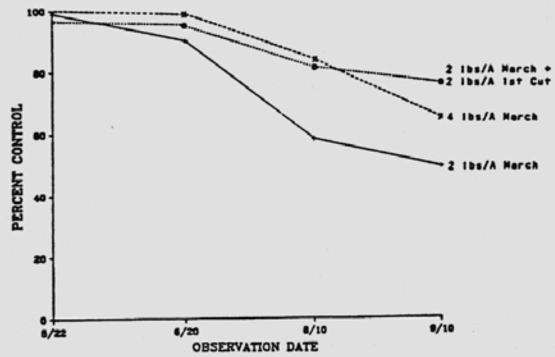
The third trial demonstrated the importance of proper timing. Poor dodder control occurred when the first application of trifluralin was made after first cutting (Figure 2). Late herbicide applications did not control early-emerging dodder and, as shown in Figure 1, the early spring flush of dodder is of greatest consequence. Some injury to attached dodder was noted. The injury consisted of short and thickened shoots. However, this injury did not constitute acceptable control.

Figure 2. Influence of application time on dodder control.



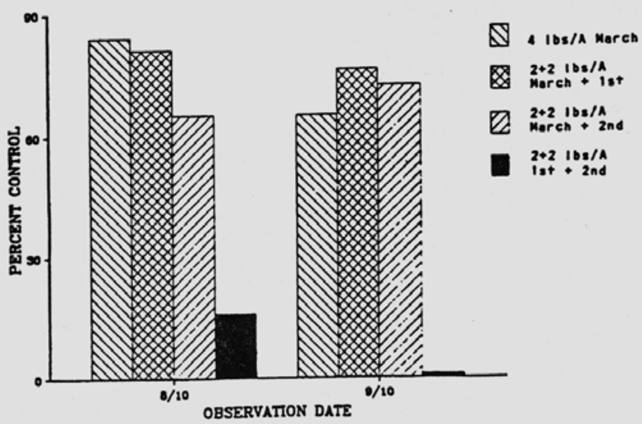
Split applications of trifluralin were found to extend the period of dodder control (Figure 3). Dodder control with a split application was similar to the single 4 lb/A rate until the end of the season where there was a trend toward better control with the split application.

Figure 3. Comparison of single versus split applications of trifluralin for dodder control.



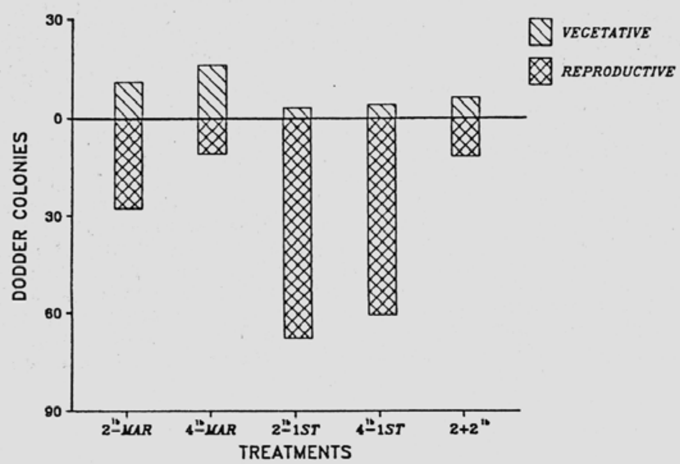
The timing and the interval between the split applications were found to have a significant effect on the dodder control (Figure 4). Similar to a single late application, a split application after first and second cutting was ineffective. A split application in March and after first cutting provided the highest degree of dodder control. These application times best coincide with the period of maximum dodder emergence and attachment (Figure 1).

Figure 4. Dodder control with trifluralin at different application intervals.



The proportion of vegetative versus reproductive dodder is illustrated in Figure 5. At the end of the season, the control plots contained mature dodder and no vegetative colonies were present. Fifty-eight percent of the dodder in the plots that received 4 lb of trifluralin in March were found to be in the vegetative stage. However, the overall total number of dodder colonies present was reduced by 70 percent when compared to the check. The split applications of trifluralin showed a trend toward a smaller percentage of dodder being present in the vegetative stage at the end of the season. The split application where trifluralin was applied after the first and second cuttings had only 13 percent of its dodder colonies in the vegetative state. These plots were similar in appearance to the checks with a very dense population of mature dodder which had emerged prior to the first trifluralin treatment.

Figure 5. Proportion of vegetative and reproductive dodder at the end of the season (Sept. 10)



Summary

Dodder emergence commenced on May 20. After an initial heavy flush of dodder emergence in the spring, dodder continued to emerge for the entire season but at a much reduced rate. Dinitroaniline herbicides were found to effectively control dodder with prodiamine providing the longest residual control. Herbicide applications must be made prior to initial dodder emergence. A single 4 lb or a split 2+2 lb application rate was needed for extended control. These results demonstrate that full-season dodder control is feasible with dinitroaniline herbicides.

EVALUATION OF THREE WILD OAT HERBICIDES IN COMBINATION WITH BROADLEAF HERBICIDES FOR THE CONTROL OF WEEDS IN SPRING BARLEY AND THE ECONOMIC VALUE OF THE CROP

V.R. Stewart and Todd K. Keener[1]

Abstract. AC 222,293 {methyl -2(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate plus methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate}, triallate {S-(2,3,3,-trichlorallyl) diisopropylthio-carbamate} and diclofop {2-[4-(2,4-dichlorophenoxy)phenoxy propanoic acid} were evaluated in combination with 2,4-D {(2,4-dichlorophenoxy) acetic acid}, MCPA {(4-chloro-o-tolyl)oxyl)acetic acid}, bromoxynil {3,5-dibromo-4-hydroxybenzonitrile} and R 9674 {methyl 3-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl-aminocarbonyl]aminosulfonyl]-2-thiophenecarboxylate} plus {methyl 2-[[[[N-(4-methoxy-6-1,3,5-triazin-2-yl)methylamino]carbomyl]amino]sulfonyl]benzoate} for control of broadleaf weeds and wild oats in spring barley (Ingrid). The combinations used and rates of chemicals are given in Table 1. Weed species in the test site were a high natural population of wild oats (Avena fatua), and a moderate population of wild buckwheat (Polygonum convolvulus), henbit (Lamium amplexicauli), night flowering catchfly (Silene noctiflora), lambsquarter (Chenopodium alba), and field pennycress (Thlaspi arvense). The phenoxy herbicides were applied as separate treatments because of the growth stage of the barley and the weed species.

The broadleaf herbicides when used with diclofop resulted in reduced wild oat control, whereas when used in combination with AC 222,293 and triallate there was 86 to 95 percent wild oat control. All the broadleaf herbicides provided excellent control of the broadleaf weeds present. No antagonism was apparent between the wild oat and broadleaf herbicides.

The values given in the last column (value above check) in Table 1 were obtained as follows: yield of barley x $1.35/bu, minus the herbicide cost, minus the value of the check. The combination of R 9674 plus AC 222,293 resulted in the highest return per acre of all treatments tested, however, 2,4-D in combination with AC 222,293 provided about equal return. Dollar return was quite low where broadleaf herbicides were used alone which is due in part to the wild oat competition. Table 1.

[1]Northwestern Agricultural Research Center, Mont. Agric. Exp. Stn., Kalispell, Montana

Table 1. Agronomic data from the wild oat and broadleaf herbicide study on spring barley, Kalispell, MT. 1986

Treatment	Rate # ai/A	Appln Type 1/	Weed W. Oat	Control Brdlf	Yield Bu/A	$ Value ¶ Check
2,4-D + AC 222,293	.3 + .45	P2/P1	93a	99	113.8a	55.44
2,4-D + triallate	.3 + 1.25	P2/PPI	95a	91	108.2a	49.10
2,4-D + diclofop	.3 + .75	P2/P1	69a	90	99.4a	36.00
Bromox + AC 222,293	.38 + .45	P1	87a	100	99.6a	29.07
Bromox + triallate	.38 + 1.25	P1/PPI	93a	100	103.3a	35.29
Bromox + diclofop	.38 + .75	P1	71a	100	103.1a	33.80
Bromox	.38	P1	0	100	70.0	1.26
Bromox + MCPA+AC222,293	.38+.38+.38	P1/P2/P1	76a	100	102.7a	32.43
Bromox + MCPA+triallate	.38+.38+1.25	P1/P2/PPI	86a	100	98.3a	27.71
MCPA	.38	P2	0	96	73.4	11.65
MCPA + bromox	.38 + .38	P2/P1	0	100	68.4	-1.88
MCPA + AC 222,293	.38 + .45	P2/P1	92a	99	111.2a	50.68
MCPA + diclofop	.38 + .75	P2/P1	75a	96	99.0a	34.21
R 9674 + AC 222,293	.125oz+.45	P1	94a	100	115.7a	55.94
R 9674 + triallate	.125oz+1.25	P1/PPI	91a	88	107.6a	46.22
R 9674 + diclofop	.125oz+.75	P1	56a	100	90.7a	22.19
R 9674	.125 oz	P1	0	100	63.2	-2.94
AC 222,293	.45	P1	94a	93	108.3a	48.62
Triallate	1.25	PPI	90a	60	106.6a	47.54
Diclofop	.75	P1	74a	0	96.4a	32.55
Check		---	0	0	63.4	0
	X		53.2	--	87.9	----
	L.S.D.		15.2**	--	20.8**	----
	C.V.%		13.17	--	8.41	----

1/ Type Application:
P1 = early post emergence P2 = late post emergence
PPI = preplant incorporated

a/ Indicates values significantly greater than the check at the .05 probability level.

INFLUENCE OF DPX-M6316 AND DPX-L5300 ON WILD OATS CONTROL WITH FOUR POSTEMERGENCE HERBICIDES.

C.V. Eberlein, T.L. Miller and J.V. Wiersma[1]

Abstract: DPX-M6316 (thiameturon) {methyl 3-[[(4-methyoxy-6-methyl-1,3,5-triazin-2-yl)amino carbonyl]amino sulfonyl]-2-thiophenecarbonylate} and DPX-L5300 {methyl 2 [[[[N-(4-methoxy-6-methyl-1,3,5-triazin-2-yl) methylamino]-carbonyl]amino]sulfonyl]benzoate} are sulfonylurea herbicides that show potential for use as postemergence broadleaf herbicides in spring wheat (*Triticum aestivum* L.) and other small grains. Since broadleaf herbicides are commonly applied in combination with wild oats (*Avena fatua* L.) herbicides to increase the spectrum of weed control, the objectives of this research were to evaluate wild oat control in spring wheat with barban {4-chloro-2-butynyl 3-chlorophenylcarbamate}, diclofop {(±)-2-[4-(2,4-dichlorophenoxy)phenoxy] propanoic acid]}, AC 222,293 {±methyl-6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2 yl)-m-toluate}, and difenzoquat {1,2-dimethyl-3,5-diphenyl-1H-pyrazolium} applied alone and in combination with DPX-M6316 or DPX-L5300. Research was conducted at St. Paul and Crookston, MN in 1985 and 1986. The experimental design was a factorial arrangement of treatments in a randomized complete block with three replications. Barban at 0, 0.28 and 0.43 kg/ha with or without aqueous nitrogen (N) at 9.35 L/ha, diclofop at 0, 0.84, and 1.12 kg/ha with or without oil at 1.2 L/ha, AC222,293 at 0, 0.43, and 0.56 kg/ha and difenzoquat at 0. 0.67, and 0.9 kg/ha were applied in combination with DPX-M6316 at 0, 0.018, and 0.035 kg/ha or DPX-L5300 at 0, 0.009, and 0.018 kg/ha. Barban treatments were applied at the 1 1/2- to 2-leaf stage of wild oats, diclofop and AC 222,293 treatments were applied at the 2- to 3-leaf stage of wild oats, and difenzoquat treatments were applied at the 4- to 5-leaf stage. Wild oat control with barban or barban + N was reduced when barban was applied in combination with DPX-L5300, but was not reduced when barban was applied in combination with DPX-M6316. Wild oats control with diclofop was reduced when diclofop was applied in combination with DPX-M6316 in 1985, but not in 1986. Addition of crop oil at 1.2 L/ha to the diclofop spray mixture overcame antagonism of DPX-M6316 with diclofop. When diclofop was applied in combination with DPX-L5300, wild oat control was reduced compared to diclofop applied alone. Addition of crop oil at 1.2 L/ha to the diclofop + DPX-L5300 spray mixture did not overcome the antagonism of DPX-L5300 with diclofop. Wild oats control with AC222,293 or difenzoquat was not reduced when these herbicides were applied in combination with DPX-M6316 or DPX-L5300. TLC analysis of ^{14}C-diclofop solutions with and without added DPX-L5300 revealed no degradation products of diclofop nor any evidence of complexing between diclofop and DPX-L5300. Therefore, DPX-L5300 may be interfering with the uptake, translocation, metabolism, or mechanism of action of diclofop.

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[1]University of Minnesota, St. Paul, Minnesota

TYCOR (SMY 1500) HERBICIDE: WHEAT RESEARCH UPDATE

J.W. Colgan, V.M. Sorensen and A.C. Scoggan

Research with SMY 1500 {4 amino-6-(1,1-dimethylethyl)-3-(ethylthio)-1,2,4-triazin-5(4H)-one} in the U.S. has been conducted in winter wheat since 1980. During the fall of 1983, 1984 and 1985 primary emphasis was placed on determining the optimum rates and timing of SMY 1500 and SMY 1500 + metribuzin {4-amino-6-(1,1-dimethylethyl-3-(methylthio)-1,2,4-triazin-5(4H)-one} combinations applied postemergence for *Bromus* spp. control. Evaluation of SMY 1500 was expanded in 1984 in the major wheat growing regions to determine differences in use pattern, rates and weed spectrum. Results to date show rates of 0.5 to 1.5 lb ai/acre provided the most consistent control of *Bromus* in the 1 to 4 leaf stage. After the wheat and *Bromus* begin to tiller, combination treatments with metribuzin at 1 or 2 ounces ai/acre may be used for effective control.

Weather patterns, particularly in the central Great Plains, produced significant differences in results from fall 1984 and fall 1985 treatments.

Trials were conducted in the central plains states of Kansas, Nebraska, Oklahoma and Texas during 1984. Soils where tests were conducted in Kansas and Nebraska were loam or clay loam soils ranging from 1.8 to 3.5% O.M. and generally a pH of 6 or less. A dryer than normal fall was experienced over much of the area in the fall of 1984.

Tests in Oklahoma and northeast Texas were conducted mostly on loam and clay loam soils with less than 2% O.M. with a few trials on sandy loam soils. Rainfall was generally greater than normal. In many trials SMY 1500 was applied when wheat was in the 2-3 leaf stage with *Bromus* in the 1-2 leaf stage.

Results in 1984 trials from the northwest states were conducted on Sil and SiCL soils with 1-3.2% O.M. and pH generally 6.0-7.6 SMY 1500 treatments were applied when wheat was at the 2-3 leaf stage and *Bromus* at 1-2 leaf.

Under 1984 conditions higher rates of SMY 1500 and tank-mix combinations were required in Kansas and Nebraska (1.25 lb ai/acre SMY 1500 and 1.0 lb plus 1 or 2 oz ai/acre metribuzin). In dryer areas or under higher *Bromus* pressure, rates of 1.5 lb ai or 1.0-1.25 lb ai plus 2 oz ai/acre metribuzin were required for greater than 95% control.

In Texas, Oklahoma and the northwest states SMY 1500 alone at 1.0 lb ai/acre generally gave good control of *Bromus* before tillering.

In 1985 SMY 1500 and SMY 1500 and metribuzin tank-mixes were evaluated under an EUP to confirm previous results, under large plot conditions.

In Kansas and Nebraska the winter wheat crop experienced more damage than usual in 1985 due to a combination of environmental factors. Young wheat plants suffered more stress than usual from dry winter conditions with little protection by snow cover from temperature extremes. These conditions contributed to greater herbicide injury than had previously been seen with SMY 1500 fall POST treatments.

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[1]Mobay Corporation, Kansas City, Missouri

Combination treatments of SMY 1500 plus metribuzin at rates of 0.75 and 1.0 lb ai/acre SMY 1500 plus 1 or 2 oz ai/acre metribuzin gave unacceptable crop injury at several test locations (early post, *Bromus* 1-3 leaf). The later post treatment results (*Bromus* 1-3 tiller) were more variable than in 1984 probably due to the later stages of *Bromus* (1-3 tiller), 1 tiller *Bromus* in 1984, combined with dryer conditions later in the winter.

After 1985 the tank-mix combinations of SMY 1500 + metribuzin were limited to late fall applications, after wheat begins to tiller.

Varietal trials to date indicate the following winter wheat varieties are tolerant to SMY 1500.

Soft Red	Hard Red		Soft White
Abe	Baca	Ram	Daws
Arthur	Bennett	Redwin	Faro
Caldwell	Brule	Pioneer 2157	Gaines
Coker 747	Buckskin	Rita	Hatton
Doublecrop	Carson	Rocky	Hill 81
Hunter	Centura	Rose	Hyslop
McNair 1003	Centurk	Roughrider	Jackmar
McNair 1813	Centurk 78	Sandy	Lewjain
Nelson	Cheyenne	Scout 66	Luke
Pike	Chisholm	Siouxland	McDermid
Southern Belle	Cree	Tam-W-101	Moro
Tyler	Eagle	TAM-W-105	NuGaines
	Hawk	Tam-W-107	Paha
	Mustang	Thunderbird	Peck
	Neeley	Wanser	Sprague
	Newton	Weston	Stephens
	Norstar	Winalta	Tyee
	Norwin		

Restricted varieties include Vona, Wings, Lindon, Triumph 64, Yamhill, Coker 68-15, 762, 983 and 916 Windridge, Brule, CO-82006, HW-1010, 3023.

FIELD BINDWEED INTERFERENCE WITH WINTER WHEAT

J.B. Swensen, D.C. Thill and G.A. Murray

Abstract. A winter wheat (*Triticum aestivum* L.) field near Moscow, Idaho, with moderate to heavy infestations of field bindweed (*Convolvulus arvensis* L.) was sampled at late boot and at mature grain stages to assess the effects of bindweed dry weight, stem number and twining interaction on winter wheat vegetative and reproductive dry matter. At both sample times four parallel transects were established and all plant material above the soil surface was collected from six quadrats, 0.093 M_2 in area, along each transect. At late boot field bindweed stems entwined 18% of stems in quadrat samples containing this weed. The number of bindweed stems and bindweed dry weight per area

[1]University of Idaho Experiment Station, Moscow, Idaho 83843

were negatively correlated with wheat vegetative dry weight per area (4=-0.44, 4=-0.46, respectively). Using multiple regression, wheat and bindweed population density explained 98% of the variability in wheat dry weight and predicted an 8.5% reduction in wheat dry weight at an average bindweed density of 70 stems M^{-2}. At mature grain harvest, bindweed population was not correlated with any measure of wheat yield, nor did bindweed population explain significant variation in wheat yield using multiple regression. However, head weights and grain yield per head in quadrats with bindweed averaged 12 and 15% lower, respectively, than in quadrats with no bindweed. Head and grain weights per head from culms entwined with bindweed were the same as those of untwined culms except when bindweed twined around the flagleaf. Heads with flagleaf entwined averaged 21% less weight per head than culms with no bindweed around the flagleaf. Only 6% of the culms showed flag leaf twining. This suggests that less than 2% of the observed yield reduction associated with the presence of bindweed was due to canopy interference, while the remaining 10 to 13% yield reduction was due to below-ground interference.

FIELD BINDWEED MANAGEMENT PROGRAM FOR WINTER GRAIN-FALLOW SYSTEMS

S.E. Blank[1]

Abstract. In the Pacific Northwest and other small grain growing regions of the United States, field bindweed (*Convolvulus arvensis* L.) is considered to be a very serious perennial weed problem. With moderate to severe infestations of this perennial, crop losses of greater than 50 percent are not uncommon. It is estimated that in excess of 5 million small grain acres are infested with this noxious weed problem in the United States. Attempts to eradicate field bindweed through single herbicide applications, clean cultivation or crop rotations have met with limited success.

From 1983-86, field trials were undertaken in eastern and central Washington and Oregon to identify a cost effective bindweed management program which dryland wheat farmers would accept and utilize. An attempt was made to define a herbicide program which would suppress bindweed growth during the fallow season, maximize winter grain yields the following year, and provide some reduction in total infestation levels.

Treatments evaluated in this bindweed management field program were a package mix of glyphosate {N-phosphonomethyl glycine}/2,4-D amine {(2,4-dichlorophenoxy)acetic acid}-Landmaster® herbicide; 2,4-D amine; a tank mix of 2,4-D amine plus picloram {4-amino-3,5,6-trichloropicolinic acid}; and clean cultivation (check). Treatments were applied as 100 ft by 40 ft nonreplicated strips to uniform stands of dryland field bindweed. Plots were maintained through several crop-fallow cycles. Visual evaluations of percent control were made at 30 days after treatment ("burn down") and at 300-360 days after treatment (year-after control). Winter grain yields were obtained by cutting and thrashing five-1 yd^2 sub-samples per plot.

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[1]Product Development Associate, Monsanto Co., Kennewick, Washington

Table 1. Field bindweed control and winter grain yields for glyphosate/2,4-D amine package mix vs. cultivated check.

Product	Rate (lb ai/A)	*Field Bindweed Control (30 DAT	(300-360 DAT)	Winter Grain %SR	%GR	Yield (Bu/A)
glyphosate/2,4-D amine package mix (Landmaster®)	1.366 (54 fl oz)	84	78	0	0	58.1
cultivated check	-	0	0	0	35	39.0

* Data from 10 locations-paired comparisons

Table 2. Field bindweed control and winter grain yields with various herbicide treatments vs. cultivated check.

Product	Rate (lb ai/A)	*Field Bindweed Control (30 DAT	(300-360 DAT)	Winter Grain %SR	%GR	Yield (Bu/A)
glyphosate/2,4-D amine package mix	1.366	82	85	0	0	61.0
2,4-D amine + R-11 surfactant	2.0 + 0.5% (v/v)	68	53	0	0	45.5
2,4-D amine + picloram + R-11 surfactant	1.0 + 0.25 + 0.5% (v/v)	62	94	3	44	22.0
cultivated check	-	0	0	0	25	38.7

*Data from 4 locations

Applications of the glyphosate/2,4-D amine package mix at 1.366 lb ai/A resulted in 84% "burn down" and 78% year after bindweed control when averaged over 10 locations (Table 1). This herbicide treatment resulted in a 49% yield increase over the cultivated check. In comparing herbicide treatments (Table 2), the glyphosate/2,4-D amine package mix provided greater "burn down" and year-after bindweed control than 2,4-D amine. This package mix and 2,4-D amine treatments provided 18% and 58% yield increases, respectively, over the untreated, cultivated check. The picloram plus 2,4-D amine tank mix treatment provided the best year-after bindweed control (94%), however, this treatment resulted in substantial crop injury, and a 55% yield reduction compared to the cultivated check. The most cost effective treatment in a dryland bindweed management approach to maximizing grain yields and reducing bindweed infestation levels over time was 1.366 lb ai/A (54 fl oz) of the glyphosate/2,4-D amine package mix. The best timing of this application in the Pacific Northwest was during the fallow cycle after August 1 but prior to fall seeding of winter grain.

CONTROLLING PURPLE NUTSEDGE ON FALLOW GROUND WITH EPTC AND BUTYLATE

J.P. Chernicky, E.S. Heathman, K.C. Hamilton and B.B. Barstow[1]

Abstract. Preliminary research was conducted at two locations (Yuma and Maricopa Counties) in Arizona to measure the response of purple nutsedge (Cyperus rotundus) to a fallow application of butylate {5-ethyl bis(2-methylpropyl)carbamothioate} and EPTC {5-ethyl dipropylcarbamothioate}. Butylate and EPTC were applied at 3.7 and 7.5 kg/ha. Application dates varied from early July to late August. At all locations herbicides were incorporated to a depth of 10 cm and all plots received a 10 cm irrigation within 24 hours. Parameters measured included: purple nutsedge control (visual and stem/meter) and tuber population in square meter area sampled to a depth of 30 cm in 15 cm increments.

[1]Dept. of Plant Sciences, Arizona State Univ., Tucson, AZ 85721

FACTORS AFFECTING THE RESPONSE OF COTTON TO PREPLANT APPLICATIONS OF EPTC AND BUTYLATE

J.P. Chernicky, E.S. Heathman, K.C. Hamilton and B.B. Barstow[1]

Abstract. *The thiocarbamate herbicides are not used by Arizona cotton* growers because of marginal crop safety, and short residual under irrigated conditions. However since cotton acreage infested with purple nutsedge is increasing, growers are willing to risk some crop injury, if early season competition from purple nutsedge (Cyperus rotundus) can be eliminated. Research was conducted in 1986 to identify production practices that might influence weed control and crop selectivity achieved with the EPTC {5-ethyl dipropylcarbamothioate} and butylate {5-ethyl bis(2-methylpropyl)carbamothioate}. Three field trials were conducted at Maricopa, AZ to measure the response of cotton (Gossypium hirsutum), palmer's amaranth (Amaranthus palmeri), and wright groundcherry (Physalis wrightii) to butylate and EPTC. In test 1 butylate was applied at 2.24 and 3.36 kg/ha and EPTC was applied at 1.12 kg/ha. These thiocarbamates were applied three different ways to determine if method of application affected their performance. Preplant applications (PPI) were made on flat ground on March 8 and incorporated to a depth of 5 and 10 cm. Preharrow (PH) applications were applied over peaked beds (100 cm apart) and shallowly incorporated with a bed mulcher on March 23. EPTC and butylate were compared against trifluralin {2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine)}/prometryn {N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine} (PPI 0.84 + 1.8 kg/ha).

[1]Dept. of Plant Sciences, Arizona State Univ., Tucson, AZ 85721

FRESNEL LENS SOLARIZATION FOR WEED CONTROL

D.W. Johnson, J.M. Krall and R.H. Delaney[1]

Abstract. A new approach for solarization called "Fresnel solarization" was investigated. A 91.4 by 152.4 cm curved linear Fresnel lens (CLFL) was used to focus solar radiation into a high intensity light beam. The beam (1 by 152 cm) exceeded temperatures of 300°C at the soil surface. "Fresnel solarization" resulted in effective control of several annual weed species. Beam exposure rates of 1 to 10 sec cm^{-1} were sufficient to control redroot pigweed (*Amaranthus retroflexus* L.) from the cotyledon to the 10-leaf stage. Additional broadleaf species killed at the 2-leaf stage after 1 sec cm^{-1} exposure rates were common purslane (*Portulaca oleracea* L.), kochia (*Kochia scoparia* L.), and lambsquarters (*Chenopodium album* L.). Grass species generally were not controlled. Surface weed seed control was also observed on several species after 5 to 15 sec exposures with the CLFL.

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[1]Graduate Assistant, Assistant Professor of Agronomy and Professor of Crop Physiology, University of Wyoming, Plant Science Division, Laramie, Wyoming 82071.

INFLUENCE OF WEED MANAGEMENT SYSTEMS ON WEED SPECIES COMPOSITION IN WYOMING IRRIGATED ROW CROPS

Daniel A. Ball and Stephen D. Miller[1]

Abstract. Changes in cropping practices such as reduced tillage and increased herbicide use produce changes in the crop micro-environment which alter weed establishment, growth and reproduction. These environmental influences can produce conditions favorable for the selection of certain weed species and unfavorable to others resulting in a shift in predominant weed species. Field experiments were conducted at Torrington, Wyoming during 1985 and 1986 to evaluate the influence of tillage and herbicides on weed species composition in three irrigated row crops grown continuously. Replicated plots received either moldboard plow or chisel plow primary tillage, various levels of secondary tillage and low, medium or high herbicide inputs. Evaluations of the weed flora and soil seed bank were made to determine the interaction effects of these treatments on weed species composition. Results indicate that there was a rapid shift in the predominate annual weeds species between crops due to selective pressure exerted by the crop/herbicide system. Reduced primary and secondary tillage inputs resulted in increased weed density in all crops. This increased weed density could be completely or partially offset by increased herbicide inputs. Shifts in weed species composition were not evident from evaluation of the weed flora but may be observed from analysis of the soil seed bank.

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[1]Department of Plant Science, University of Wyoming, Laramie, Wyoming 82071

MANAGEMENT OF COMPETITION FOR WATER BETWEEN CABBAGE (*Brassica oleracea*) AND A PERENNIAL RYEGRASS (*Lolium perenne*) LIVING MULCH

Mary B. Graham and Garvin Crabtree[1]

Abstract. The effect of management practices on yield of cabbage (*Brassica oleracea*) in monocultures and living mulch systems using perennial ryegrass (*Lolium perenne*) was compared in a 1986 field study in Corvallis, Oregon. Cabbage yield was used as an indicator of the relative competitive ability of the five interrow treatments. Five water levels (20, 35, 63, 83 and 100%), imposed by a line source, were factorially combined with five interrow treatments. Cabbage at 41,667 plants/ha had half of the plot area in grass managed by mechanical (2 mowings), chemical (one application at .17 kg ai/ha of fluazifop-p-butyl {(±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]-phenoxy]propanoate} or no suppression. Cabbage monocultures had bare ground between rows or another row of cabbage, doubling the density. Interrow cabbage decreased the yield of the remaining cabbages as much as the mechanically and unsuppressed grass -- by 14% at the 100% water level, though total marketable yield for the double density plots was 64% higher than for the low density monoculture. Compared with the low density monoculture, chemically suppressed grass decreased the yield as much as the other treatments at the 65% water level, less so at the 83% water level and was no different at the 100% water level. Results suggest that cabbage and grass are equally competitive against cabbage. Chemical suppression reduced the competitive ability of grass. If enough water is available, a living mulch system may yield as well as monoculture.

Introduction

In Oregon's Willamette Valley, cabbage matures after the rains have begun. Excessive soil moisture makes harvesting with heavy machinery difficult and the soil may be damaged for the following crop.

A living mulch may provide a solution. A living mulch is a cover crop that is grown simultaneously with the main crop in a reduced tillage system. It may reduce erosion and weed invasion. Butler (3) states that a grass living mulch improves water infiltration, trafficability and soil structure.

Yield decreases and maturity delays in living mulch systems are most often attributed to competition for nutrients or water (1,4,5), though Box et al. (2) found corn yield decreases in a strip killed sod that were attributed to something other than competition for nutrients, water or light. Nicholson and Wien (6) found that mulch dry matter production was negatively correlated to cabbage yield.

Regulation of a living mulch is usually necessary. Management strategies include improving plant spacing for optimal use of resources, providing more of limiting resources, and reducing the growth and resource use of the mulch. Shearman and Beard (7) report that cultural factors such as mowing height and fertilization level can significantly influence the water requirements of a turfgrass. William and Brenner (8) suppressed grass growth for up to eight weeks with sublethal rates of grass herbicides.

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[1]Department of Horticulture, Oregon State University, Corvallis, Oregon 98331-2911

The purpose of this study was to evaluate mechanical and chemical suppression of a perennial ryegrass living mulch as management tools for reducing competition with cabbage for water. Cabbage yield was used as an indicator of the relative competitive ability of the interrow treatments. Water requirements and crop yields were compared for each system studied.

Materials and Methods

This experiment was conducted in 1986 at the Oregon State University Vegetable Research Farm near Corvallis, Oregon, on a Cumulic Ultic Hapoxeroll, mixed mesic (Chehalis silty clay loam) soil.

Five water application levels, imposed by a line source, were factorially combined with five interrow treatments. Cabbage was spaced 30 x 80 cm in plots sized 240 x 270 cm. In the three living mulch treatments 40 cm strips of grass between the cabbage rows were managed by mechanical, chemical or no suppression. The cabbage monocultures had bare ground between rows, or another row of cabbage, doubling the crop density.

Plots were arranged in eight complete blocks with systematic water application levels and randomized interrow treatments. Analysis is similar to that for a split-plot design because the water application levels are not randomized. The line source generates a pattern of water distribution from no water at the distal end of the block to a high level of water proximal to the line.

Water from both irrigation and precipitation was measured in catchcans placed in two plots at each water level in four blocks.

Fertilizer was banded in the cabbage rows prior to hand seeding of 'Market Victor' on 11-12 June. Cabbage was thinned to a 30 cm spacing on 16-17 July and side dressed with additional fertilizer on 5 and 9 August.

'Manhattan II' perennial ryegrass was planted at 22.4 kg/ha on 12 June and fertilizer was broadcast over the grass area the next day.

Irrigation was uniform until the grass was established. Weekly line source irrigation began 14 July. On 14 July .17 kg ai/ha of fluazifop-p-butyl was applied for the chemical suppression treatment with a CO_2 pressurized backpack sprayer. Mechanically suppressed plots were mowed to approximately 4 cm on 23 July and 14 August.

Fonofos was incorporated into the soil prior to planting. Carbaryl, *Bacillus thuringiensis* and diazinon were applied as needed to control insects. All weeding was by hand or hoe.

On 29 August, approximately 14 heads of cabbage per plot were harvested from the two rows adjacent to the center of the plot. Guard plants were excluded. Plants were counted, weighed and trimmed to marketable condition. All heads of marketable size were counted and weighed.

Results and Discussion

Catchcan measurements indicate that an average of 33.3 cm of water was applied throughout the season, as rainfall and irrigation, at the high water application level. The other water application levels, in increasing distance from the line source, were 83, 65, 35 and 20% of the highest water application level.

Cabbage yield relationships were the same for total weight and marketable weight, therefore only marketable weight will be discussed. Fig. 1 shows the marketable weight means for each treatment at each water level.

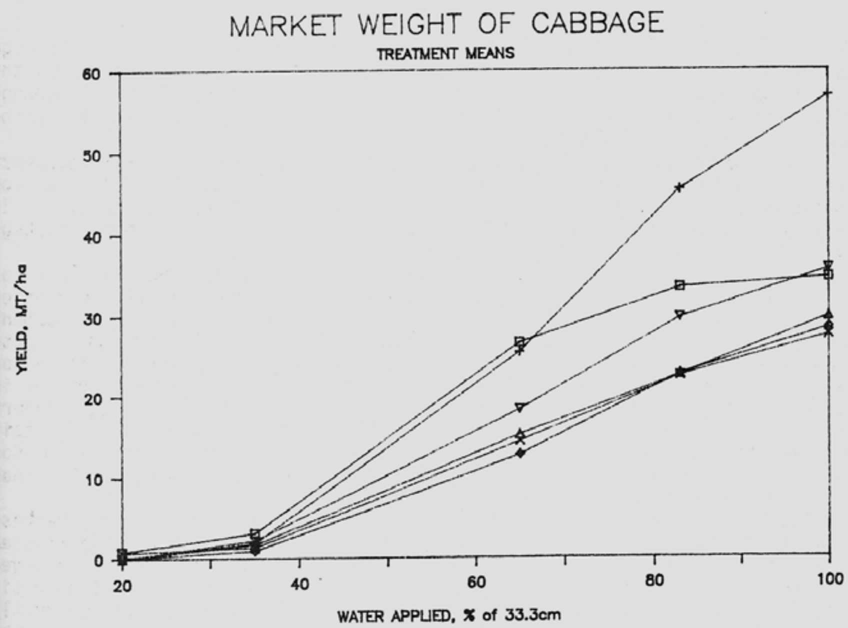

Figure 1. Treatment means for marketable weight of cabbage. □ = low density monoculture, ▽ = chemically suppressed grass, X = mechanically suppressed grass, △ = unsuppressed grass, + = double density cabbage total, ◇ = cabbage as an interrow treatment. LSD = 4.3 MT/ha.

Two lines represent the double density cabbage treatment. One is the total marketable weight for that treatment. The other ignores the yield of the added rows of cabbage, considering them only as an interrow treatment, and in effect measures their influence on the other rows of cabbage.

Yields for all treatments were similarly low at the two lowest water application levels. Significant treatment differences occurred only at the three highest water application levels.

The double density plots yielded 64% higher than the low density monoculture at the highest water application level. Doubling the number of plants more than compensated for somewhat smaller head size at the two highest water application levels.

Cabbage yields in the unsuppressed and mechanically suppressed grass treatments were significantly lower than the low density monoculture at all water application levels with treatment differences. The difference was 14% at the highest water application level.

Cabbage in the chemically suppressed grass treatment yielded the same as the other grass treatments at the 65% water application level, better at the 83% water application level, and as well as the low density monoculture at the highest water application level.

The double density cabbage yielded better than other treatments at high water application levels, but the utility of that system depends on the importance of head size and other factors not considered here. With enough water and grass suppression, cabbage yields in a living mulch system can be equal to those in a conventional system.

Comparison of the yields of cabbage under various interrow treatments with the low density monoculture, which had bare ground as the interrow treatment, reveals the relative competitive ability of each treatment. In this case, competitive ability is defined as the ability to reduce cabbage yield.

Interrow cabbage in the double density treatment reduced the yield of the remaining cabbage as much as the unsuppressed and mechanically suppressed grass at all water application levels that have significant treatment differences. This indicates that cabbage and perennial ryegrass compete equally well with cabbage. Mechanical suppression at two mowings per season had no effect on the competitive ability of the grass. The reduction in water use through cultural techniques that Shearman and Beard (7) report utilized more frequent mowing and reduced grass fertilization. In this experiment grass was adequately fertilized to eliminate competition for nutrients. Increased mowing frequency may be more appropriate for turf than living mulch applications.

Chemical suppression reduced the competitive ability of the ryegrass slightly at the 65% water application level, and more so at the higher water application levels. For all treatments, the degree of competition lessened as more water was applied and at the highest water application level competition between the cabbage and the chemically suppressed grass had apparently been eliminated. It is unclear from these data whether the addition of water alone would eventually eliminate all competition, but it seems that under the conditions of this study competition was mainly for water. The addition of any interrow treatment to the low density monoculture increased the water requirements of the system, though the effect of chemically suppressed grass was less than the other treatments.

Further evidence of the reduced competitive ability of the chemically suppressed ryegrass was the higher level of weed invasion. Quantative comparisons were not possible because weeding of the plots was not systematic, but weeds were more prevalent and more difficult to control in the chemically suppressed grass than in the unsuppressed or mechanically suppressed grass.

Summary

The amount of water required for a given cabbage yield increases when perennial ryegrass is added to the system as a living mulch. Mechanical suppression of the ryegrass at two mowings per season does not improve cabbage yields over the unsuppressed grass treatment. Chemical suppression with one application of fluazifop-p-butyl apparently decreases competition for water and, at high water application levels, cabbage yields are comparable to those in a conventional system.

Chemical suppression can reduce water use or increase yields in a living mulch system. The suitability of such a system will depend in part on the achievement of an acceptable balance between the living mulch's competition against weeds and its competition against the main crop.

Literature Cited

1. Adams, W.E., J.E. Pallas, Jr. and R.N. Dawson. 1970. Tillage methods for corn-sod systems in the Southern Piedmont. Agron. J. 62:646-649.

2. Box, J.E., Jr., S.R. Wilkinson, R.N. Dawson and J. Kozachyn. 1980. Soil water effects on no-till corn production in strip and completely killed mulches. Agron. J. 72:797-802.

3. Butler, J.D. 1986. Grass interplanting in horticulture cropping systems. HortScience 21(3):394-397.

4. Carreker, J.R., J.E. Box, Jr., R.N. Dawson, E.R. Beatty and H.D. Morris. 1972. No-till corn in fescuegrass. Agron. J. 64:500-503.

5. Loy, S.J.L. 1984. Competition of bush winter squash and bell pepper with permanent cover crops in strip tillage cultural systems. MS Thesis. Univ. New Hampshire.

6. Nicholson, A.G. and H.C. Wien. 1983. Screening of turfgrasses and clovers for use as living mulches in sweet corn and cabbage. J. Am. Soc. Hort. Sci. 108(6):1071-1076.

7. Shearman, R.C. and J.B. Beard. 1973. Environmental and cultural preconditioning effects on the water use rate of _Agrostic palustris_ Huds., cultivar Penncross. Crop Science 13:424-427.

8. William, R.D. and L.K. Brenner. 1985. Living mulch suppression using postemergence grass herbicides. Abstr. Weed Sci. Soc. Am. p.32.

GERMINATION AND GROWTH CHARACTERISTICS OF FIVE JOINTED GOATGRASS (_AEGILOPS CYLINDRICA_) ACCESSIONS

J.A. Gleichsner, D.J. Rydrych and A.P. Appleby[1]

Abstract. Five jointed goatgrass (_Aegilops cylindrica_ Host.) accessions were collected from sites in Echo, Ione, Pendleton, Condon and Elgin, OR. Spikelets were germinated for 27 days at room (23 ± 2 C) and constant 7, 18, 23, 29 and 38 C) temperatures after storage for 0 to 12 months. Temperature effect on germination was similar for all accessions. Optimum germination temperature was 18 or 23 C for all ages, except 12-month-old spikelets, which germinated best at 29 C. Freshly harvested spikelets (0-month-old) were predominantly dormant at high temperatures, but some germination occurred at lower temperatures (7 and 18 C). As storage time increased, spikelets after-ripened (lost their dormancy) and gained the ability to respond to a wider range of temperatures. At the same time, germination rate and percentage increased as the temperature was raised. No germination occurred at 38°C.

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[1]Oregon State University, Corvallis, Oregon

A field study was conducted at Pendleton, OR, during 1983 to 1984 to evaluate growth and morphological characteristics of five jointed goatgrass accessions. Emergence and flowering times were similar for all accessions. Jointed goatgrass from Condon was significantly taller and produced fewer spikelets per spike than the other accessions. Spikelet yield and stand counts differed among accessions, but this may have been due to spikelet quality differences at planting. No significant differences were observed for leaf and stem dry weight, spikes per plant, and spikelets per plant.

NAPROPAMIDE STRESS-INDUCED POLYAMINE ACCUMULATION IN PEA ROOT TIPS

Joseph M. DiTomaso, Thomas L. Rost and Floyd M. Ashton[1]

Abstract. Considerable evidence exists linking polyamines to the regulation of cell division, normal and abnormal growth, embryogenesis, photomorphogenesis, and normal or stress-induced senescence. Accumulation of putrescine, for example, has been shown to occur in a number of species exposed to a variety of stresses, including mineral deficiency, high acidity, high temperature and salinity, osmotic shock and water stress. This investigation considers the effect of herbicide-induced stress on the levels of various polyamines in pea roots. AT 20 uM napropamide, DNA synthesis and the rate of cell division were reduced by 90 and 80%, respectively, although no effect was observed within 8 h of treatment. An analysis of sequential 1 mm segments of the root tip indicate that the levels of polyamines most closely associated with cell division were unaffected by napropamide treatment, even after reduction in the rate of cell division had occurred.
However, an accumulation of polyamines putrescine and cadaverine coincided temporally with the cell cycle inhibitory response following herbicide treatment. After 48 h, napropamide exposure, putrescine concentration increased by over 600% in the 1 mm section of the root tip, and cadaverine levels doubled in sections 4 mm proximal to the root apex. This represents the first report of a herbicide-polyamine interaction. The possible phytotoxic affect of putrescine accumulation on roots will be discussed.

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[1]University of California, Davis, California

EVALUATION OF HERBICIDES FOR EARLY SEASON CONIFER RELEASE

Elizabeth C. Cole, Michael Newton and Diane E. White[1]

Early season application of herbicides offers the possibility of treatment of weed species at a time when conifers are less susceptible. To examine this possibility, several herbicides (Table 1) were tested on three sites in Oregon in spring, 1985. In addition some of the sites included trials with simultaneous application of nitrogen to see if efficacy of the herbicides was enhanced by addition of nitrogen.

The first site (Clam plots) was located in the Oregon Coast Range a few miles from the Pacific Ocean. The site was scarified before planting. After scarification, seedling alder (*Alnus rubra* Bong.) invaded. Seedlings were four years old and 7 to 10 feet tall when treated. Salmonberry (*Rubus spectabilis* L.) was present as the result of seed; there were small numbers of salmonberry sprouts also present. Seedlings were about 1 to 2 feet tall, sprouts 2 to 5 feet tall. Seedling elderberry (*Sambucus racemosa* Nutt.), Himalaya blackberry (*R. procerus* Muell.), thimbleberry (*R. parviflorus* Nutt.), and evergreen blackberry (*R. laciniatus* Willd.) were present in the 1- to 3-foot range. Miscellaneous minor shrubs and herbs were also on the plots.

The second site (Bull Springs) was located east of the Cascade Mountains near Bend, Oregon. The site was part of a large wildfire in 1979. Snowbrush ceanothus (*Ceanothus velutinus* Dougl. var. *velutinus*) and greenleaf manzanita (*Arctostaphylos patula* Greene) germinated after the fire and revegetated the site. Shrubs ranged from 2 to 3 feet tall at the time of treatment. The site had been planted with 2-0 ponderosa pine (*Pinus ponderosa* Dougl.) three years prior to treatment.

The third site (Bummer Creek) was located in the midrange of the Oregon Coast Range. The site was logged in 1983 and planted in the winter of 1984 with 2-1 Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*). Both red alder and salmonberry germinated in 1984 and were approximately 1 to 2 feet tall at the time of treatment. Some salmonberry from sprout origin were present, and these shrubs varied from 3 to 4 feet tall. Thimbleberry and vine maple (*Acer circinatum* Pursh.) were common in small areas. Other miscellaneous shrubs and herbs were present in minor quantities.

TREATMENT PROCEDURES

Each herbicide was tested in a factorial experiment with two (Coast Range sites) or three (Bull Springs) replications. Herbicide and dosage are shown in Tables 2, 3 and 4. Clam plots were sprayed in mid-April, 1985; Bull Springs was sprayed the first of May, 1985, and Bummer Creek was treated in early May and mid-June, 1985.

All liquid treatments were applied at 10 gallons per acre, the nominal rate for aerial application. The 29 by 15 foot plots (0.01 acre) were sprayed with a backpack sprayer with a single adjustable Chapin nozzle using the "waving wand" technique. Volume per acre was calibrated by measuring delivery rate of the nozzle per second and applying coverage in two passes, usually in opposite directions. On a few plots, heavy slash or dense

[1]Oregon State University, Corvallis, Oregon

Table 1. Common and chemical names for herbicides used in early conifer release experiments.

Common Name	Chemical Name
AC 252,925	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
2,4-D	2,4-dichlorophenoxyacetic acid, butyl esters
Fluroxypyr	4-amino-3,5-dichloro-6-fluoro-2-pyridyloxyacetic acid methyl heptylester
Hexazinone	3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione
Metsulfuron methyl	methyl 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]-amino]sulfonyl] benzoate
Picloram	4-amino-3,5,6-trichloropicolinic acid, isooctyl ester
Sulfometuron methyl	methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]-carbonyl]amino]sulfonyl] benzoate
Triclopyr	3,5,6-trichloro-2-pyridinyloxy acetic acid, butoxyethyl ester
XRM-3972	3,6-dichloropicolinic acid, monoethanolamine salt

Table 2. Summary of treatments at Clam plots.

Chemical	Rate/Acre
2,4-D	2.0 lbs 3.0 lbs
Granular hexazinone	1.5 lbs 3.0 lbs
Hexazinone prills	1.5 lbs + 200 lbs N/Acre 3.0 lbs + 200 lbs N/Acre
Granular hexazinone + Metsulfuron methyl	1.5 lbs + 0.5 oz
Triclopyr ester	2.0 lbs 3.0 lbs
Sulfometuron methyl	2.0 oz 4.0 oz
Control	0

Table 3. Summary of treatments at Bull Springs.

Chemical	Rate/Acre
Metsulfuron methyl	0.25 oz
	0.5 oz
	1.0 oz
Fluroxypyr	0.5 lb
	0.75 lb
	1.0 lb
Triclopyr ester	0.5 lb
	1.0 lb
Liquid hexazinone	1.0 lb
	2.0 lbs
Sulfometuron methyl	2.0 oz
	4.0 oz
2,4-D	1.0 lb
	2.0 lbs
Picloram pellets	0.5 lb
	1.0 lb
Picloram prills	0.5 lb + 50 lbs N/Acre
	1.0 lb + 50 lbs N/Acre
2,4-D + Sulfometuron methyl	1.0 lb + 1.0 oz
Granular hexazinone	1.0 lb
	2.0 lbs
Hexazinone prills	1.0 lb + 110 lbs N/Acre
	2.0 lbs + 110 lbs N/Acre
XRM-3972	1.0 lb
	2.0 lbs
2,4-D + XRM-3972	1.0 lb + 0.5 lb
	2.0 lbs + 0.5 lb
Control	0

Table 4. Summary of treatments at Bummer Creek.

Chemical	Rate/Acre	Timing
Fluroxypyr	0.5 lb	May
	0.75 lb	May
	1.0 lb	May
AC 252,925	0.25 lb	May
	0.5 lb	May
	0.75 lb	May
Metsulfuron methyl	0.5 oz	May, June
	1.0 oz	May, June
	2.0 oz	May, June
Triclopyr ester	1.0 lb	May
	1.5 lbs	May
Control		

vegetation dictated that both passes be from the same direction. For all plots, spray time was clocked so that the second pass could compensate for inadvertent variation in the first pass. Nearly all plots received +-5 percent of their nominal dosage.

Granular applications were made using a "whirlybird" granular spreader. For the granular hexazinone applications, pounds per acre were calibrated by measuring the delivery rate of the spreader. Herbicide was applied based on the amount of time required to spread the nominal dosage. For the herbicide plus nitrogen treatments ("weed and feed"), mixtures of nitrazine and urea were blend-coated with hexazinone, and urea was blend-coated with picloram. The amount of mixture needed for each plot was determined and applied by using the spreader until empty.

Before or immediately after treatment, up to 10 shrubs of each major species were tagged for later evaluation. Specimens were not tagged if they showed significant pretreatment damage from disease, browsing or frost.

Shrubs were evaluated in June and July, 1986. Each tagged shrub was ocularly rated for percent crown and stem reduction. In addition, conifers were rated for injury on a five-point scale: 1) no injury; 2) minor damage to foliage; 3) major damage to foliage and terminal dieback; 4) dieback at least one-third of crown; and 5) dead.

RESULTS

Clam Plots

Red Alder: Two treatments (2,4-D at 3 lbs/acre and triclopyr ester at 1.5 lbs/acre) resulted in 100 percent kill of all sample alder (Table 5). The lower rates of these herbicides, 2 and 1 lb/acre, respectively, had 96 percent crown reduction and 90 to 95 percent stem reduction. The rest of the herbicides were less than 50 percent effective.

Table 5. Crown and stem reduction for red alder at Clam plots. Means followed by the same letter are not significantly different at $\alpha = 0.05$ using Duncan's multiple range test.

Treatment	Rate/Acre	Red Alder %Crown Reduction	Red Alder %Stem Reduction
Control	0	2 f	0 d
2,4-D	2.0 lbs	96 a	90 a
	3.0 lbs	100 a	100 a
Triclopyr ester	1.0 lb	96 a	95 a
	1.5 lbs	100 a	100 a
Sulfometuron methyl	2.0 oz	19 cde	7 cd
	4.0 oz	11 de	8 cd
Granular hexazinone	1.5 lbs	9 ef	6 cd
	3.0 lbs	42 b	36 b
Hexazinone prills	1.5 lbs	2 f	0 d
	3.0 lbs	24 c	19 c
Granular hexazinone + metsulfuron methyl	1.5 lbs + 0.5 oz	23 cd	18 c

Salmonberry: The best treatment for salmonberry was sulfometuron methyl at 4 oz/acre, with 92 percent crown reduction and 95 percent stem reduction (Table 6). Five other treatments, triclopyr ester (both rates), granular hexazinone (3 lb/acre) sulfometuron methyl (2 oz/acre) and granular hexazinone plus metsulfuron methyl (1.5 lb/acre plus .5 oz/acre) had 50 percent or greater crown reduction. Stem reduction for these treatments ranged from 80 to 100 percent.

Almost all of the treatments had greater stem reduction than crown reduction. This results from shrubs dying back to the ground after treatment, but vigorously resprouting the year following treatment. In some treatments, the shrubs had recovered a large percentage of the pretreatment leaf area. This was seen in the 2,4-D treatments and to some extent in the hexazinone treatments.

In previous trials metsulfuron methyl has resulted in 100 percent kill on salmonberry. The lower amount of control in these plots is probably due to the April application being too early for the most effective control.

Thimbleberry: Several treatments resulted in 100 percent kill on thimbleberry (Table 6)--sulfometuron methyl (4 oz/acre), granular hexazinone (3 lb/acre) and granular hexazinone plus metsulfuron methyl. Granular hexazinone (1.5 lb/acre), hexazinone prills (3 lb/acre) and triclopyr ester (1 lb/acre) gave excellent control, ranging from 80 to 95 percent crown reduction and 95 to 100 percent stem reduction. 2,4-D was the least effective. As with salmonberry, thimbleberry had greater stem reduction than crown reduction due to stem dieback and resprouting.

Table 6. Crown and stem reduction for salmonberry and thimbleberry for Clam plots. Means followed by the same letter are not significantly different at α=0.05 using Duncan's multiple range test.

Treatment	Rate/Acre	Salmonberry %Crown Reduction	Salmonberry %Stem Reduction	Thimbleberry %Crown Reduction	Thimbleberry %Stem Reduction
Control	0	6 fg	12 g	0 a	20 c
2,4-D	2.0 lbs	0 g	86 abcd	0 e	100 a
	3.0 lbs	11 fg	73 de	35 d	67 b
Triclopyr ester	1.0 lb	71 ab	100 a	80 abc	100 a
	1.5 lbs	50 cd	96 ab	55 cd	100 a
Sulfometuron methyl	2.0 oz	52 bcd	66 de	67 bc	100 a
	4.0 oz	92 a	95 abc	100 a	100 a
Granular hexazinone	1.5 lbs	38 de	56 ef	94 a	94 a
	3.0 lbs	61 bc	82 abcd	100 a	100 a
Hexazinone prills	1.5 lbs	37 de	37 f	77 abc	100 a
	3.0 lbs	25 ef	79 bcd	92 ab	100 a
Granular hexazinone + Metsulfuron methyl	1.5 lbs + 0.5 oz	23 cd	18 c	58 bcd	75 cde

Conifer Injury: There were not enough Douglas-fir trees available for an adequate sample of conifer injury. Major damage (terminal dieback) was noted in the granular hexazinone plus metsulfuron methyl, triclopyr ester (1.5 lb/acre) and sulfometuron methyl (4 oz/acre) treatments. Minor injury (damage to foliage) was noticeable on trees in the sulfometuron methyl (2 oz/acre) treatment, but the trees are expected to recover.

Summary: For all species, adding nitrogen to hexazinone granules did not increase efficacy. Overall, the best treatment was triclopyr ester at either 1 or 1.5 lb/acre. Triclopyr was more effective on red alder than on salmonberry. To increase efficacy on salmonberry, triclopyr or 2,4-D could be mixed with sulfometuron methyl (4 oz/acre). These mixtures would result in excellent control on all three species with an April application, although some damage to Douglas-fir would be expected. In addition, sulfometuron methyl was very effective on evergreen and Himalaya blackberry.

Bull Springs. During spring, 1986, the plots and surrounding areas were damaged by frost. Snowbrush ceanothus was affected significantly with some shrubs having 30 percent crown reduction from frost. Manzanita was not noticeably affected by frost. Some injury to conifers was also visible. When rating damage to snowbrush and conifers, no distinction was made between frost and herbicide injury. However, since frost damage was apparent in the control plots, those herbicide treatments which are significantly different from the control reflect herbicide injury rather than frost damage.

Snowbrush Ceanothus. The best treatments were 2,4-D (both rates), triclopyr ester (1 lb/acre) and metsulfuron methyl (1 oz/acre). Crown reduction ranged from 65 to 80 percent and stem reduction 60 to 75 percent (Table 7). The high rate of 2,4-D plus clopyralid (2 lb/acre plus .5 lb/-acre, the 1 lb/acre rate of fluroxypyr, the .5 lb/acre rate of triclopyr and the .5 oz/acre rate of metsulfuron methyl ranged from 55 to 60 percent crown reduction and 45 to 55 percent stem reduction.

Adding cloyralid or sulfometuron methyl to 2,4-D did not increase efficacy on snowbrush. None of the granular applications were effective treatments and most were not significantly different from the control. All hexazinone treatments were not highly effective, although the granular treatments were significantly different from the control (37 percent crown reduction compared to 20 percent). The control plots averaged 20 percent crown reduction due to frost damage.

Greenleaf Manzanita. Several treatments gave excellent control of manzanita. 2,4-D (2 lb/acre), fluroxypyr (1 lb/acre) and 2,4-D plus clopy-ralid (2 lb/acre plus .5 lb/acre) reduced crowns by 94 to 98 percent and stems by 93 to 97 percent (Table 8). Several shrubs were killed in each treatment. The 1 lb/acre rate of 2,4-D either alone or mixed with clopyralid also gave very good results--85 percent crown reduction and 70 to 80 percent stem reduction.

The .75 lb/acre rate of fluroxypyr and the mixture of 2,4-D plus sulfometuron methyl resulted in good control with 65 to 75 percent crown reduction and 60 to 65 percent stem reduction. All other treatments had less than 50 percent control.

Granular hexazinone was the best granular treatment but with less than 50 percent crown reduction. All other granular treatments were not sig-nificantly different from the control.

As with snowbrush, adding colpyralid or sulfometuron methyl to 2,4-D did not increase efficacy.

Table 7. Crown and stem reduction for snowbrush Ceanothus at Bull Springs. Means followed by the same letter are not significantly different at $\alpha = 0.05$ using Duncan's multiple range test. Ponderosa pine injury is based on a 5-point scale with 5 signifying a dead tree.

Treatment	Rate/Acre	Snowbrush Ceanothus %Crown Reduction	Snowbrush Ceanothus %Stem Reduction	Ponderosa Pine Injury
Triclopyr ester	1.0 lb	78 a	76 a	3.0
2,4-D	1.0 lb	75 ab	69 a	1.5
2,4-D	2.0 lbs	69 abc	62 ab	3.0
Metsulfuron methyl	1.0 oz	67 abc	64 ab	2.0
Fluroxypyr	1.0 lb	62 bc	45 c	1.0
2,4-D + XRM-3972	2.0 lbs + 0.5 lb	55 c	54 bc	3.7
Metsulfuron methyl	0.5 oz	54 c	46 c	2.0
Triclopyr ester	0.5 lb	54 c	44 c	1.7
Sulfometuron methyl	2.0 oz	37 d	29 d	1.8
Granular hexazinone	1.0 lb	37 d	27 de	1.0
Granular hexazinone	2.0 lbs	37 d	21 de	1.0
Sulfometuron methyl	4.0 oz	32 de	26 de	1.0
2,4-D + XRM-3972	2.0 lbs + 0.5 lb	30 def	30 d	1.3
Fluroxypyr	0.75 lb	28 def	18 de	1.0
Metsulfuron methyl	0.25 oz	28 def	14 de	1.7
Fluroxypyr	0.5 lb	26 def	19 de	1.3
2,4-D+Sulfometuron methyl	1.0 lb +1.0 oz	24 def	23 de	1.2
Liquid hexazinone	2.0 lbs	24 def	11 e	1.0
Liquid hexazinone	1.0 lb	22 def	16 de	1.7
Hexazinone prills	2.0 lbs	21 ef	19 de	1.0
Picloram prills	0.5 lb	20 ef	16 de	1.5
Control	0	20 ef	11 e	1.1
Hexazinone prills	1.0 lb	19 ef	18 de	1.0
Picloram prills	1.0 lb	19 ef	17 de	2.0
XRM-3972	1.0 lb	16 f	14 de	2.0
XRM-3972	2.0 lbs	16 f	11 e	1.8

Ponderosa Pine Injury. The most injury occurred with the 2,4-D treatments, with terminal dieback being common. Trees with minor terminal dieback should recover, but some of the trees suffered major damage, and recovery is uncertain. Significant amounts of injury were also noted with triclopyr ester, picloram, sulfometuron methyl, metsulfuron methyl and colpyralid treatments. These trees generally exhibited some minor terminal dieback and some foliage damage. Most of the trees should recover.

Trees with fluroxypyr, hexazinone (liquid and granular), and control treatments exhibited minor to no damage. Some of the damage can be attributed to frost, but there were still significant amounts of herbicide injury in the previously noted treatments. Table 7 lists pine damage by treatment based on the previously described five-point scale.

Table 8. Crown and stem reduction for greenleaf manzanita at Bull Springs. Means followed by the same letter are not significantly different at α=0.05 using Duncan's multiple range test.

Treatment	Rate/Acre	Manzanita %Crown Reduction	Manzanita %Stem Reduction
2,4-D	2.0 lbs	98 a	97 a
Fluroxypyr	1.0 lb	97 a	95 a
2,4-D + XRM-3972	2.0 lbs + 0.5 lb	94 a	93 a
2,4-D	1.0 lb	86 a	80 ab
2,4-D + XRM-3972	1.0 lb + 0.5 lb	84 a	71 bc
Fluroxypyr	0.75 lb	67 b	56 c
2,4-D + Sulfometuron methyl	1.0 lb + 1.0 oz	66 b	62 c
Fluroxypyr	0.5 lb	49 c	34 d
Granular hexazinone	2.0 lbs	46 cd	24 d
Triclopyr ester	1.0 lb	44 cd	37 d
Granular hexazinone	1.0 lb	30 de	24 d
Metsulfuron methyl	0.5 oz	29 de	22 de
Liquid hexazinone	2.0 lbs	14 ef	5 ef
Metsulfuron methyl	1.0 oz	11 ef	5 ef
XRM-3972	2.0 lbs	8 f	5 ef
Liquid hexazinone	1.0 lb	8 f	4 f
Hexazinone prills	2.0 lbs	6 f	3 f
Triclopyr ester	0.5 lb	5 f	3 f
Metsulfuron methyl	0.25 oz	4 f	2 f
Sulfometuron methyl	2.0 oz	4 f	2 f
Hexazinone prills	1.0 lb	3 f	2 f
XRM-3972	1.0 lb	2 f	1 f
Control	0	2 f	1 f
Sulfometuron methyl	4.0 oz	2 f	0 f
Picloram prills	0.5 lb	1 f	0 f
Picloram prills	1.0 lb	1 f	0 f

Summary. No single herbicide treatment gave excellent control on both snowbrush and manzanita. The best treatment was 2,4-D at 2 lb/acre which exhibited excellent control on manzanita and good control on snowbrush. However, this was also the treatment which caused the greatest injury to pine. Fluroxypyr at 1 lb/acre gave equivalent control on manzanita but was slightly less effective on snowbrush. Damage to pine was minor with this treatment and the apparent selectivity warrants further attention. Triclopyr ester had the highest crown and stem reduction on snowbrush but was not significantly different from 2,4-D (2 lb/acre) or metsulfuron methyl (1 oz/acre).

These results indicate that a high rate of 2,4-D (2 lb/acre or greater), a mixture of triclopyr ester plus 2,4-D (1 lb/acre plus 1 to 2 lb/acre), a mixture of triclopyr ester plus fluroxypyr (1 lb/acre for both), a mixture of metsulfuron methyl plus 2,4-D (1 oz/acre plus 1 to 2 lb/acre) or a mixture of metsulfuron methyl plus fluroxypyr (1 oz/acre plus 1 lb/acre) would offer the best control on both species.

Unfortunately, the 2,4-D and triclopyr ester treatments resulted in the greatest injury to ponderosa pine. Clopyralid did not reduce 2,4-D injury to pine nor add efficacy on either shrub species. The metsulfuron methyl treatments also resulted in significant damage to pine but not as severe as 2,4-D or triclopyr ester. Fluroxypyr caused minor or no damage to pine when applied in early May and gave excellent control on manzanita but only good control on snowbrush. Examination of these four herbicides at different timings and in different mixtures may provide for a treatment with excellent control on both species with minimal damage to pine.

Bummer Creek

Red Alder. One treatment (imazapyr .75 lb/acre) resulted in 100 percent kill on red alder (Table 9). However, this treatment was not statistically different from triclopyr ester at 1.5 lb/acre with 96 percent crown and 95 percent stem reduction nor fluroxypyr at 1 lb/acre with 84 percent crown and 82 percent stem reduction.

Table 9. Crown and stem reduction for red alder and salmonberry at Bummer Creek. Means followed by the same letter are not significantly different at α=0.05 using Duncan's multiple range test.

Treatment	Rate/ Acre	Month	Red Alder %Crown Reduction	Red Alder %Stem Reduction	Salmonberry %Crown Reduction	Salmonberry %Stem Reduction
Control	0		0 e	0 d	0 h	0 g
Imazapyr	0.25 lb	May	50 c	48 c	54 bcd	31 cd
	0.5 lb	May	76 b	74 b	41 de	22 de
	0.75 lb	May	100 a	100 a	68 b	41 bc
Triclopyr ester	1.0 lb	May	73 b	74 b	48 cd	34 cd
	1.5 lbs	May	96 a	95 a	61 bc	53 b
Fluroxypyr	0.5 lb	May	51 c	44 c	23 fg	11 efg
	0.75 lb	May	46 c	40 c	13 gh	4 fg
	1.0 lb	May	84 ab	82 ab	32 ef	18 def
Metsulfuron methyl	0.5 oz	May	8 de	7 d	95 a	92 a
	1.0 oz	May	1 e	0 d	100 a	100 a
	2.0 oz	May	12 de	12 d	100 a	100 a
Metsulfuron methyl	0.5 oz	June	14 de	11 d	100 a	100 a
	1.0 oz	June	20 d	17 d	100 a	100 a
	2.0 oz	June	16 de	14 d	100 a	100 a

Good control (75 percent crown and stem reduction) was obtained with imazapyr at .5 lb/acre and triclopyr ester at 1 lb/acre. The lowest rate of imazapyr (.25 lb/acre) and the .5 lb/acre and .75 lb/acre rates of fluroxypyr gave intermediate control--45 to 50 percent crown reduction and 40 to 50 percent stem reduction.

Although the June metsulfuron methyl treatments had higher crown and stem reduction than the May treatments, none of these treatments were significantly different from the control.

Salmonberry. Metsulfuron methyl treatments resulted in 100 percent kill of all sample salmonberry in all but the .5 oz/acre rate in May (Table 9). This treatment had 95 percent crown and 92 percent stem reduction, but was not statistically different from the other metsulfuron methyl treatments.

The imazapyr and triclopyr ester treatments gave intermediate control--40 to 60 percent crown reduction and 20 to 50 percent stem reduction. The higher reductions correspond to the higher rates. The fluroxypyr treatments were generally ineffective, even though most were significantly different from the control.

Conifer Injury. Some slight damage to Douglas-fir was observed with fluroxypyr, triclopyr ester and the low rates of imazapyr. With imazapyr and fluroxypyr, needle dieback and stunting were noticed on foliage present at the time of treatment. Most of the current foliage appeared healthy. With the highest rate of imazapyr, some terminal dieback occurred, but the trees were recovering unless severely damaged.

In May, only the highest rate of metsulfuron methyl caused severe damage, including some mortality. In June, mortality was occurring with all rates.

Summary. On red alder, the high rates of triclopyr ester, imazapyr and fluroxypyr had the greatest crown and stem reductions. These chemicals were intermediate in control on salmonberry.

Metsulfuron methyl gave the best control on salmonberry with almost 100 percent kill at all rates and both seasons. The shrubs that were not killed at the lowest rate in May may indicate that metsulfuron methyl is less effective with early season treatments (as seen with the Clam plots). This also corresponds to the season when metsulfuron methyl is less damaging to Douglas-fir.

For red alder control, triclopyr ester, imazapyr or fluroxypyr could be used at the rates indicated for release. Some damage to Douglas-fir would occur with fluroxypyr and imazapyr, being most severe with the higher rates of imazapyr. If mixed with metsulfuron methyl, salmonberry control could be obtained. In order to avoid severe injury to Douglas-fir, early season applications and low rates would be necessary.

Conclusions. Early season applications of herbicides for conifer release do offer the possibility of shrub control with minimal conifer damage. In order to accomplish this, herbicide, rate, timing and species of conifer should be considered carefully.

SEASONAL IMPACTS OF FLUROXYPYR AND TRICLOPYR ON CONIFERS AND SHRUBS

Bruce R. Kelpsas[1]

Douglas-fir (*Pseudotsuga menziesii* (mirbel) Franco) commonly competes with red alder (*Alnus rubra* Bong.) and salmonberry (*Rubus spectabilis* Pursh) in commercial conifer plantations in the Pacific Northwest. In 1985 a trial was installed in this vegetation type to investigate seasonal impacts of

[1]Northwest Chemical Corporation, Salem, Oregon

triclopyr {[3,5,6-trichloro-2-pyridinyl)oxy]acetic acid}, a registered forestry compound, and fluroxypyr {4-amino-3,5-dichloro-6-fluro-2-pyridyloxy acetic acid}, an experimental chemical, on these three species. Fluroxypyr (.56, 1.12 and 2.24 kg/ha) and triclopyr (1.12 kg/ha) were applied during the dormant season (March) in an oil carrier, and in the early and late foliar periods (May and September) in a water carrier at 93 l/ha. A completely randomized plot design was used at each season. One year later, at the end of the second growing season in 1986, a final evaluation for crown reduction was made for each species.

Douglas-fir was severely damaged by the medium and high rates of fluroxypyr at the dormant timing (37% and 67% crown reduction), but the low and medium rates were tolerated with only a minor shoot deformation in the early foliar season just before bud burst. The highest rate produced unacceptable injury (28% crown reduction) at this time. No long-term damage was noted on conifers treated with fluoxypyr in September at any rate, while triclopyr caused little injury during any timing.

Red alder was controlled effectively at the dormant timing only with fluroxypyr at 2.24 kg/ha (94% crown kill), but sensitivity increased during the early foliar period, with both the 1.12 and 2.24 kg/ha rates providing complete crown kill (100%). The late foliar application provided only moderate crown kill at the highest fluroxypyr rate (41%). The triclopyr treatments generally provided good alder control during the dormant and early foliar timings (88-94% crown kill), but reduced activity resulted from the late foliar treatment (67%).

Fluroxypyr and triclopyr treatments were less effective on salmonberry at all timings and rates. Dormant and late foliar applications of compounds resulted in poor control (5-15% crown kill). The sensitivity of salmonberry increased during the early foliar period, but control was still moderate for fluroxypyr at 1.12 and 2.24 kg/ha (50-60%) and marginal for triclopyr (28%).

The results of these trials suggest that red alder and salmonberry sensitivity to fluroxypyr is greatest during the early foliar period and that medium rates of this compound (1.12 kg/ha) at this growth stage may be useful for releasing Douglas-fir from these species without appreciable long-term injury.

EFFECT OF RELIEVING MOISTURE STRESS WITH EXTENDED WEED CONTROL IN DOUGLAS-FIR

Michael Newton, David S. Preest and Diane E. White[1]

Growth of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*) seedlings was increased during the first five years by controlling grasses and forbs in seven herbicide regimes during the first three years after planting. The greatest effect from a single year of weeding was from first-year weed control despite adequate moisture levels for survival in all plots the first year. Second and third years of weed control provided further increments of growth, diminishing with time after planting. Growth increases attributable to early weeding continued through the fifth year. At year five, differences between degrees and periods of weed control were still

[1]Oregon State University, Corvallis, Oregon

being expressed in diverging growth rates. Devegetated plots had more available moisture through the growing season than those with bentgrass (Agrostis tenuis L.) or forb/grass mixtures dominated by bentgrass and cat's-ears (Hypochaeris radicata L.) cover, in that order. Tree moisture stress followed soil moisture, but only after allowing for the large fluctuations of diurnal stress. Weed control relieved moisture stress in trees, increasing the number of hours each year when moisture stress was compatible with photosynthesis.

Douglas-fir photosynthesis tends to shut down in the vicinity of -2.0 MPa moisture stress. Plotting the number of MPa-hours above -2.0 MPa during the first three years after planting explained 77 percent of the variation in fifth-year biomass of Douglas-fir. We estimate that, for the first three years, in a favorable coastal environment, about 1,700 MPa-hours above -2.0 MPa is necessary for survival and that increments of moisture beyond that will contribute significantly to growth. Examples from a dry site in Southwest Oregon suggest that this relationship is not restricted to coastal sites.

VENTENATA DUBIA IN THE PACIFIC NORTHWEST

R.R. Old and R.H. Callihan

Ventenata dubia (Leers) Coss. in Dur. is a weedy annual grass in the tribe Aveneae. It bears a strong resemblance to a diminutive wild oat including the large glumes and bent and twisted awns. Its first report in North America was in 1957 near Lake Coeur d'Alene in northern Idaho. It presently infests at least 60,000 square miles in the Pacific Northwest with records from Idaho, Montana, Oregon, Washington and Nevada. An intensive survey of Venenata in Idaho in 1986 showed it to be primarily restricted to the western border of the state. Ventenata was not found in the drier and lower sites such as the Boise Valley. A mail survey undertaken prior to the field survey failed to produce reliable results.

Ventenata is highly aggressive in bluegrass, alfalfa, winter wheat, pasture and rangeland. Its palatability is very low and in cropland it can act as a mechanical impediment to harvesting. Field studies showed a high degree of association with Bromus mollis L. (62%) and Madia glomerata Hook (72%). These studies also showed a very low degree of association with Bromus tectorum L. (14%).

The only herbicide registered for use on Ventenata is terbacil {5-chloro-3-(1,1-dimethylethyl-6-methyl-2,4(1H,3H)-pyrimidinedione} bluegrass production. Research has failed to produce a consistent, reliable chemical control program in crop or rangeland.

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[1]University of Idaho, Moscow, Idaho

BROOM SNAKEWEED (Gutierrezia Sarothrae) CONTROL WITH A SERIES OF HERBICIDES AND HERBICIDE COMBINATIONS

T.D. Whitson and M.A. Ferrell[1]

Abstract. Phenoxy herbicides have been used to control broom snakeweed (Guierrezia sarothrae (Pursh) Britt. & Rusby) with varying degrees of success on western rangeland. A number of herbicides were compared to 2,4-D {(2,4-dichlorophenoxy)acetic acid} to determine their effectiveness in controlling broom snakeweed.

A study was established near McFadden, Wyoming, August 1, 1985, to determine tolerance of 'Fairway' crested wheatgrass to herbicides and potential for control of broom snakeweed. Broom snakeweed during application was in early bloom, crested wheatgrass was in the boot stage. Plots were 9 by 30 ft. with four replications arranged in a randomized complete block design. Treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack unit delivering 40 gpa at 45 psi. The soil was a sandy loam (75% sand, 18% silt and 7% clay) with 2.4% organic matter and 7.8 pH. Weather data: temperature, air - 78 F, soil surface - 89 F, 1 inch - 86 F, 2 inch-76 F and 4 inch - 72 F. The relative humidity was 30% with winds to 3 mph.

Treatments were evaluated August 5, 1986. No crested wheatgrass damage was found within any treated area. 2,4-D LVE was the least effective treatment used in the study. When applied at 2.0 lb ai/A only 60% of the broom snakeweed was controlled. Herbicides (rates - lb ai/A) providing 98 to 100% control included: triclopyr {(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid} + 2,4-D (1.0 + 2.0 lb) and (1.5 + 3.0 lb), triclopyr (2.0 lb), picloram {4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid} + clopyralid {3,6-dichloro-2-pyridinecarboxylic acid} (0.125 + 0.125 lb) and (0.25 + 0.25 lb), picloram (0.25) and (0.5 lb) and fluroxypyr {4-amino-3,5-dichloro-6-fluro-2-pyridyloxy acetic acid} (1.0 lb).

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[1]Department of Plant Science, University of Wyoming, Laramie, Wyoming

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METSULFURON METHYL - A NEW BROADLEAF HERBICIDE FOR BROOM SNAKEWEED CONTROL IN RANGELAND

J. D. Crosby, F.B. Maxcy and H.L. Palm[1]

Abstract. Field studies conducted in New Mexico and Texas from 1982 to 1986 show metsulfuron methyl {methyl 2 [[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]-sulfonyl]benzoate} to be a highly effective herbicide for controlling broom snakeweed (Gutierrezia sarothrae) in rangeland. Over the past four years applications of metsulfuron methyl have been made in both spring and fall using rates of 0.125-2.0 ozai/ac. The effective rate range for the control of broom snakeweed was found to be between 0.25-0.75 ozai/ac. At these rates, total control of the existing broom snakeweed could

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[1]E.I. DuPont de Nemours & Company, Denver, Colorado 80235

be achieved as well as preemergence control of germinating seeds. There were no differences in control from either the fall or the spring application. Excellent control of broom snakeweed has been achieved with rates as low as 0.25 ozai/ac at both timings. Warm season grasses showed very good tolerance to metsulfuron methyl at rates as high as 2.0 ozai/ac. Consequently grass production following a treatment of metsulfuron methyl has been observed as high as nine times greater than the untreated check. Metsulfuron methyl (Escort) is presently under an EUP for broom snakeweed control in New Mexico and Texas.

CONTROL OF WEEDS IN FALLOW WITH FMC 57020

C.G. Ross[1]

Abstract: FMC 57020 {2-(2-Chlorophenyl)methyl-4,4-dimethyl-3-isoxazolidinone} is a new herbicide from FMC Corporation, currently registered for use on soybeans. Since the fall of 1983, it has been investigated for use in chemical fallow. It is formulated as an 4 EC. Acute oral LD_{50}, dermal LD_{50}, and inhalation LC_{50} studies put FMC 57020 in the Toxicological Category III. Eye irritation is rated as moderate. Skin irritation rating is slight. It has also been determined to be non-mutagenic, non-teratogenic and non-carcinogenic. Toxicity to upland birds and waterfowl is considered "practically non-toxic." Lastly, FMC 57020 is only slightly toxic to fresh water fish. As a result, no acute or chronic hazards to mammalian, avian or aquatic organisms are anticipated with the use of this herbicide.

FMC 57020 is primarily a soil active herbicide that is taken up through shoots and roots and translocated to the leaves. Its mode of action is the inhibition of chlorophyll and carotenoid biosynthesis. Soil mobility is classed low (Class 2) in loam soils with slightly increased mobility in fine sand. Degradation of FMC 57020 in the soil is primarily microbial. Soil persistence at commonly used rates is often longer than six months and rotational restrictions are required for use in soybean weed control.

Control of weeds in the fallow portion of the wheat-fallow-wheat cropping system with FMC 57020 has been the target of research for the past three years. The primary area of testing has been in the Great Plains Region of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota and Wyoming. Characteristics of FMC 57020 that have made it an attractive candidate herbicide for this use include: 1) It is highly efficacious in controlling volunteer wheat and downy brome. 2) Losses under dry conditions prior to activation are not significant. 3) FMC 57020 is readily activated without being incorporated. 4) It is compatible with other herbicides currently registered for fallow use.

Efficacy studies (established in late August through November) show that FMC 57020 has a high degree of activity on many weed species commonly found in fallow. Average percent control of these species at the expected use rate of 0.75 pounds active ingredient/acre is as follows:

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[1]FMC Corporation, Loveland, Colorado

Weed Species	Percent Control
Volunteer Wheat (*Triticum aestivum*)	95
Downy Brome (*Bromus tectorum*)	95
Jointed Goatgrass (*Aegilops cylindrica*)	95
Wild Buckwheat (*Polygonum convolvulus*)	88
Russian Thistle (*Salsola iberica*)	50
Lambsquarters (*Chenopodium album*)	94
Kochia (*Kochia scoparia*)	98
Common Purslane (*Portulaca oleracea*)	98
Prickly Lettuce (*Lactuca serriola*)	98
Cutleaf Nightshade (*Solanum triflorum*)	65
Witchgrass (*Panicum capillare*)	72
Green Foxtail (*Setaris viridis*)	80
Stinkgrass (*Eragrostis cilianensis*)	95

Efficacy studies have been followed by plant back studies to determine the potential for FMC 57020 carryover in winter wheat planted back in the trials 10-12 months after initial application. To date, no significant carryover has been observed.

LINE SOURCE HERBIGATION OF CINMETHYLIN (SD-95481) FOR GRASS CONTROL IN PINTO BEANS

R.N. Arnold, E.J. Gregory and D. Smeal[1]

Abstract. The purpose of this study was to evaluate the effectiveness of herbigation on pinto beans (cv. Ul-114) with cinmethylin {exo-1-methyl-4-(1-methylethyl)-2-[(2-methylphenyl)methoxyl]-7-oxabicyclo[2.2.1]heptane} using a line-source-sprinkler design for control of green foxtail (*Setarai viridis* (L.) Beauv.) and barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.). Weed yields for both grasses decreased quadratically with increased rates of cinmethylin. There were no correlations between pinto bean yields and cinmethylin rates.

Materials and Methods

A line source experimental plot design was used to evaluate annual grass control and pinto bean response to variable rates of cinmethylin application. The experimental design consists of three single lines placed with the lateral spacing equal to the sprinkler's wetted radius. An equal quantity of water is applied through each lateral while the sprinkler-applied cinmethylin is injected into the center lateral. This will provide an application gradient of decreasing magnitude away from and on each side of the center line, while a uniform application of water will be provided by the two outer lines (Fig. 1 and 2). The laterals were placed on a spacing of 50 ft, one sprinkler wetted radius. The in-line sprinkler spacing was 20 ft, two-fifths

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[1]New Mexico State University, Farmington, New Mexico

the wetted radius. The sprinkler heads were Rainbird Model 30 H with 3/16 range nozzles and 3/32 spreader nozzles with an operating pressure of 45 lb/sq in.

Cinmethylin was injected into the irrigation water at the center lateral on June 3, 1986, using a calibrated Pulsa 340 diaphragm metering pump to supply cinmethylin in frequent small increments. Sprinkler-applied cinmethylin gradients were: .04 to .64 lb ai/A.

Pinto beans (Phaseolus vulgaris cv. U1-114) were planted in rows spaced 34 in. apart parallel to the line-source laterals. A uniform preplant application of 100 lb N/A was applied on June 1, 1986.

Weed species, green foxtail and barnyardgrass were planted 20 in. apart in separate rows on each side of each bean row at 1.0 lb/A, using a tractor driven cone seeder. Remaining weed growth was removed by hand throughout the growing season.

Irrigation was scheduled according to estimated evapotranspiration (ET). Before complete canopy cover, ET was estimated from pan evaporation (Ep) times an appropriate crop factor. Irrigation periods did not exceed 30 to 45 min per application because of the high application rate of the line source. Irrigation was scheduled in early morning to minimize wind interference with the sprinklers. During injection of cinmethylin .8 in. of irrigation water were applied.

Individual plots consisted of 4.9 ft sections of row, which within a given row, were replicated 20 times. Water and cinmethylin received by the plots were measured by collecting a sample intercepted by a 4.75 diameter catchment can. These were spaced 4 per row on each side of the central injection line at a 20-ft distance. Each sample collected was then measured with a graduated 100 ml cylinder and recorded.

Two samples were then combined and sent to Shell Agricultural Chemical Company Biological Sciences Research Center, Department of Analytical Chemistry at Modesto, California, for cinmethylin determination. Weed yields were harvested from each plot on August 19 and 20, 1986. Field bean yields were harvested from each plot September 22, 1986. After the field bean plants had dried, they were run through a custom-built plot thresher and the seed then weighed. Statistical analyses will employ regression and correlation techniques to determine whether or not there is a significant relationship between herbicide application and weed control and herbicide application and yield.

Results and Discussion

Figure 3 shows average rates of cinmethylin across rows. Slight wind movement from west to east (2 to 4 mph) resulted in higher cinmethylin rates on the east side of the center line. Cinmethylin rates ranged from a low of .04 to a high of .64 lb ai/A.

Regression analysis for lb ai/A vs. weed yields (grams) resulted in a high correlation for both green foxtail and barnyardgrass control. These relationships were curvilinear and are given in Figures 4 and 5. Rates of 0.3 to 0.4 lb ai/A were very effective in removing both annual grasses.

Figure 6 shows that there were no relationships between bean yield and lb ai/A cinmethylin. Pinto bean yields varied from a high of 1.04 lb/plot at 0.4 lb ai/A to a low of 0.7 lb/plot at 0.54 lb ai/A.

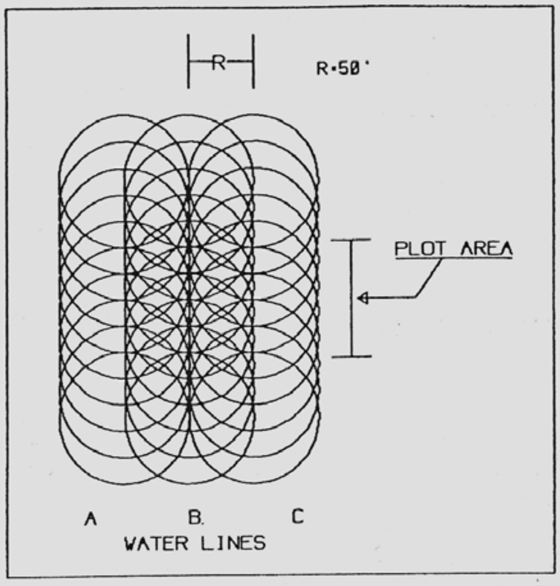

fig. 1 Sprinkler line layout and the associated sprinkler patterns.

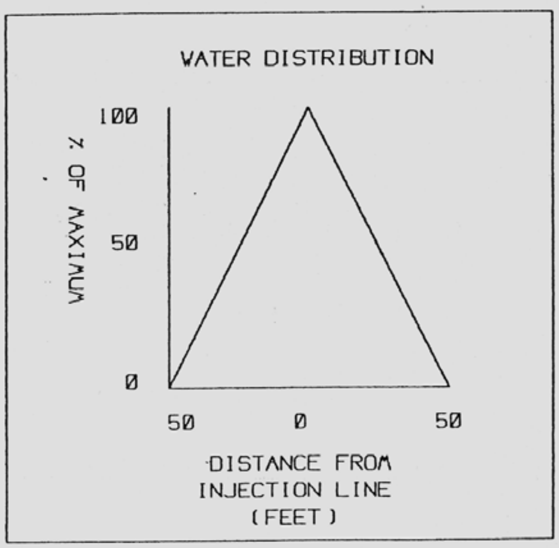

fig. 2 Distribution of center line.

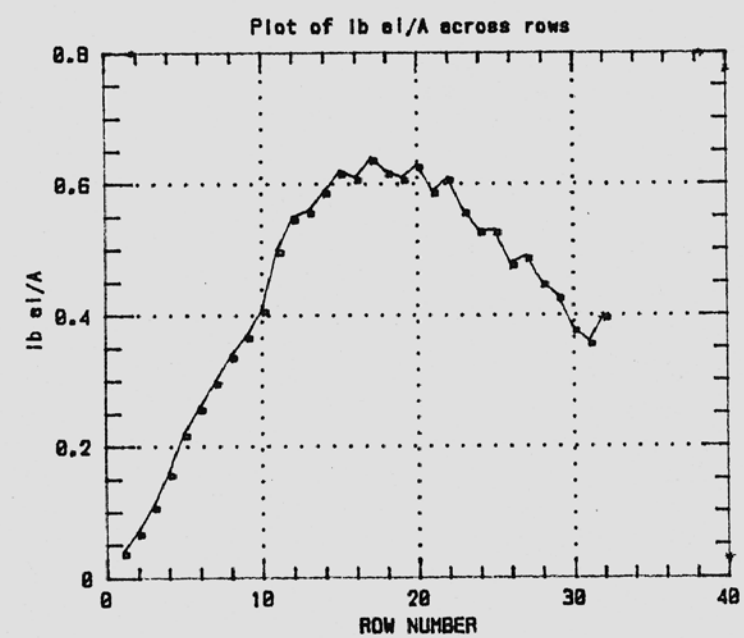

fig. 3 Injected rates of cinmethylin across rows.

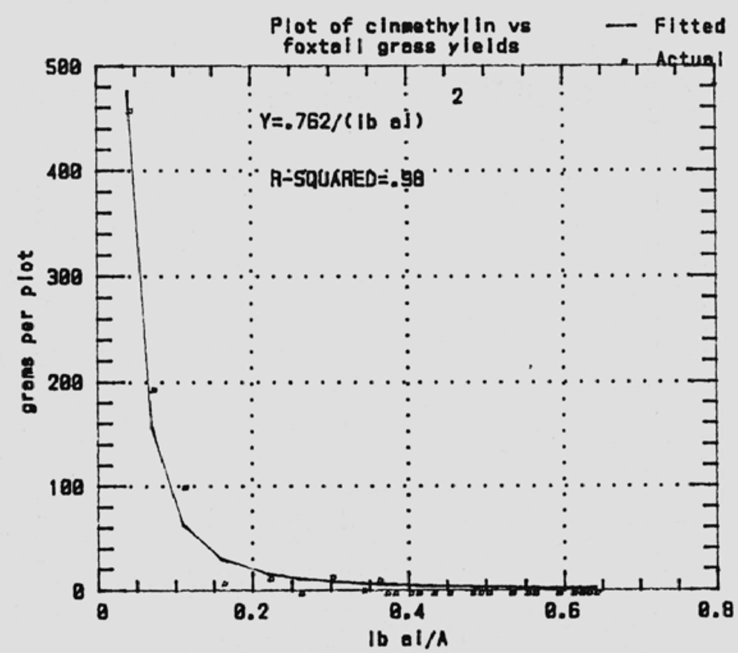

fig. 4 Green foxtail yields as a function of cinmethylin application.

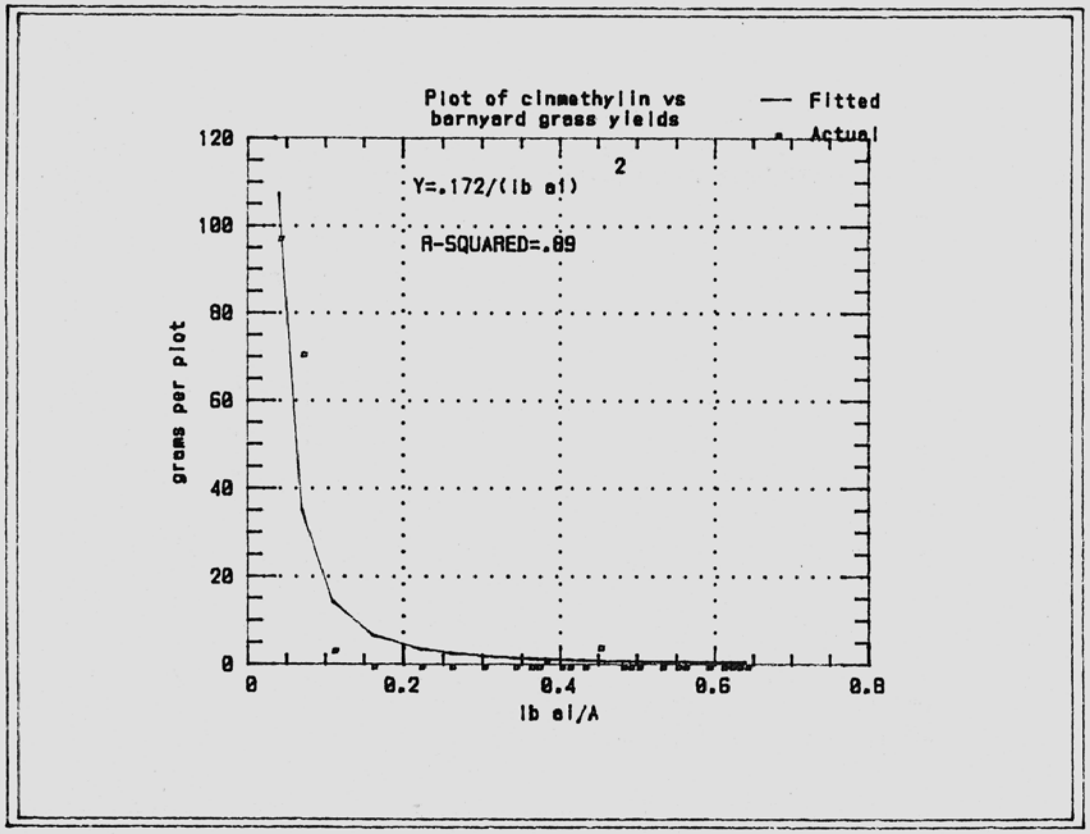

fig. 5 Barnyardgrass yields as a function of cinmethylin application.

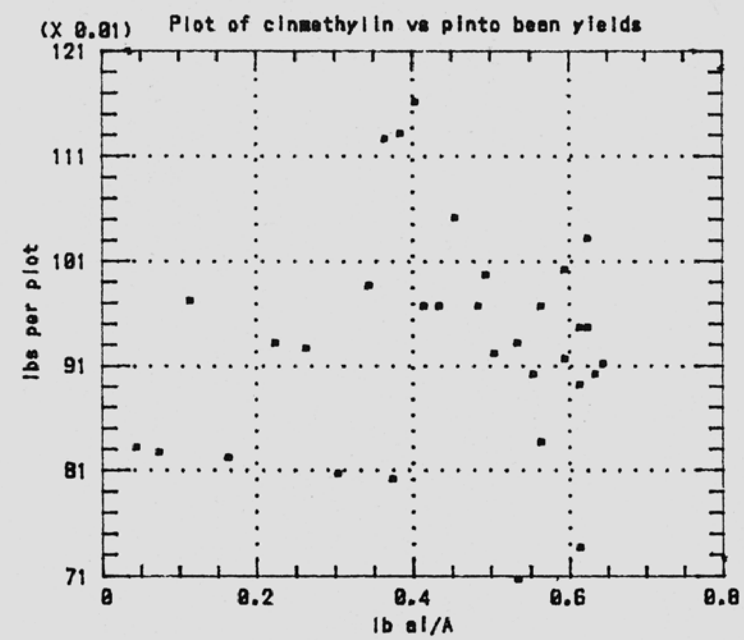

fig. 6 Pinto bean yields vs cinmethylin application.

Conclusions

1. The analyses show that there were a strong relationship between annual grass yields and lb ai/A of injected cinmethylin.
2. Rates of injected cinmethylin at the center line were more effective than expected, resulting in little or no correlation between weed and bean yields. Therefore, injected rates of cinmethylin should be reduced by 50% for further studies.
3. Rates of 0.3 and 0.4 lb ai/A injected cinmethylin were very effective in removing both annual grasses.
4. Pinto bean yields were not affected by injected cinmethylin rates.
5. Water applied through growing season should be measured to correlate irrigation into the analyses.

WILD PROSO MILLET CONTROL IN CORN

Stephen D. Miller[1]

Abstract. Wild proso millet (*Panicum miliaceum* L.) is becoming a serious weed problem in much of Wyoming's irrigated acreage. Wild proso millet is now present in Platte, Goshen and Fremont counties and could spread to others. Wild proso millet is a prolific seed producer and a vigorous competitor with crops. Field studies were conducted in Cassa, Wyoming, in 1986 to evaluate the efficacy of preplant incorporated, preplant incorporated/preemergence or preplant incorporated/postemergence treatments for wild proso millet control in corn (*Zea mays* L.).

Several treatments provided effective season-long control of wild proso millet. Preplant incorporated application of EPTC {S-ethyldipropyl carbamothioate} plus dichlormid {2,2,-dichloro-N,N-di-2-propenylacetamide} or cycloate {S-ethyl cyclohexlethylcarbamothioate} plus dichlormid followed by complementary preemergence applications of pendimethalin {N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine} alone or with cyanazine {2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methylpropanenitrile} and complementary postemergence application of cyanazine with tridiphane {2-(3,5-dichlorophenyl)-2-(2,2,2-trichlorethyl)oxirane} and/or pendimethalin looked good. Silage yields related closely to wild proso millet control and were 3.9 to 8.8 T/A higher in herbicide treated compared to untreated plots.

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[1]Plant Science Department, University of Wyoming, Laramie, Wyoming 82071

NEW HERBICIDE COMBINATIONS - WILL THEY SAVE CALIFORNIA RICE?

J.E. Hill, B.W. Brandon, D.E. Bayer, J.L. Pacheco, M.J. Holzer[1]

Environmental concern over the pollution of public waterways by the currently used rice herbicides in California has sharply restricted their use. As a result, rice growers have been mandated to prescribed water holding periods following the application of herbicides and encouraged to develop self-continued irrigation systems. Pollution levels have been greatly reduced but still approach recently established secondary and primary health action levels which, if exceeded, could halt the continued use of the herbicides. For example, secondary action levels as low as 1 ppb in the Sacramento River at the municipal drinking water intake could trigger the curtailment of the use of thiobencarb {S[4-chlorophenyl)methyl[diethylcarbamothioate}. Similarly, primary health action levels for thiobencarb, molinate {S-ethyl hexahydro-1H-azepine-1-carbothioate} and bentazon {3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H-one 2, 2-dioxide} have been set at 10, 15 and 8 ppb respectively.

Recirculating irrigation systems and ponding in set-aside acreage has resulted in a partial solution. The current herbicides, although effective, are not always compatible with the best water management practices for restricting water movement. The broadleaf herbicides, for example, require lowering or drainage to achieve adequate spray coverage on small weeds. The long-term solution to the problem of rice weed control in California will be the integration of: 1) improved water management systems, 2) cultural practices that minimize the infestation of weeds, and 3) new and improved herbicides that are compatible with best management practices and with minimal environmental impact.

The herbicides bensulfuron-methyl {methyl 2-[[[[[(4,6-dimethoxypyrimidin-2-yl)amino]carbonyl]amino]sulfonyl]methyl]benzoate}, and BAS 514 {3,7-dichloro-8-quinolinecarboxylic acid} were tested alone and in appropriate combination with each other and with the current rice herbicides to determine their spectrum of weed control and safety to rice. Two similar experiments were conducted in south Sutter County, California, and the Rice Experiment Station, Butte County, California. Basins of 0.005 A were separated by levees to prevent water movement of herbicides between plots and to allow independent regulation of water depth. Granular formulated herbicides were applied by hand broadcasting and sprayable formulations with a constant pressure CO_2 backpack sprayer. The combinations of bensulfuronmethyl with molinate or thiobencarb were prepared on a single granule. All treatments were applied into the water excepting fenoxaprop-ethyl, bentazon and MCPA which were applied to drained basins. Water was returned to the bentazon and MCPA treatments 24 hours after and to the fenoxaprop-ethyl 72 hours after the application.

The Sutter County location contained an array of broadleaf weed species including California arrowhead (<u>Sagittaria</u> <u>montevidensis</u>, Cham. & Schletc. SAGMO), ducksalad (<u>Heteranthera</u> <u>limosa</u> (Sw.) Willd. HETLI), roughseed bulrush (<u>Scirpus</u> <u>mucronatus</u> L. SCPMU), smallflower umbrellaplant (<u>Cyperus</u> <u>difformis</u> L. CYPDI) and redstem (<u>Ammannia</u> sp.) as well as watergrass (<u>Echinochloa</u>

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[1]Agronomy Extension, University of California, Davis, CA and Rice Experiment Station, Biggs; Botany Dept. UCD, Dupont Company, Menlo Park, CA

oryzoides. The Butte County location contained roughseed bulrush and a mixture of early and late watergrasses (Echinochloa oryzoides (Ard.) Fritsch, ECHOR and Echinochloa phyllopogen (Stapf) Koss).

Tables 1 and 2 show that bensulfuron-methyl controlled broadleaf weeds at highly acceptable levels but showed limited activity on watergrass. Bentazon, a widely used herbicide for broadleaf weed control in California rice, provided somewhat less broadleaf weed control than bensulfuron-methyl and no grass control. Fenoxaprop-ethyl provided watergrass control but did not control the broadleaf weeds. BAS 514 controlled watergrass at the Butte County location but failed to control this species at the Sutter County site. BAS 514 did not control broadleaf weeds at either location. Molinate and thiobencarb provided good watergrass control. Thiobencarb, although weak on the broadleaf weeds, provided good control of the two major sedges--smallflower umbrellaplant and roughseed bulrush.

Combinations of molinate, thiobencarb, BAS 514 and fenoxoprop-ethyl with bensulfuron-methyl gave nearly complete control of all watergrass and broadleaf weeds. Significant differences in yield at the Sutter County location were primarily due to watergrass interference (the most competitive of rice weeds) as reflected by significantly lower yields where broadleaf-only herbicides were applied (bentazon) and in the unexplained failure of BAS 514. Significant differences in yield at the Butte County location resulted primarily from barnyardgrass interference.

The results of these experiments indicated that several new herbicides show considerable promise for rice weed control. All of these new herbicides have relatively lower use rates than the conventional rice herbicides, thus reducing the potential for environmental loading of herbicides in water. Additionally, BAS 514 and bensulfuron-methyl are applied into the water with no requirement for field drainage. The compatibility of bensulfuron-methyl for formulation as a mixture of granules or on the same granule in combination with BAS 514, molinate or thiobencarb could reduce the number of applications needed to achieve complete broad spectrum rice weed control and thus reduce grower costs. The consistently moderate level of watergrass control by bensulfuron-methyl alone (5.5, Sutter County; 4.3, Butte County) may also allow for lowering of the rates of conventional watergrass herbicides, when used in combinations. Finally, none of these new herbicides of combinations will solve the problem of rice herbicide movement in the public waterways of California without the increased use of improved cultural management systems--especially recirculating irrigation systems.

SURFACTANTS EFFECTS OF QUIZALOFOP-ETHYL ON COTTON

A.A. Baber and R.S. Boyce

Abstract. Quizalofop-ethyl, {2-[4-[6-chloro-2-quinoxalinyl)oxy]phenoxy]-propionic acid, ethyl ester}, formerly DPX-Y6202, "Assure" Herbicide has been evaluated in irrigated cotton for selective control of perennial grasses such as bermudagrass (Cynodon dactylon) and johnsongrass (Sorghum halepense), and crop tolerance. Application of quizalofop-ethyl in combination with nonionic

[1]E.I. DuPont de Nemours & Co., Menlo Park, California

surfactants has provided excellent control of grasses with little or no injury to cotton foliage. Application of quizalofop-ethyl in combination with 0.5-1.0 percent of a paraffin based oil concentrate or emulsified crop oil has caused red to brown spotting on newly expanded cotton leaves. The leaf spotting appears directly related to temperature at time of application. This spotting has not been seen on leaves which develop after the herbicide application.

Because of the observed spotting on cotton foliage following applications made in combination with paraffin based oil concentrates or crop oil concentrates, only nonionic surfactants will be recommended for applications of quizalofop-ethyl in irrigated cotton.

BROADLEAF WEED CONTROL IN SAFFLOWER WITH POST EMERGENCE HERBICIDES

D.M. Wichman, G.R. Carlson, P.K. Fay and E.S. Davis[1]

Trifluralin is currently the primary weed control herbicide used in Northern Plains safflower (Carthamus tinctorius) production. Trifluralin provides satisfactory weed control under ideal conditions. However, under the dry, windy conditions frequently experienced in the Northern Plains during March and April, proper application of trifluralin is often difficult. Further, the required two preplant incorporations of trifluralin dry and loosen the soil contributing to poor stand establishment and increased erosion potential in a region already experiencing severe wind erosion. Therefore, post emergence herbicides were evaluated at Havre, Bozeman and Geraldine, Montana, for safflower weed control.

Safflower exhibited high tolerance to DPX-M6316 {methyl 3-[[(4-methyoxy-6-methyl-1,3,5-triazin-2-yl)amino carbonyl]amino sulfonyl]-2-thiophenecarbonylate} alone at: .125, .25 and .75 oz ai/a and to DPX-M6316 at .25 oz ai/a tank mixed with: sethoxydim {2-[1-(ethoxyimino)butyl]5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one} at 3.0 oz ai/a; DPX-Y6202 {2-[4-6-chloro-2-quinoxalinyl)oxy)phenoxy}propionic acid, ethyl exter} at 0.8 oz ai/a; and AC 222,293 {±methyl-6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2 yl)-m-toulate} at 6.0 oz ai/a applied early post emergence (safflower 2-8 leaves and weeds 2-6 lf). Safflower exhibited stunting and chlorosis 7-10 days after application but grew out of these symptoms within five weeks. Safflower exhibited significant foliar injury from the DPX-M6316 + fluazifop {(±)2-[4-[[5-(trifluoromethyl)-2-pyradinyl]oxy]phenoxy]propanoic acid} (.25 + 4.0 oz ai/a) tank mix as late as August 14 at the Bozeman site. However, it did not significantly affect seed yields at Moccasin and Havre.

The use of a non-ionic surfactant, at .125% and .25% v/v rates, improved DPX-M6316 control of common lambsquarters, (Chenopodium album), cowcockle (Vaccaria pyramida), tansy mustard (Descurainiai pinnata), field pennycress (Thlaspi arvense), redroot pigweed (Amaranthusy retroflexus) and kochia (Kochia scoparia). Tank mixes with AC 222,293 and the graminicides did not affect DPX-M6316 control of most broadleaf weeds and improved its control of others. However, AC 222,293 did appear to reduce DPX-M6316's control of Russian thistle at Havre. DPX-M6316 in tank mixes with AC 222,293 and the

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[1]CARC-MAES, Moccasin, Mt., NARC-MAES, Havre, Mt., P&S Dept. and Weed Lab. MSU, Bozeman, Montana

graminicides did not affect wild oat (Avena fatua) control. AC 222, 293 alone exhibited excellent control of wild and tansy mustards, common bedstraw and wild oats, fair-poor control of redroot pigweed, field pennycress, Russian thistle, kochia and poor control of common lambsquarters and cow-cockle.

POTENTIAL ALTERNATIVES TO DINOSEB FOR WEED CONTROL IN GREEN PEAS

Stott W. Howard[1]

Abstract. Cinmethylin {exo-1-methyl-4-(1-methylethyl)-2-[(2-methylphenyl)methoxy]-7-oxabicyclo[2.2.1]heptane}, chlorimuron ethyl {ethyl 2-[[[[(4-chloro-6-methoxypyrimidin-2-yl)amino]carbonxl]amino]sulfonyl]benzoate}, ethiozine {4-amino-6-(1,1-dimethylethyl)-3-(ethylthio)-1,2,4-triazine-5(4H)-one}, fenoxan {2-(2-chlorophenyl)methyl-4,4-dimethyl-3-isoxazolidinone} and lactofen {1′-(carboethoxy)ethyl-5[2-chloro-4-(trifluoromethyl)penoxy]-2-nitrobenzoate} were evaluated for use in green pea production in western Washington. In addition, treated pea plots were planted into logical rotation crops (wheat and barley) after peas were harvested to assess crop rotation restrictions. Preemergence applications of cinmethylin at 0.56, 0.84 and 1.12 kg/ha; ethiozine at 0.84 and 1.12 kg/ha; fenoxan at 0.28, 0.56 and 0.84 kg/ha; and lactofen at 0.28 and 0.14 kg/ha controlled a broad-spectrum of weeds without yield reductions or phytotoxicity to green peas. Chlorimuron ethyl at 24 and 32 g/ha and lactofen 0.56 kg/ha produced slightly abnormal plants and reduced the rate of green pea emergence, respectively. No injury was determined on successive plantings of wheat or barley in ethiozine or lactofen plots. However, there was noticeable rate dependent injury to wheat in fenoxan plots and barley in cinmethylin plots.

[1]Northwestern Washington Research and Extension Center, Washington State University, Mount Vernon 98273

POTATO RESPONSE TO SIMULATED DRIFT FROM THE TWO NEW HERBICIDES, DPX-L5300 AND DPX-R9674

Lloyd C. Haderlie[1]

Abstract. Two new herbicides to be registered for use in grain crops were applied to potato foliage to determine effects from low or sublethal doses. Russet burbank potatoes were planted May 12, 13, 1986, and grown in the field at Aberdeen, Idaho. DPX-L5300 {methyl 2 [[[[N-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]carbonyl[amino]sulfonyl]benzoate}at 0.00016, 0.0008, 0.0039 lb ai/A and DPX-R9674 {2:1 ratio methyl 3-[[(4-methoxy-6-methyl-1,3,5-triazin-2yl)amino-carbonyl]amino sulfonyl]-2-thiohene carbonylate + methyl 2-

[1]Assoc. Professor, University of Idaho, Dept. Plant, Soil & Ent. Sciences, Research & Extension Center, Aberdeen, Idaho

[[[[[3-(4-methoxy-6-methyl-1,3,5-triazin-2yl)N-methyl]amino]carbony]amino]-sulfonyl]benzoate} at 0.0005, 0.0024 and 0.0118 lb ai/A were sprayed July 14, 1986, with a backpack CO_2 propelled, 5.5 ft boom, hand sprayer. Potatoes were forming tubers at treatment time. Plot size was 12 by 50 ft with 6 by 40 ft sprayed and 6 by 25 ft harvested. Each treatment was replicated four times in a randomized complete block design. Foliar injury was apparent at the highest rates of each herbicide for several weeks with a wilted and stunted appearance. Leaf chlorosis was obvious for about two weeks. Tuber yields were reduced from 376 and 359 cwt/A for the lowest rates of DPX-L5300 and DPX-R9674, respectively, to 328 and 222 cwt/A for DPX-L5300 and 296 and 148 cwt/A for DPX-R9674 at the higher two rates. Untreated yield was 347 cwt/A. Malformed tubers were significantly higher for all rates of both herbicides than in the untreated plots. Tuber creases or folds occurred in over 80% of all tubers for all herbicide treatments and percentage of tubers with knobs increased to 95% at the highest rates for each herbicide. About 70% of all tubers were less than 4 oz at the highest rates.

HERBICIDE APPLICATION TO POTATOES THROUGH SPRINKLER

L.C. Haderlie and D.L. Cammack[1]

The purpose of this study was to determine annual weed control and crop tolerance in Russet Burbank potatoes with herbicides applied through a small plot simulated sprinkler system. Metribuzin {4-amino-6-(1,1-dimethylethyl-3-(methylthio)-1,2,4-triazin-5(4H)-one} at 0.1 and 0.25 lb ai/A, metribuzin + lactofen {(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate} at 0.25 + 0.25 lb ai/A and EPTC {5-ethyl dipropylcarbamothioate} + lactofen at 3.0 + 0.25 lb ai/A were applied preemergence to weeds and early postemergence to potatoes. Metribuzin at 0.1 was applied preemergence, with fluazifop-P-butyl {(R)-2[4-[[5-(trifluoromethyl-2-pyridinyl]oxy]phenoxy]propanate} at 0.188 lb ai/A being applied postemergence.

The soil was declo silt loam with 8.0 pH and 1.3% organic matter. Irrigation was by solid-set sprinklers. The experiment was a randomized complete block design with four replications for each treatment. Plot size for evaluation was 24 by 25 ft. with a 15 ft. border between plots.

Cut seed pieces were planted on May 12 and 13, 1986, with a two-row hand-assist feed planter. Seed was cut. The last cultivation and hilling was June 4, 1986. Preemergence treatments were applied between June 6 and 11, 1986. On June 6, approximately 5 to 10% potato emergence had occurred. By June 9, 50% of the potatoes had emerged, and on June 11, 97% emergence had occurred. Between July 3 and 7, the postemergence herbicide was applied. All herbicides were applied through a simulated sprinkler irrigator with a 24 ft. boom that moved back and forth on an overhead "H" beam for a 25 ft. distance. The simulated sprinkler system had low pressure impact sprinkler heads at 30 psi, spaced 6 ft. apart on the 24 ft. boom. There was at least 100% overlap for water.

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[1]University of Idaho Research and Extension Center, Aberdeen, Idaho

Table 1. Weed control in potatoes after herbicides were applied through a smiulated sprinkler system. Evaluations were made twice. Data are means of four replications

Chemical	Formulation	Rate (lb ai/A)	Application	% Injury	24 June 1986 % Control Redroot Pigweed	24 June 1986 % Control Common Lambsquarters	24 June 1986 % Control Green Foxtail	16 September 1986 % Control Redroot Pigweed	16 September 1986 % Control Common Lambsquarters	16 September 1986 % Control Green Foxtail
1. untreated				0	0	0	0	0	0	0
2. metribuzin	75 DF	0.1	Pre	1	100	99	96	98	93	97
3. metribuzin		0.25	Pre	1	100	100	98	99	99	99
4. metribuzin+lactofen	2 EC (lactofen)	0.25 + 0.25	Pre	44	100	100	100	100	100	99
5. EPTC + lactofen	7 EC (EPTC)	3.0 + 0.25	Pre	49	100	100	100	98	91	99
6. metribuzin+		0.1 +	Pre	1	97	100	91	92	95	98
fluazifop-P-butyl	1 E	0.188	Post							
LSD (0.05)				19	3	1	6	5	4	3
CV				79	2	1	5	4	3	3
Weed density (No. per m^2)					111	69	72			

Table 2. Potato tuber yield and percent in each grade following herbicide application through a simulated sprinkler system. Potatoes were harvested 2 and 3 October 86. Data are means of four replications

Chemical	Formulation	Rate (lb ai/A)	Application	Total Yield cwt/A	Total Yield t/ha	% of Total <4oz	% of Total 4-10oz	% of Total >10oz	% of Total No.1's	% of Total Malformed
1. untreated				334	38	22	60	13	73	5
2. metribuzin	75 DF	0.1	Pre	387	43	14	51	23	74	11
3. metribuzin		0.25	Pre	406	46	16	55	19	74	9
4. metribuzin+lactofen	2 EC (lactofen)	0.25 + 0.25	Pre	360	40	20	50	19	69	11
5. EPTC + lactofen	7 EC (EPTC)	3.0 + 0.25	Pre	369	41	20	53	14	67	13
6. metribuzin+		0.1 +	Pre	382	43	18	55	18	73	9
fluazifop-P-butyl	1 E	0.188	Post							
LSD (0.10)				37	4	ns	ns	5	ns	5
LSD (0.05)				45*	ns	ns	ns	6	ns	ns
CV				8	8	18	9	22	8	40

* The F test does not show significance, but the LSD at α=0.01 is a 63 cwt/A, indicating the good probability that there is a yield difference between the lowest and highest yielding plots.

Each plot had 100 gallons of water applied followed by the application of the herbicide in 60 gallons of water; then another 240 gallons of water. A total of 400 gallons (0.85 inches) of water was applied in about 35 min to each treatment plot.

Weed control was evaluated on June 24 and September 16. Weeds evaluated were green foxtail (Setaria viridis), common lambsquarters (Chenopodium album), and redroot pigweed (Amaranthus retroflexus). Weed control was over 90% for all treatments and most were at or near 100% (Table 1). However,there was statistically (at 0.05) lower control in September for common lambs-
quarters from EPTC + lactofen compared to the other treatments, except metribuzin at 0.1 lb ai/A.

Crop injury was evaluated on June 24. Treatments with lactofen (applied early postemergence)d were the only ones causing crop injury (44% and 49%) (Table 1). Potatoes outgrew the injury.

Plots were harvested October 2 and 3 and then weighed and graded October 24. Potato tuber yields were over 330 cwt/A and percent No. 1's were over 65% (Table 2). Metribuzin alone at 0.25 lb ai/A had the highest yield of 406 cwt/A. Where early severe crop injury did occur from lactofen, slightly lower yields (360 and 369 cwt/A) and reduction in No. 1's did occur (67 and 69%) (Table 2). However, the decrease was not statistically different at 0.05.

Metribuzin applied at the low rate (0.1 lb ai/A) gave excellent weed control, yields and grade (387 cwt/A, 75% No. 1's).

RESPONSE OF PROCESSING TOMATOES TO DIFFERENT DURATIONS OF FIELD BINDWEED COMPETITION

W. Thomas Lanini and Eugene M. Miyao[1]

Abstract. A field study was conducted during 1986 (summer) in Yolo County, California, to determine the influence of field bindweed (Convolvulus arvensis L.) competition on processing tomatoes. Plots were established and maintained relatively free of field bindweed for 5, 7, 10 or 12 weeks after which it was allowed to grow. Field bindweed was also allowed to grow in plots for 5, 7, 10, 12 weeks, or until harvest, after which it was removed. Maintaining plots free of field bindweed for 7, 10 or 12 weeks resulted in no higher yields than a 5-week period. When field bindweed was allowed to grow for 5 or more weeks before removal, yields were reduced. The longer field bindweed was allowed to compete before initial removal, the greater the yield reduction. Unweeded check plots yielded 19.1 tons per acre, approximately 50% less than the highest yielding plots.

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[1]University of California Cooperative Extension Service, Davis, California

CONTROL OF VOLUNTEER ASPARAGUS SEEDLINGS

Rick A. Boydston[1]

Introduction

Volunteer asparagus plants are a problem in established asparagus fields and in other crops. Volunteer asparagus seedlings harbor asparagus aphids and diseases, interfere with asparagus harvest and may reduce asparagus yield by competition for water and nutrients. Volunteer asparagus seedlings emerge from shallower depths than the crop and are spindly and fibrous making them unmarketable.

Volunteer asparagus control by herbicides is difficult to evaluate due to a mixed population of first year seedling volunteer asparagus and perennial volunteer plants, the latter being more difficult to control. This study focused on the control of first-year seedling asparagus by preemergence and postemergence herbicides.

Materials and Methods

Herbicides were evaluated for the control of seedling asparagus in field experiments conducted three times in the summer of 1986. Asparagus seeds were planted in separate tests conducted under furrow and sprinkler irrigation. All herbicides were applied preplant with a hand-held backpack sprayer delivering 187 L/ha at 276 kPa and then incorporated to a depth of 5 cm.

Results and Discussion

Under furrow irrigation, cinmethylin {exo-1-methyl-4-(1-methylethyl-2-[(2-methylphenyl)methoxy]-7-oxabicyclo[2.2.1]heptane} (1.1 kg ai/ha), diuron {N′(3,4-dichlorophenyl)-N,N-dimethylurea} (3.6 and 5.4 kg ai/ha), fluorochloridone {3-chloro-4-(chloromethyl)-1-[3-(trifluoromethyl)phenyl]-2-pyrrolidinone} (1.1, 2.2 and 4.5 kg ai/ha), hexazinone {3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-tiazine-2,4-(1H,3H)-dione} (4.5 kg ai/ha), napropamide (N,N-diethyl-2-(1-naphthalenyloxy)propanamide (6.7 and 9.0 kg ai/ha), oryzalin {4-(dipropylamino-3-5-dinitrobenzenesulfonamide} (4.5 kg and 6.7 kg ai/ha) and prodiamine {2,4-dinitor-N^3,N^3,-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine} (2.2 and 4.5 kg ai/ha) controlled 86% or more of seedling asparagus.

Under sprinkler irrigation, diuron (3.6 and 5.4 kg ai/ha), fluorochloridone (2.2 and 4.5 kg ai/ha), hexazinone (1.1, 2.2 and 4.5 kg ai/ha), norflurazon {4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone} (4.5 kg ai/ha), metribuzin {4-amino-6-(1,1-dimethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one} (2.2 and 3.4 kg ai/ha), oryzalin (4.5 and 6.7 kg ai/ha), prodiamine (2.2 and 4.5 kg ai/ha), simazine {6-chloro-N,N-diethyl-1,3,5-triazine-2,4-diamine} (1.8 and 3.6 kg ai/ha) and terbacil {5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyimidinedione} (0.9, 1,3 and 1.8 kg ai/ha) controlled 88% or more of seedling asparagus.

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[1]Agricultural Research Service, USDA, Prosser, Washington

Linuron {N'-(3,4-dichlorophenyl)-N-methoxy-N-methylurea} (2.8 kg ai/ha), trifluralin {2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine} (2.2 kg ai/ha) and EL 107 (0.3 kg ai/ha) did not control more than 80% of seedling asparagus under furrow or sprinkler irrigated trials.

Simazine, metribuzin, terbacil and hexazinone controlled asparagus seedlings well under sprinkler irrigation but required higher rates for equal control under furrow irrigation. Seed rows were planted 38 cm from the center of the furrow in the furrow irrigated tests. These four herbicides may have been more readily leached from the area adjacent to the furrow than the other herbicides tested.

In an established stand of furrow irrigated asparagus, hexazinone (4.5 kg ai/ha), metribuzin (2.2 and 3.4 kg ai/ha), napropamide (9.0 kg ai/ha), prodiamine (4.5 kg ai/ha) and terbacil (1.8 kg ai/ha) controlled 76% or more of volunteer asparagus and did not reduce spear number or spear weight of established asparagus during the year of treatment.

Herbicides applied postemergence were evaluated for seedling asparagus control in four tests in 1986. In two experiments, herbicides were applied when seedlings were 5 to 6 cm tall and had two to four stems. Glyphosate {N(phosphonomethyl)glycine} + 2,4-D {2,4-dichlorophenoxy)acetic acid} (1.0 + 1.8 kg ai/ha), oxyfluorfen {2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene} (1.1 kg ai/ha), dicamba {3,6-dichloro-2-methoxy-benzoic acid) plus 2,4-D (0.6 + 1.7 kg ae/ha) and glyphosate (5.6 kg ai/ha) controlled 70 to 81% of emerged asparagus seedlings.

In two other experiments, asparagus seedlings 15- to 20-cm tall with four to eight stems were treated. Glyphosate (5.6 kg ai/ha), glyphosate + 2,4-D (1.0 + 1.8 kg ai/ha) and dicamba + 2,4-D (0.6 + 1.7 kg ae/ha) gave the best control of asparagus seedlings at this stage, but all of the treatments tested gave less than 90% control.

DPX-R9674 (0.035 kg ai/ha) and bentazon {3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-oxide (2.2 kg ai/ha) injured seedling asparagus less than 20% regardless of the stage of application.

EVALUATION OF ACIFLUORFEN-SODIUM FOR ANNUAL PLANTED STRAWBERRIES (FRAGARIA X ANANASSA)

Harry S. Agamalian[1]

Introduction

The production of strawberries in California is mainly one of growing the crop as an annual. The primary method for weed control is with the use of methyl bromide as a preplant soil fumigant. Even with this practice, there are three major escape weeds: little mallow (*Malva parviflora*), California burclover (*Medicago polymorpha* L.) and whitestem filaree (*Erodium moschatum* (L.) L'He'r). The harvest season extends over an eight - nine month period, thus weeds such as common groundsel (*Senecio vulgarus* L.) and annual sowthistle (*Sonchus oleraceus* L.) may be introduced with windborne seeds. The objectives of these experiments were to evaluate acifluorfen-sodium {5-[2-chloro-4-(triflouromethyl)phenoxy]-2-nitrobenzoic acid} on four

[1]Farm Advisor, Weed Science, U.C. Cooperative Extension, Salinas, California 93901

varieties: Chandler, Heidi, Pajaro and Selva and to determine a method of application for maximizing strawberry selectivity. Although there are several existing registered herbicides for strawberries, their utilization by growers has been restricted because of performance and/or crop selectivity. The fate of methyl bromide as a continued pesticide has been questioned by regulatory agencies; the loss of this biocide would greatly affect weed control practices.

Materials and Methods

The three-year study included preplant and postplant preemergence applications to dormant transplants. In California, dormant refers to a plant held in cold storage and transplanted in September through November, depending upon variety. The plant grows vegetatively through autumn and bears fruit in late winter - early spring. Experimental design was a complete randomized block design with four replications. Plot size was generally 10 or 15 sq. meters. Experimental locations were extended over several soil types but two soil textures were used mainly. These were Elkhorn fine sandy loam: 88.8% sand, 5.3% silt, 6.2% clay and 0.8% O.M; and Chualar loam: 50.1% sand, 31.5% silt. 18.4% clay, 1.2% O.M.

Acifluorfen was applied at 0.28, 0.56, 0.84 and 1.12 kg/ha active ingredient. The herbicide was applied in 325 l/ha using a CO_2 backpack sprayer. Preplant applications were made to preformed beds, followed by transplanting within 24 hours. Postplant applications were made to recent transplants. All treatments were followed by sprinkler irrigation within 24 hours. In most situations the amount applied was 2.5 cm of water.

Efficacy evaluations (% weed control) were made on indigenous weeds at the respective sites. Strawberry tolerance, phytoxicity data was collected on a visual scale, runner weights and fresh fruit yields.

Results and Discussion

Initial experiments conducted in 1984 with Pajaro and Heidi varieties were designed to establish the most effective application method for acifluorfen selectivity. These studies indicated that preplant application, followed by transplanting into the treated soil, provided greater selectivity than postplant treatments. This was evident at the higher rates of 0.84 and 1.12 kg/ha. Besides strawberry tolerance considerations, the practical application of spraying the herbicide before planting lends itself to a better management system than spraying the herbicide after planting. The timeliness of moving sprinkler systems into the field and avoiding spray drift to transplanting crews becomes important to the California grower (see Tables 1 and 2).

Strawberry selectivity data was obtained from harvested runner weights 85 days after treatment. Runners are normally pruned in California strawberry culture to force growth toward crown development. In one study with the variety Chandler, significant differences in runner weights were evident at the 0.84 and 1.12 kg/ha over the weeded control. Runner weights from Pajaro showed no significant differences in runner weights at 0.28, 0.56, 0.84 and 1.12 kg/ha yield data obtained from the respective experiments, usually in six-week harvest periods. Acifluorfen at 0.28, 0.56 and 0.84 kg/ha resulted in no significant yield differences from Chandler, Heidi Pajaro or Selva when applied as a preplant application. Postplant applications to Heidi in one experiment resulted in significant yield differences at the 0.84 kg/ha rate. In one experiment with Chandler, measurements of mean

Table 1. Yield Data From Two Methods of Application to Variety Pajaro

STRAWBERRY VARIETY PAJARO
Preplant/Postplant

Treatment	lb/A	Berry Yield/Plot
Acifluorfen	0.5 p	1706
Acifluorfen	0.5 pp	1770
Napropamide	4.0 p	1521 A
Control	0	1693

p = Preplant surface
pp = Postplant preemergence

STRAWBERRY VARIETY PAJARO
Preplant/Postplant

		Berry Yield Gm/Plot/6 Weeks			
Treatment	Lb/A	4-5/1	5-6/26	6/26-8/7	8/7-9/18
Acifluorfen	0.5 p	374	761	333	238
Acifluorfen	0.5 pp	396	803	340	230
Napropamide	4.0 p	327	673	315	205
Control	0	427	735	306	223

p = Preplant surface
pp = Postplant preemergence

Table 2. Comparison of Two Methods of Application on Variety Heidi

STRAWBERRY SELECTIVITY
Variety Heidi - 48 D.A.T.

Treatment	Lb/A	% Plant Vigor Preplant	Postplant
Acifluorfen	0.25	98.2	98.0
Acifluorfen	0.5	98.0	96.2
Acifluorfen	0.75	96.0	94.0
Napropamide	4.0	99.3	99.5
Control	0	99.8	99.8

Table 3. Strawberry Tolerances To Acifluorfen Measured by Runner Weights

STRAWBERRY VARIETY CHANDLER
Runner Evaluation - 85 D.A.T.

Treatment	Lb/A	Dried Wt Gm/ Plot	Runner Count/ Plant
Acifluorfen	0.5	521.0 A	5.8
Acifluorfen	0.75	391.0 B	5.1
Acifluorfen	1.0	468.0 B	5.1
Control	0	567.0 A	5.8

STRAWBERRY VARIETY PAJARO
Runner Evaluation - 60 D.A.T.

Treatment	Lb/A	Runner Count	Dried Wt. Gm/Runner
Acifluorfen	0.5 p	33.7 A	4.6 A
Acifluorfen	0.5 pp	39.0 A	4.4 A
Napropamide	4.0 p	18.2 B	3.1 B
Control	0	39.7 A	5.0 A

p = Preplant surface
pp = Postplant preemergence

Table 4. Strawberry Quality and Yield Data

1986 YIELD DATA - STRAWBERRY RESEARCH STATION
VARIETY CHANDLER - WATSONVILLE, CALIFORNIA

	Treatment	lbs/A	1 - 6 Weeks Gm/Plot	6 - 12 Weeks Gm/Plot	12 - 18 Weeks Gm/Plot	$\bar{X}$ Gm Per Berry	Fruit Firm-ness Index	Total Crates Per Acre
1.	Acifluorfen	0.5	505	708	139	23.4	6.4	2634 A
2.	Acifluorfen	0.75	419	600	124	22.6	5.9	2317 B
3.	Acifluorfen	1.0	425	743	168	24.1	5.4	2659 A
4.	Metolachlor	2.0	397	647	132	24.9	5.8	2234 B
5.	Metolachlor	4.0	392	467	88	24.4	6.7	1755 C
6.	Control	0	489	704	138	22.9	5.8	2575 A

Table 5. Efficacy of Acifluorfen on Three Weed Species

WEED CONTROL EVALUATIONS
Summary - 4 Experiments

Treatment	lb/A	Little Mallow	Red Stem Filaree	California Burclover
Acifluorfen	0.25	8.5	8.2	7.0
Acifluorfen	0.5	9.5	9.0	9.0
Aciflourfen	0.75	10.0	10.0	10.0

berry weight and fruit firmness resulted in no significant differences at 0.56, 0.84 and 1.12 kg/ha dosage when compared to the weeded control (see Tables 3 and 4).

Of the three major escape weeds evaluated in these experiments, excellent control was obtained with little mallow at all dosages. Burclover and whitestem filaree control was 80% or better with 0.56 kg/ha, but less effective at 0.28 kg/ha. Residual control of these three species was evident for 150 days following treatment (see Table 5).

Conclusion

The information collected in the three-year study, 1984 - 1985 and 1986 season indicates excellent selectivity with acifluorfen on California strawberry varieties. The most effective and selective method of treatment is a preplant application. This project has been partially funded by the IR-IV program. Cooperating personnel from other institutions indicate similar results. Analysis of fruit for a 60-day PHI is underway at this time. The registration of acifluorfen for California strawberries would greatly improve present day weed management systems.

ISOXABEN FOR BROADLEAF WEED CONTROL IN ORNAMENTALS, TURF AND NONBEARING TREES AND VINES

F.O. Colbert and D.H. Ford[1]

Research by university and Eli Lilly and Company scientists from 1979 to 1986 has resulted in the development of isoxaben, a new selective preemergence surface applied herbicide for use in ornamental plantings, turf and in orchard crops. Isoxaben is an amide with the chemical name N-[3-(1-Ethyl-1-methylpropyl)-5-isoxazolyl]2,6-dimethoxy-benzamide. Isoxaben is commercially marketed in Europe for broadleaf weed control in small grains (2). Weed control in small grains and sunflower in North America has been reported (1). In our research isoxaben has been found to be herbicidally active on many broadleaf weeds while exhibiting excellent safety to ornamentals, established turf and orchard crops. The weed control spectrum of isoxaben is complementary to oryzalin, a dinitroaniline herbicide currently marketed by Elanco Products Company, a division of Eli Lilly and Company.

The objectives of this paper are to report the research results regarding (1) the chemical and physical properties of isoxaben which make it an effective surface applied herbicide, and (2) the biological response to desirable and weedy plants to isoxaben pre- and postemergence applications.

Chemical and Physical Properties

Table 1 presents selected chemical and physical properties of isoxaben as compared to oryzalin.

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[1]Senior Research Scientist and Research Advisor, Lilly Research Laboratories, Fresno, California

Table 1. Selected physical and chemical characteristics of isoxaben as compared to oryzalin.

Property	Isoxaben	Oryzalin
Vapor Pressure mm Hg, 30 C	< 3.9 x 10 -7	< 1 x 10 -7
Water Solubility PPM, 25 C	1	2.5
Soil/Water Distribution Coefficient Kd	6.5 - 13	5 - 15
Soil Half-Life T 1/2 Month	3-6	1-3

In comparison with oryzalin, isoxaben has a similar vapor pressure and tends to be stable when exposed to UV light under field conditions. Thus, like oryzalin, isoxaben can be surface applied and activated by rainfall or sprinkler/flood irrigation with minimal loss.

The surface stability of isoxaben was confirmed in experiments conducted in 1985 and 1986 at Fresno, California (Table 2).

Table 2. Percent control of field grown bioassay species with isoxaben from 1985 and 1986 soil surface exposure[1]

		Soil Surface Exposure Prior to Incorporation: 1985[2] (15 Days) % Control, Months After Appl.				1986[3] (28 Days) % Control, Months After Appl.	
Compound	Rate[4] Kg/Ha	1	3	6	12	1	6
Isoxaben	0.28	99	93	100	99	97	95
Oryzalin	2.24	85	92	98	63	--	--

[1]Bioassay species were Indian mustard (Brassica juncea) for isoxaben and annual grass weeds for oryzalin.

[2]Experiment established on bare ground August, 1985, with maximum air temperatures of 32 to 35 C and soil temperature at 1.25 cm depth of 48 to 52 C for the 15-day surface exposure period, at which time 0.425 cm of rainfall was received. The 75 percent dry flowable formulation (75DF) of isoxaben was used in studies reported within this paper.

[3]Experiment established on bare ground in August, 1986, with maximum air temperatures of 34 to 42 C and soil temperatures at 1.25 cm depth of 46 to 55 C for the 28-day surface exposure period, at which time 5 cm of sprinkler irrigation was applied to the experimental area.
4All compound rates represented in this paper are in active ingredient.

In field trials exposed to excessive rainfall or irrigation, isoxaben leached slightly more than oryzalin (Table 3), but the major portion remained in the weed germination zone (Table 4). In selected trials shallow cultivation (tillage), 2.5 to 7.5 cm deep, did not decrease herbicidal efficacy.

Table 3. Percent of assayed isoxaben and oryzalin found in the upper soil profile at 29 and 92 days after surface application of the chemicals[1]

Sampling Depth	% Isoxaben		% Oryzalin	
	Days After Application			
(cm)	29	92	29	92

[1]The experiment was established in Fresno, California, on October 18, 1985, with soil texture as described in Table 4. Isoxaben 75DF at 1.12 kg/ha and oryzalin 85DF at 3.36 kg/ha were surface applied to bare ground and received 1.4 cm of sprinkler irrigation within three hours after application. Total rainfall and irrigation moisture was 15.5 and 23.6 cm at 29 and 92 days after application, respectively. All assays were run on 20 composite soil subsamples drawn from three replicates.

Table 4. Percent isoxaben distribution and amount remaining in the upper soil profile[1]

Sampling Depth (cm)	% Isoxaben Months After Application 0	3	8	12
0- 7.5	104	58	15	11
7.5-15	-	6	3	6
15-22.5	-	1	1	2
22.5-30	-	-	-	1
30-37.5	-	-	-	NDR
37.5-45	-	-	-	NDR
Total[2]	104 (107)	65 (79)	19 (27)	20 (21)

[1]Isoxaben 75DF was surface applied at 1.12 kg/ha to a clay loam soil type (28% sand, 38% silt, 34% clay, O.M. 1.2%) and received 1.4 cm of sprinkler irrigation within three hours after application. Total rainfall and irrigation moisture was 23.6, 44.6, and 125 cm at 3, 8 and 12 months after application, respectively.
[2]Values in ( ) are results from a second treatment of isoxaben applied at 1.12 kg/ha within the same experiment. All assays were run on 20 composite soil subsamples drawn from three replicates.

These results demonstrate that greater than 75% of the isoxaben for the three- and eight-month samplings remains in the upper 7.5 cm of the soil profile and greater than 50% of the original concentration remains in the upper 7.5 cm at the one-year sampling. These results are in agreement with Huggenberger and Ryan in that the major portion of isoxaben remains in the upper 15 cm of the soil profile (3). These data indicate a soil half-life of approximately five months with 20% of the applied herbicide remaining after 12 months. This agrees with results from Europe (2, 3) and unpublished data from Lilly Research Laboratories.

Biological Activity

Desirable Plant Tolerance: Research results from over 50 trials have demonstrated that newly planted ornamentals and orchard crops and established turf are tolerant to isoxaben at rates up to 2.24 kg/ha (Tables 5 and 6).

Table 5. Landscape trees and orchard species tolerant to soil surface application of isoxaben at rates up to 2.24 kg/ha[1]

Type	Common Name	Scientific Name
Trees		
	Ash	Fraxinus spp.
	Birch	Betula spp.
	Elm	Ulmus spp.
	Eucalyptus	Eucalyptus spp.
	Liquidambar (Sweetgum)	Liquidambar spp.
	Maple	Acer spp.
	Oak	Quercus spp.
	Pine	Pinus spp.
	Sycamore	Platanus spp.
	Willow	Salix spp.
Nonbearing Orchard Crops		
	Almond	Prunus amygdalus
	Apple	Malus sylvestris
	Grape	Vitis vinifera
	Nectarine	Prunus persica nectarina
	Orange	Citrus sinensis
	Pear	Pyrus communis
	Peach	Prunus persica
	Pecan	Carya illinoensis
	Plum	Prunus salicina
	Walnut	Juglans spp.

[1]Research trials by University of California Cooperative Extension and Lilly Research Laboratories personnel with each species observed in two or more trials.

Table 6. Shrubs, ground covers and established turf tolerant to over top sprays of isoxaben at rates up to 2.24 kg/ha[1]

Type	Common Name	Scientific Name
LANDSCAPE ORNAMENTALS:		
Shrubs		
	Agapanthus	Agapanthus spp.
	Bottlebrush	Callistemon spp.
	Oleander	Nerium spp.
	Pittosporum	Pittosporum spp.
	Privet	Ligustrum spp.
	Pyracantha	Pyracantha spp.
	Raphiolepis	Raphiolepis spp.
	Rhododendron	Rhododendron spp.
Ground Covers		
	Gazania	Gazania spp.
	Iceplant	Carpobrotus, Drosanthemum spp.
	Ivy	Hedera spp.
	African Daisy	Osteospermum fruticosum
TURF:		
Warm Season		
	Bermudagrass	Cynodon dactylon
	St. Augustinegrass	Stenotaphrum secundatum
Cool Season		
	Bluegrass, Kentucky	Poa pratensis
	Bentgrass	Agrostis spp.
	Fescue	Festuca spp.
	Ryegrass, perennial	Lolium perenne

[1]Research trials by University of California Cooperative Extension and Lilly Research Laboratories personnel with each species observed in two or more trials

Table 7. Plant growth response from surface application of isoxaben 75DF[1]

Treatment	Rate Kg/ha	Trunk Measurement: Nonbearing Almond	Trunk Measurement: Red Gum Eucalyptus	Percent Visual Crop Injury: Red Gum Eucalyptus	Percent Visual Crop Injury: Monterey Pine
		% Control (10 months After Appl.)		(3 Months After Appl.)	
Isoxaben	2.24	134	164	17	37
Isoxaben+ Oryzalin	2.24+ 6.72	142	167	30	53
Oryzalin	4.48	134	159	7	23
Weedy Control	0	(151.7)[2]	(77.3)	0	0

[1]Isoxaben was directed sprayed to almonds seven months after planting and overtop sprayed to eucalyptus and pines (5-cm-square liner stock, 25 cm tall) at 24 days after planting.
[2]Value in ( ) equals trunk circumference in mm at 15 cm above soil level.

Results shown in Table 7 demonstrate the excellent safety from isoxaben applications to well established almond plants; whereas, in the case of newly planted eucalyptus and pine seedlings, early visual injury was observed. This injury was due to isoxaben movement into the young-developing, shallow root system from over-head moisture

In one field trial at Fresno, California, newly planted plums were treated with elevated rates of isoxaben for three consecutive years, and the crop exhibited no visual injury. Tree growth measurement results are presented in Table 8.

Table 8. Tree trunk measurements as percent of control taken at three times after planting[1]

Treatment	Rate Kg/ha	Cumulative Rate (Kg/Ha) 3 Yrs.	Trunk Measurement % of Control (Months After Planting) 13	25	29
Isoxaben	4.48	13.44	153	148	148
Isoxaben+ Oryzalin	1.12+ 4.48	3.36+ 13.44	150	147	141
Oryzalin	4.48	13.44	145	130	135
Weedy Control[2]	0	0	(86.7)	(155.7)	(196.2)

[1]July Santa Rosa plums were planted on 03/16/84 and treated on 03/30/84, 03/30/85 and 04/12/86. Trial was established on a loam soil type with 1% organic matter content.
[2]Value in ( ) equals trunk circumference in mm at 15 cm above soil level.

Weeds Controlled: Table 9 reports a summary of Lilly Research Laboratories and University of California trials from surface application of isoxaben at rates of 0.28 to 1.12 kg/ha. Results of broadleaf weed species controlled within U.S. trials are comparable to European data (2).

Table 9. Representative weeds controlled (95%+) from surface applications of isoxaben[1]

Rate (Kg/ha)	Common Name	Scientific Name
0.28 to 0.56		
	London Rocket	Sisymbrium irio
	Mustards	Brassica spp.
	Shepherdspurse	Capsella bursa-pastoris
	Tansymustard	Descurainia pinnata
	Lance-leaved ground-cherry	Physalis lanceifolia
0.56 to 0.84		
	Chickweed, Common	Stellaria media
	Clovers	Trifolium spp.
	Fleabane, Blackleaved	Conyza bonariensis
	Horseweed	Conyza canadensis
	Pigweeds	Amaranthus spp.
	Purslane, Common	Portulaca oleracea
	Sowthistle, common (annual)	Sonchus oleraceus
	Woodsorrel, Creeping (from seed)	Oxalis corniculata
0.84 to 1.12		
	Filaree, Whitestem	Erodium moschatum
	Groundsel, Common	Senecio vulgaris
	Lambsquarters, Common	Chenopodium album
	Spurge, Spotted	Euphorbia maculate

[1]Data on each weed species observed in two or more trials.

Control of little and dwarf mallow (Malva spp.), wild oat (Avena fatua), barnyardgrass (Echinochloa crus-galli) and perennial weeds; i.e., field bindweed (Convolvulus arvensis) from isoxaben applications at 1.12 to 2.24 kg/ha has been erratic or poor.

When problem weeds exist that are not controlled satisfactorily with isoxaben, a combination treatment may be desirable. Isoxaben 75DF has been found to be compatible with glyphosate, paraquat, oryzalin, trifluralin and several auxin-type herbicides. An example of the complementary weed control spectra that can be obtained from two such combinations is presented in Table 10.

Table 10. Percent control of selected weeds from tank mix combination applications of isoxaben + oryzalin.

		Expt. 1 Coarse Soil Type % Control		Expt. 2 Medium Soil Type % Control	
Treatment	Rate Kg/ha	Common Groundsel	Wild Oat	Lanceleaf Ground-cherry	Barn-yard grass
Isoxaben	0.84	100	87	100	73
Isoxaben+ Oryzlin	0.84+ 2.55	100	100	100	100
Oryzalin	4.48	90	97	43	97

[1]Visual percent control rating taken at 1 to 3 months after application from trials established in Fresno, California.

SUMMARY

Seven years of laboratory, greenhouse and field testing have demonstrated isoxaben is an effective surface applied preemergence broadleaf weed herbicide and is selective on newly planted ornamental crops, established turf and nonbearing trees and vines. Eli Lilly and Company has submitted to the Environmental Protection Agency for registration of isoxaben for this use.

Literature Cited

1. Banks, J.C. et al. 1986. Evaluation of Isoxaben for weed control in small grains and sunflower. Abstracts Weed Science Society of America, 26-33.

2. Huggenberger, F., E.A. Jennings, P.J. Ryan, K.W. Burow. 1982. EL-107, A new selective herbicide for use in cereals. Proceedings 1982 British Crop Protection Conference. Weeds 1, 47-52.

3. Huggenberger, F., P.J. Ryan. 1985. The biological activity of EL-107 and its mobility and degradation in soil. Proceedings 1985 British Crop Protection Conference. Weeds. 947-954.

USE OF BETWEEN-ROW (DIRECTED) HERBICIDE BANDS FOR WEED CONTROL DURING ESTABLISHMENT OF GRASSES GROWN FOR SEED

George W. Mueller-Warrant[1]

Introduction

The period of establishment of new stands of grasses grown for certified seed production represents a critical phase for control of weeds. Two primary methods for weed control during this establishment period are currently in use: (1) the carbon-banding, broadcast-diuron {3-(3,4-dichlorophenyl)-1-1-dimethylurea} system for fall-planting developed by W.O. Lee in the 1970's, and (2) the chemical (stale) seedbed system for late winter-planting. Concerns over the high cost of activated charcoal used in the first system and the difficulty of operating planting equipment in wet soils in the second have led to grower interest in developing a less costly system for weed control during establishment of fall plantings. Banding of non-selective rates of simazine {6-chloro-N,N'-dimethyl-1,3,5-triazine-2,4-diamine} between rows at planting has been tried by seed growers, with widely varying results in terms of crop safety and weed control.

Objectives of this study were to compare several possible herbicides and banding patterns in terms of crop safety and weed control efficacy. These comparisons were made in reference to each other and to the standard method for controlling weeds during fall plantings of grass, i.e., use of activated charcoal in the row in conjunction with broadcast application of diuron. Five herbicides were selected for use in bands based on criteria including cost, spectrum and longevity of weed control, stability when applied to dry soil surface and resistance to leaching and horizontal movement in the soil. Banding patterns were chosen to be representative of those giving erratic results in preliminary grower tests. Treatments were chosen in full recognition of the fact that not all combinations of herbicides, rates and banding patterns could be tested at any one time.

Materials and Methods

Herbicides tested in 1986-86 season included simazine at 2.2 kg/ha in treated zone, propazine {6-chloro-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine} at 2.2 kg/ha, prometryn {N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine} at 3.3 kg/ha, diuron at 1.8 kg/ha and prodiamine {2,4-dinitro-N,N-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine} at 1.1 kg/ha. Standard checkplot treatment has charcoal banded at 336 kg/ha in 2.5 cm wide zones over the crop rows + broadcast application of diuron at 2.7 kg/ha, both with and without post-emergence application of ethofumesate at 1.1 kg/ha. One group of treatments included four herbicides broadcast pre-planting, relying on the row openers on the planter to move treated soil away from the crop seeds. Other groups of treatments consisted of herbicides applied in bands between the crop rows, leaving 5.0, 3.8 or 2.5 cm wide untreated zones over the rows with a spacing of 30.5 cm between the rows. A four-row John Deere Precision Planter was modified to spray directed bands of herbicides through nozzles in a boom located behind the press wheels.

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[1]National Forage Seed Production Res. Center, USDA-ARS, Corvallis, OR

Crops planted included HW-1 annual ryegrass, Fawn tall fescue and Hallmark orchardgrass. Planting was done from Sept. 30 - Oct. 3, and plots were sprinkler irrigated with 2.5 cm of water on Oct. 4 and again on Oct. 9. Fall rains began in mid-October, and good emergence of the crops had occurred by Oct. 25. Severe weather with very poor growing conditions began on Nov. 12 and lasted through Dec. 31. Alternating freezing and thawing of the soil occurred on a nearly daily basis during this time.

Soil samples were taken in the early morning hours of Nov. 12-14 while the soil was still frozen from plots that had been treated with simazine in various banding patterns. Samples were approximately cube shaped with edges 15 cm in length. Samples were dried at room temperature and stored for six months before analysis. At that time, they were subdivided into cross-sections 1.5 cm in height by 1.0 cm in width by 15 cm in length parallel to the crop row. Division of the soil was performed using knives to cut the soil apart while it was held in place in a specially designed box which exposed one section of the soil at a time. Early analyses revealed that detectable levels of simazine existed only within the upper 2 or 3 cm of the soil surface; therefore only the upper two 1.5 cm deep zones of soil were subdivided in these samples. Samples weighed an average of approximately 25 grams. Dry samples were extracted for 1 hour on a wrist action shaker with a mixture 18 ml methanol plus 7 ml distilled water per 25 grams of soil, filtered through Whatman #42 paper, dried at 50 degrees C, redissolved in 2.5 ml methanol containing 0.5 ppm (w:v) propazine and injected without further cleanup into an HP 5890A gas chromatograph with a Carbowax 20M column and an NP-specific detector. Lower limit of detection of simazine was approximately 0.025 nanograms simazine per microliter injected, which corresponds to about 6 ppb simazine in the soil using these extraction procedures.

Responses evaluated included visual ratings of crop injury, stand, weed control and chemical analysis of soil sections for simazine content. Visual ratings of crop injury, stand and weed control were made on Nov. 12, March 14 and June 13. Soil samples were taken on Nov. 12-14. No seed yield data was recorded, but yield was obviously highly correlated with crop stand. Only annual ryegrass developed sufficiently to produce any seed this year.

Results and Discussion

Germination of tall fescue, orchardgrass and annual ryegrass was generally excellent and very early growth did not show noticeable herbicide injury symptoms except for the case of prodiamine in treatments #3 and 16. No crop seedlings or weeds emerged through broadcast prodiamine (treatment #3), and only a very few crop seedlings came up in the 2.5-cm wide untreated band of treatment #16, with most of those dying later in the fall. Prodiamine continued to provide good weed control throughout the winter and spring but was clearly not well suited to use as a directed band spray at planting time.

Stands were up well by Oct. 25, and injury from broadcast herbicide treatments #4, 5 and 6 became evident during the following two weeks, which would correspond to the time of the normal exhaustion of seed reserves and the onset of reliance on photosynthesis. Injury in these treatments was quite severe by Nov. 12 when it was rated, and many of the surviving plants continued to decline in vigor until their death later in the fall. This period of declining vigor coincided with repeated night-time freezing and daytime thawing of the soil, and a similar decline occurred in many of the banded herbicide treatments. Orchardgrass appeared to be more sensitive to frost damage than tall fescue and annual ryegrass. The repeated frosts caused damage to crops in all treatments, and even the carbon-banded check plots showed moderate levels of crop injury (stand reduction) compared to weedy border strips without any herbicide.

The carbon-banded check was the safest treatment for establishment of each of the three grasses. Addition of ethofumesate to this standard treatment caused only minor injury to tall fescue and annual ryegrass, but virtually destroyed the seedling orchardgrass.

In the case of tall fescue, the most successful banded herbicide treatment was #12, diuron using a 2.5-cm wide untreated zone. Treatment #7, simazine applied using a 5.0-cm wide untreated zone, was almost as good as treatment #12. Treatment #8, simazine with a narrower untreated zone, caused more injury than #7. Treatments #9, propazine, and #13, another simazine band, were roughly equivalent to #8 in terms of crop damage, and damage with all three was probably a little too severe to be acceptable to growers. The general order of damage to tall fescue by the herbicides was prodiamine > prometryn > propazine > simazine > diuron.

For establishing orchardgrass, the most successful banded herbicide treatment was #15, prometryn. Treatment #12, diuron using 2.5-cm wide untreated band, was not quite as safe, and level of injury may have been a little too severe for grower use. All other banded treatments generally caused unacceptably high levels of crop damage. The general order of damage to orchardgrass by the herbicides was prodiamine > propazine >= simazine > diuron > prometryn.

For establishing annual ryegrass, the most successful banded herbicide treatments were #7 and 8, simazine using 3.8 and 5.0-cm wide untreated zones. Treatments #12 and 15, diuron and prometryn using 2.5-cm wide untreated bands, were almost as good as treatments #7 and 8. Injury from prometryn in treatments #10 and 15 tended to be erratic from plot to plot, possibly due to changes in spray pattern related to travel into or away from the wind during planting of individual plots. Treatment #9, 13 and 14 all caused extremely severe crop damage, much more than could be tolerated by growers. The general order of damage to annual ryegrass by the herbicides was prodiamine > propazine > prometryn = diuron >= simazine.

The highest levels of simazine were recovered from treatment #4 and were equivalent to about 0.7 kg/ha in a 10-cm wide band extending 5 cm to each side of the row. With this treatment, there was no meaningful reduction in simazine content even in the zone directly over the row, implying that the planter had failed to push enough soil to the side to reach untreated soil. This finding is in agreement with visual observation of how little of the soil was actually moved to the side by the row openers on the planter. Treatment #13 gave the next highest level of simazine recovery in the area near the crop row, which would correlate well with the relative crop damage it caused. In decreasing order, the amount of simazine recovered in soil cross-sections either 2, 3, 4 or 5 cm to the side of the crop row was as follows: treatment #4 > treatment #13 > treatment #11 > treatment #8 > treatment #7. This order is in very good agreement with visual ratings of crop damage and implies that a critical zone for freedom from simazine existed out to a width of at least 2 cm from the crop row. Simazine was found closer to the crop row in treatment #11 than in #8, reflecting problems in readjusting the spray boom after the planter was damaged in an accident.

Due to relatively low weed pressure in the test area, all treatments gave reasonably good control of annual grasses. Diuron was not effective on speedwell and gave only partial control of knotweed. Prodiamine gave

Table 1. Crop stand ratings and simazine distribution in soil.

TREATMENT	Rate in treated zone	Crop stand ratings on March 14, 1986			Soil cross-section[2] simazine content					
		FESAR	DACGL	LOLMU	0	1	2	3	4	5
	(kg/ha)	--------(%)--------			--(micrograms/cm)--					
CARBON-BANDING CHECKS										
1. DIURON	2.7	73	50	87						
2. DIURON /	2.7									
ETHOFUMESATE[1]	1.1	60	18	70						
PRE-PLANT BROADCAST										
3. PRODIAMINE	1.1	0	0	1						
4. SIMAZINE	2.2	1	1	0	69	64	91	91	76	71
5. PROPAZINE	2.2	1	1	0						
6. PROMETRYN	3.4	2	4	1						
UNTREATED BAND 5.0 CM										
7. SIMAZINE	2.4	43	20	45	2	4	4	4	4	7
UNTREATED BAND 3.8 CM										
8. SIMAZINE	2.3	32	23	47	2	2	5	14	22	16
9. PROPAZINE	2.3	27	13	22						
10. PROMETRYN	3.4	8	23	28						
11. SIMAZINE /	2.3									
ETHOFUMESATE[1]	1.1	27	0	4	2	6	14	23	24	20
UNTREATED BAND 2.5 CM										
12. DIURON	1.8	48	32	40						
13. SIMAZINE	2.4	30	8	15	18	31	39	51	58	31
14. PROPAZINE	2.4	15	7	13						
15. PROMETRYN	3.5	15	47	42						
16. PRODIAMINE	1.1	3	1	2						
LSL(.05)		8	11	16	--	--	--	--	--	--

[1]Ethofumesate applied post-emergence on Oct. 29, 1985.

[2]Soil cross-sections are those located at distances of 0, 1, 2, 3, 4, or 5 cm from the crop row. Simazine quantity based on soil sample size of 15 cm long by 3 cm deep by 0.8 cm wide (1.0 cm width - loss due to knife). A quantity of 67 micrograms in this volume of soil would correspond to 100% recovery of simazine applied at a rate of 0.56 kg/ha.

Table 2. Weed control ratings in tall fescue and orchardgrass plantings and in unplanted weedy areas.

Treatment	Rate in treated zone	June 16, 1986, weed control ratings[2] POLAV in FESAR	POLAV in DACGL	POLAV in POATR	VERPE in DACGL	POATR alone	BROTE alone
	(kg/ha)	(%)					
CARBON-BANDING CHECKS							
1. DIURON	2.7	50	0	58	0	60	0
2. DIURON /	2.7						
ETHOFUMESATE[1]	1.1	42	10	35	17	50	50
PRE-PLANT BROADCAST							
3. PRODIAMINE	1.1	94	100	95	100	98	70
4. SIMAZINE	2.2	59	53	70	90	100	90
5. PROPAZINE	2.2	66	57	75	83	75	95
6. PROMETRYN	3.4	13	0	40	0	40	0
UNTREATED BAND 5.0 CM							
7. SIMAZINE	2.4	47	0	45	63	94	30
UNTREATED BAND 3.8 CM							
8. SIMAZINE	2.3	23	0	38	42	60	25
9. PROPAZINE	2.3	50	27	48	47	80	50
10. PROMETRYN	3.4	0	0	0	0	50	0
11. SIMAZINE /	2.3						
ETHOFUMESATE[1]	1.1	8	0	40	23	28	40
UNTREATED BAND 2.5 CM							
12. DIURON	1.8	27	20	40	0	53	0
13. SIMAZINE	2.4	20	17	25	97	78	20
14. PROPAZINE	2.4	58	30	83	90	67	70
15. PROMETRYN	3.5	17	25	40	47	38	20
16. PRODIAMINE	1.1	87	97	80	100	85	60
LSD(.05)		30	35	40	57	--	--

[1]Ethofumesate applied post-emergence on Oct. 29, 1985.

[2]Weed control ratings made in plots planted to orchardgrass and tall fescue and in unplanted areas which had weed seeds broadcast over them in late November. Seeds of BROTE and POATR were broadcast in unplanted areas; POLAV and VERPE were naturally present in the entire test area.

generally good to excellent control of weeds. Triazine herbicides gave only partial control of knotweed. Simazine and propazine, but not prometryn, gave good control of speedwell.

Conclusions

In the fall of 1985, a critical zone for freedom for simazine existed out to a distance of at least 2 cm to each side of the crop row. Width of the unsprayed zone may need to exceed 4 or 5 cm in the case of simazine for adequate crop safety in a year such as this one. Degree of injury was undoubtedly compounded by shortness of the fall growing season in 1985. Herbicides other than simazine may be safer than it was when applied in bands near the row, but some critical width for an untreated zone must exist for any herbicide lacking true selectivity on a crop. None of the banded herbicide treatments used in this test were as successful as the carbon banded check in establishing grass seed crops, but some of them did provide superior control of weeds.

PRODIAMINE: A LONG RESIDUAL PREEMERGENCE HERBICIDE FOR USE IN TURF

Mark G. Sybouts[1]

Introduction

Prodiamine {N^3,N^3,-Di-n-propyl-2,4,-dinitro-6-(trifluoromethyl)-m-phenylenediamine} is a preemergence dinitroanaline herbicide which provides good long-term control of annual grass weeds in established turf.

Prodiamine should be used as a surface applied preemergence treatment to established turf before target weed species germinate. Incorporation by rainfall or irrigation after application is needed for prodiamine to be effective.

During 1985-1986 prodiamine was tested by Sandoz Crop Protection Corporation under a Federal Experimental Use Permit for annual grass control in established turf. Rates of prodiamine tested ranged from 0.28 to 2.24 kg ai/ha and were compared to normal use rates of the following standard herbicides: Benefin {N-butyl-N-ethyl-alpha,alpha,alpha-trifluoro-2,6-dinitro-p-toluidine), bensulide {S-(0,0-diisopropyl phosphorodithioate) ester of N-(2-mercaptoethyl)benzenesulfonamide}, DCPA (dimethyl tetrachloroterephthalate), oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide), oxadiazon {2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-delta^2-1,3,4-oxadiazolin-5-one}, and pendimethalin {N-(1-ethylpropyl)-3,4-dimethyl-2,6 dinitrobenzenamine.

Results

Prodiamine at 0.56 and 1.12 kg ai/ha was compared to 2.24 kg ai/ha of pendimethalin for large crabgrass [*Digitaria sanguinalis* (L.) Scop.] control on a sandy loam soil (Table 1). Control of crabgrass by prodiamine was 89%

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[1]Sandoz Crop Production Corporation, Fallbrook, California

for both rates at 11 weeks after treatment (WAT). Prodiamine at 0.56 and 1.12 kg ai/ha, respectively, provided 95 and 98% control at 20 WAT. At 27 WAT, the two respective rates of prodiamine gave 93 and 95% control. Control with pendimethalin was 84% at 11 WAT, then declined to 79 and 70% at the 20 and 27 WAT ratings, respectively.

Prodiamine gave longer control of smooth crabgrass {Digitaria ischaemum (Schreb. ex Schweig.)Schreb ex Muhl.} in a comparison with oryzalin, benefin and oxadiazon (Table 2). Three trials applied in December on coarse soils are summarized.

Smooth crabgrass control with 0.56 and 1.12 kg ai/ha of prodiamine and 2.24 kg ai/ha of oryzalin ranged from 97 to 100% at 26 WAT while benefin and oxadiazon at 3.36 and 4.48 kg ai/ha, respectively, provided good control at 90% for the 0.56 kg ai/ha rate and 98% for the 1.12 kg ai/ha rate. Oryzalin, benefin and oxadiazon control dropped to 60, 57 and 52% respectively at the 36 WAT evaluation.

Table 3 is a comparison of prodiamine, benefin, DCPA and oxadiazon applied in the spring on a fine-textured soil for control of smooth crabgrass. Control ranged from 97 to 99% at 20 WAT with 0.56 and 1.12 kg ai/ha of prodiamine and 16.81 kg ai/ha of DCPA. Benefin at 3.36 and oxadiazon at 4.48 kg ai/ha provided 74 and 80% control at 20 WAT. Prodiamine at 1.12 kg ai/ha was still providing good control (97%) at 25 WAT, but at 0.56 kg ai/ha control dropped to 80%. Respective control for benefin, oxadiazon and DCPA at 25 WAT was 61, 65 and 85%.

Annual bluegrass (Poa annua L.) control with prodiamine was compared to bensulide in four trials conducted in Oregon (Table 4). Prodiamine at rates of 0.56, 1.12 and 2.24 kg ai/ha provided 88, 94 and 96% control, respectively, at 35-42 WAT and 74, 79 and 91% control at 56-63 WAT. Bensulide at 9.0 kg ai/ha provided 87 and 54% control of annual bluegrass at 35-42 and 56-63 WAT, respectively. No phytotoxicity was noted from any treatment to the fine-leaved fescue (Festuca arundinacea Schreb.), perennial ryegrass (Lolium perenne L.) and Kentucky bluegrass (Poa pratensis L.) in these trials.

Turf Safety

During 1986 prodiamine was tested in over 80 trials in California and Arizona on established turf for annual grass control. Turf species in the trials included common and hybrid bermudagrass [Cynodon dactylon (L.)Pers.] and kikuyugrass (Pennisetum clandestinum Hochst. ex Chiov.). No phytotoxicity was noted in any trial from prodiamine applications.

Conclusion

Prodiamine herbicide, at 0.56 to 2.24 kg ai/ha, provided good long-term control of crabgrass and annual bluegrass in trials conducted during the 1986 season with good safety to established turfs in the trials.

Prodiamine at 1.12 kg ai/ha gave longer control than the normal use rates of benefin, bensulide, DCPA, oxadiazon, oryzalin and pendimethalin in coarse and fine-textured soils when applied in the spring or fall.

Table 1. Large crabgrass control provided by spring applications of prodiamine and pendimethalin (Sacramento, California).

Treatment	Rate(kg ai/ha)	------Percent Control------		
		11 WAT[1]	20 WAT	27 WAT
Prodiamine	0.56	89	95	93
	1.12	89	98	95
Pendimethalin	2.24	84	79	70

[1](WAT) - weeks after treatment.

Table 2. Smooth crabgrass control provided by winter applications of prodiamine, benefin, oxadiazon, and oryzalin.

Treatment	Rate(kg ai/ha)	------Percent Control[1]------	
		26 WAT[2]	36 WAT
Prodiamine	0.56	97	90
	1.12	100	98
Benefin	3.36	84	57
Oxadiazon	4.48	87	52
Oryzalin	2.24	98	60

[1]Percent control data are averages of evaluations from 3 locations.

[2](WAT) - weeks after treatment.

Table 3. Smooth crabgrass control provided by spring applications of prodiamine, benefin, DCPA, and oxadiazon (Stockton, California).

		------Percent Control------	
Treatment	Rate(kg ai/ha)	20 WAT[1]	25 WAT
Prodiamine	0.56	97	80
	1.12	99	97
Benefin	3.36	74	61
Oxadiazon	4.48	80	65
DCPA	16.81	98	85

[1](WAT) - weeks after treatment.

Table 4. Annual bluegrass control provided by prodiamine and bensulide.

		------Percent Control[1]-----	
Treatment	Rate(kg ai/ha)	35-42 WAT[2]	56-63 WAT
Prodiamine	0.56	88	74
	1.12	94	79
	2.24	96	91
Bensulide	9.00	87	54

[1]Percent control is an average of 4 locations.
[2](WAT) - weeks after treatment.

MINUTES OF BUSINESS MEETING
WESTERN SOCIETY OF WEED SCIENCE
BOISE, IDAHO
MARCH 12, 1987

The 40th business meeting was held at the Red Lion Motor Inn, Riverside in Boise, Idaho. President Evans called the meeting to order at 7:40 a.m. President Evans thanked the hotel for excellent accommodations and especially thanked Elanco Products Co. for hosting the delicious breakfast before the business meeting.

The minutes of the business meeting on March 20, 1986, are in the proceedings and available for your information. President Evans stated there were several items of interest which were: two constitutional amendments to be voted upon, one thousand dollars was donated to CAST for increased distribution of its magazine, Science of Food and Agriculture which went from 12,000 to 160,000 copies and set aside twenty-five hundred dollars to CAST to study the feasibility of an education movie. CAST does not feel the television movie project to be a high priority so the money WSWS approved for the project will not be allocated.

Thomas Schwartz moved and Bob Callihan seconded a motion to accept the minutes. Motion carried.

Nominations

Peter Fay stated that approximately one-third of the membership voted for the slate of new officers. Those elected were:

President Elect - Donn Thill
Secretary - Galen Schroeder
Chairman Elect - Research Section - Steve Radosevich
Chairman Elect - Education & Regulatory Section - Paul J. Ogg

Peter Fay moved and Harvey Tripple seconded a motion to accept the nomination report. Motion carried.

Local Arrangements

Loal Vance indicated the accommodations were very good and thanked the entire committee for the tremendous amount of work they performed. The projectors, screens, etc. were supplied by individuals and organizations which will save the society some funds on the meeting. Vance thanked LaMar Anderson and Jack Evans for their support, time and work to get the arrangements in order.

Vance moved and Pete Fay seconded a motion to accept the local arrangements report. Motion carried.

Program Report

Larry Mitich presented the report and stated that fifty-two abstracts were submitted, including ten student papers. The program paper deadline was changed to December 1 which allowed time for the programs to be printed and available for the WSSA meeting in St. Louis. The Data Collection Systems Display was brought in for information and educational exchange.

Mitich moved and Steve Radosevich seconded a motion to accept the program report. Motion carried.

Research Section Report

Bart Brinkman presented the report and stated that 217 individual reports were submitted from 128 different authors and 441 pages in length.

The new chairman for the Research Section is Stephen Miller and chairman elect is Steve Radosevich. The chairman and chairman elect for the projects are as follows:

	Chairman	Chairman Elect
Project 1	Phil Westra	George Beck
Project 2	Tom Whitson	Steven Whisenant
Project 3	Vanelle Carrithers	Tom Lanini
Project 4	Rick Boydston	Scott Howard
Project 5	Doug Ryerson	Dennis Rasmusson
Project 6	Barbra Mullin	Lars Anderson
Project 7	Jodie Holt	Rick Boydston

The reports from individual project sections are as follows:

Summary of Project 1 Discussion, Perennial Herbaceous Weeds
Philip Westra, Colorado State University

Researchers have studied levels of total non-structural carbohydrates (TNC) in perennial weed rhizomes and roots with the objective of finding weak points in their biology and life cycles. The assumption is that low points in TNC levels would correspond to optimum periods to effect control through mowing, cultivation or competition. Current thinking is that herbicide application is best made when maximum TNC movement is occurring into root or rhizome material. Thus maximum TNC movement may not necessarily correlate with minimum levels. Repeated treatments might starve a perennial plant to death. With some weeds, uncertainty exists concerning whether the underground material is stem-like material or root-like material. A large literature search on the relationship of carbohydrate levels and movement in perennial weeds revealed a paucity of published information on this topic. Studies on TNC levels versus sampling time showed that seasonal variation was very different between grassy and broadleaf perennial weeds. For broadleaf weeds, the low level occurs after bud elongation and rapid growth, usually around flower bud development or at very early flowering. For many broadleaf plants there is another dip in levels shortly after flowering, after which TNC levels build up and rise through autumn until soil freeze up. Since percent TNC levels closely parallel dry matter accumulation in rhizome and root material, some researchers have suggested that dry matter measurements over time can be used to estimate low TNC levels in a weed's life cycle. Depending on the species, TNC as a percent of total dry matter can vary from 3 to 60% within a growing season. For Canada thistle, it appears that cool root temperatures favor more root TNC accumulation than warm root temperatures.

In contrast to broadleaf weeds, Johnsongrass has its lowest TNC levels in the spring after shoot development, and levels rise through flowering. Radiolabel studies showed that highest levels of TNC moved into Johnsongrass rhizomes at flowering. Patterns of TNC levels were similar in quackgrass, with relatively little difference between the high and low levels in the cycle.

Two general methods exist for studying TNC levels and both require periodic sampling to build a profile of TNC movement. The first involves extraction and quantification of TNC from plant tissues, although it can be difficult to remove unwanted materials in the extraction procedure. Chromatography or ion exchange methodology can be used for quantification. The second involves the use of radioisotopes to study the movement and accumulation of TNC. If radiolabeled herbicide translocation studies are carried out in conjunction with TNC studies, it will be important to verify whether we recover the active parent material or some metabolite.

Those who work with and teach perennial weed control have several fundamental beliefs about these weeds. There is a source-sink relationship between photosynthetically active material and other plant parts. Stage of growth is a morphological predictor of when translocation occurs in a perennial weed; this translocation can be dramatically affected by xenobiotic compounds. There is a need for more detailed herbicide absorption and translocation studies at various stages in the growth of different perennial species to better understand application timing for optimum control. Much of the evidence we cite to demonstrate TNC movement in plants is circumstantial. Is it possible that growing degree days can be a useful predictor of weak points in a plant's growth cycle?

Some feel it is difficult for herbicides to move from primary root or rhizome material into attached lateral tissue. Photoperiod may affect herbicide absorption and translocation patterns in perennial weeds, especially those of aquatic habitats. More research is needed to determine if pretreatment with non-labeled herbicide alters morphology and metabolism in such a way that absorption and translocation of radiolabeled herbicides in various perennial weeds is affected. Glean appears to quickly shut down the export of carbon compounds from a treated leaf, although carbon dioxide fixation continues. It is important to back greenhouse studies up with, or at least correlate them with field studies. When picloram is applied to leafy spurge, up to 50% can be excreted into the soil environment, while significant movement into buds only occurs concurrent with bud elongation and growth in the spring. Picloram is not metabolized in leafy spurge, but can be conjugated with sugars. TNC levels dropped off in leafy spurge in the fall, but sucrose levels rose at the same time, which may confer winter hardiness to the pink buds that develop in the fall and lie dormant near the snow line. Major temperature fluctuations over several days have a major impact on increasing TNC and picloram translocation in leafy spurge when cool temperatures follow periods of warm temperatures. Actual root temperature may be very important in regulating translocation into root or rhizome material. Perhaps we should consider targeting maximum herbicide absorption and make maximum translocation a secondary concern.

Root or rhizome fragmentation from soil heaving or insect injury may leave unattached perennial bud material in the soil resulting in eventual new infestations. Some felt that little information has been published on the developmental anatomy of perennial buds, and the relationship of plant growth regulators to herbicide translocation. It was suggested that the WSWS form a group of weed scientists interested in coordinating regional research on perennial weeds and that this be done with the goal of some day producing a monograph on perennial weed control research. This could perhaps be accomplished via coordinated activity in the CSRS system by a western region research group.

Summary of Project 2 Discussion, Herbaceous Weeds of Range and Forest

Celestine Lacey, Montana Department of Agriculture

Subject 1: Herbicide use on federal lands.

Approximately 47.8 percent of land in the 11 western states is administered by federal agencies. A survey of five states in the Pacific Northwest indicate that about 25 million acres are infested with noxious weeds. Coordination of control programs between private, state and federal entities is critical in order to adequately address the weed issue.

The current status of herbicide use of federal lands is as follows: 1) Bureau of Land Management (BLM): The Northwest Area E.I.S. was challenged by NCAP (National Coalition for Alternatives to Pesticides). The final decision on the amendments to the E.I.S. will be the first week in April. If successful, B.L.M. will continue herbicide use on land managed by their agency. 2) Forest Service (F.S.): In Montana, Forest Service is writing an E.I.S. on each forest in the state. Region 2 forests have written an E.I.S. for the entire region, and it has been approved.

The discussion centered mainly around the use of education and communication in working with environmental groups and federal agencies. Richard Old, University of Idaho, suggested working with environmental groups and explain the impact of noxious weeds on the environment and the advantages of herbicides for control. He mentioned that they had been very successful working with these groups. Scott Fluer, Montana, believes that education of all groups is extremely important. Rollin Elliston felt that communication and a knowledge of legislation would be helpful in directing legislation. Bruce Maxwell, Oregon State University, mentioned that groups like NCAP should be contacted concerning research development. Pete Fay felt that only a few people support the use of herbicides for noxious weed control and that only a very few people can effectively shut a program down. Ed Adams felt that education on the nature of the weed problems must be conducted to allow people to see what problems these weeds cause. We need to direct these groups as a member rather than an opposing force. Jim Freeman, Montana, suggested working with schools and developing a populous of support.

Lars Baker, Wyoming, mentioned that a weed district's reputation is that of killing everything in the environment. He also suggested that weed districts and other interested groups become more vocal in supporting federal programs. He believes that the federal government works under pressure, and we need to let them understand our concerns and needs. He suggested that a law suit be filed against the federal government for not controlling noxious weeds.

The group also discussed current legislation that may assist federal agencies in completing E.I.S.'s. The Symms amendment, SB 398, was the most thoroughly discussed. This bill would amend FIFRA: 1) federal agencies may use registered pesticides as prescribed on the label unless the administrator of the EPA determines that missing or deficient data is sufficiently important to warrant a suspension or cancellation. 2) The research and analysis done by EPA when registering pesticides is to an E.I.S. and that research may be incorporated by reference and relied on in any other federal document developed in compliance with the national EPA of 1969. 3) Other federal agencies are not required to duplicate research already reviewed during EPA's registration process.

The discussion group decided to vote on support for the Symms Amendment. The vote was 45 for and 0 against SB 398. The group recommended to the chairman to write a letter to the President of WSWS requesting the support of the entire organization for SB 398.

The group also discussed the idea of a weed science position among federal agencies. This position would be to direct the weed control efforts on federal land and coordinate control programs. George Hittle will be travelling to Washington D.C. with a delegation to support the weed science position. The group voted for support of a weed science position within federal agencies. The vote was 54 for and 0 against. This recommendation will be made to the President of WSWS.

Subject 2: Economic impact of weeds on rangeland - are research and extension expenditures adequate to meet needs?

The question to be answered was why aren't more funds being spent on research and extension for range weed?

Dr. Peter Fay, Montana State University, led this discussion session. Pete said that a problem with weed control on rangeland is the low economic return per acre received from rangeland. He also believes we need to place more emphasis on the weed science in range courses taught at the universities in the western states. Mike Newton asked if there was any weeds training in range ecology or management courses. Celestine Lacey responded that there was no training in this area in Montana. Steven Wysenaut, B.Y.U. said that the range weed training in Texas was very good and included in the scholastic program as part of a range science degree. Mike felt that we must deal with range ecologists and animal production and how they relate to weeds. Bruce Maxwell felt that weed scientists should be trained so that they can adapt to both a rangeland and cropland management system. Most herbicide people work on a monoculture system whereas a range system is extremely complex and difficult to work with. Robert Whitset, Utah State University, felt that range weed science positions are important.

The conclusion of the group was that many land management people come out of school with diverse background, and we need to mesh weed science technology with their management skills.

Subject 3: Evaluation techniques for herbaceous weed research on forest lands.

The questions to be addressed are:

1) Are herbs important in the forest community?
2) How do herbs influence tree growth?

The biggest problem in forestry is survival of trees. Mike Newton-what measurements can be taken to determine tree survival and growth. A tree must go through a growing season to determine whether it will grow. We can measure many factors such as vegetative competition to allow us to predict the tree growth. Wildlife must be considered a part of the total management program. Total management is important. For example, a seedling of grasses and forbs will help prevent alder from invading mature stands. Erosion prevention is also of crucial importance.

How does erosion influence sites? In the southeast 8 to 75 tons per acre of topsoil were moved in selected soils. Erosion is a minor problem in the Pacific Northwest.

How can you evaluate herbaceous cover or growth?

1) moisture storage
2) slope
3) sunshine
4) rainfall in drying periods

A formula for estimating cover is:

Allowable Cover for Avoidance of Drought is:

$$\% \text{ cover} = \frac{78000 \ (\text{M+R})}{0.3 \ (\text{CoS. H.}) \ (\text{D}) \ (\text{Rad})}$$

Minor differences between grasses vs forbs in water use. Differences exist in zone that the water is used from.

Jim Freeman, Cascade County Weed Supervisor, Montana nominated Steven Whisenant, Brigham Young University as chairman for the discussion section for 1989. Steve was elected by unanimous ballot.

Summary of Project 3 Discussion: Undesirable Woody Plants

Diane White, Oregon State University

This session had 39 people in attendance. Two major topics were discussed. The first was an update on the efficacy of nonchemical weed control methods, primarily grazing and manual cutting, and the second was to determine if there was a niche in forest weed control for which there is no good herbicide and to find out if that niche would be expanded if 2,4-D was lost.

Livestock grazing for weed control has been used successfully in Australia and New Zealand and is being studied for applications in the U.S. In some cases, for example, controlling dyers woad, cattle are effective. They are also used by Weyerhaeuser in their tree farms near Klamath Falls. A lot of the research on grazing has one major shortcoming--there is comparison of grazed vs not grazed, but no standard silvicultural-treatment comparison. Competition research shows that both brush and herbs must be kept at very low levels to maximize conifer growth and grazing research needs to concentrate on how to manipulate livestock to achieve this.

Weed control workers who use manual methods, such as cutting, on brush are all in agreement it is not an alternative to herbicides. The cost is much higher and the brush sprouts back vigorously. One exception to that is cutting large alder during June or July; resprouting is minimal because fungi invade the stumps.

Two important areas of herbicide development in forestry were pinpointed. Since the ban on 2,4,5-T, there is not a good chemical to use for pine release, although fluroxypyr and clopyralid are being tested. Another area is release of Douglas-fir from alder and salmonberry. Currently this requires application of two chemicals, each at a different time. A treatment with one chemical would be more cost effective.

If 2,4-D were not available for use, other more expensive chemicals would have to be substituted. The feeling of the group was that the loss would be more important politically--if 2,4-D were banned, what herbicide would be next? The point was emphasized that we, as both weed scientists and general public, need to be more involved in policy formulation.

Summary of Project 4 Discussion: Weeds in Horticultural Crops

Lee Darlington, BASF Wyandette Corporation

Subject 1: Registrations in minor crops.

Third party labels - Commodity groups will have to help fund residue analysis. Some industry representatives said their companies would not support third party labels as the liability has not been fully tested yet. Liability by third party registration may also include other environmental aspects other than efficacy and phytotoxicity.

IR-4 Program - Industry expressed concern over the limited data base for the IR-4 labels. Companies must coordinate the IR-4 activities with respect to their chemicals. At present, financial limitations are severely hampering the IR-4 process, and this situation will get worse as more data will be needed for the minor crop registrations. WSSA will be talking to leaders in Washington D.C. about increased funding for IR-4 programs.

Special local needs -- Some minor crops are getting state labels by using SLN registrations. Crop must have an established tolerance in order to apply for SLN label.

General comments -- Some companies with products currently under reregistration are considering dropping the minor uses of these products. Liability was the biggest issue at hand for labeling herbicides in minor use crops. Concern was expressed about minor use registrations, i.e., third party, IR-4 and companies being able to control the uses of their product. It was thought that the deep pocket syndrome would prevail. It was suggested that WSSA bring up the subject of tort reform as it applies to herbicide usage in minor crops, with the proper channels in Washington D.C. Grower groups are going to have to help support the research needed for minor crop herbicides. Varietal testing would be required.

Subject 2: Results of herbicide screening trials on horticultural crops.

This subject was brought up and no one had anything to report.

Subject 3: Measurement of yield data in perennial horticultural crops.

The types of crops included in this discussion were fruit trees, vines and asparagus. Comments about the research in these crops included the following: need more years of data, 20 to 30 replications, covariance and other statistical analysis used to reduce the effect of soil variability use Latin square design.

Summary of Project 5 Discussion, Weeds in Agronomic Crops

Douglas Ryerson, Monsanto Agricultural Products Company

Subject: What impacts will recent developments in the area of biotechnology (i.e. transfer of genetic herbicide resistance into existing crop cultivars) have on the field of weed science?

1. Impacts on university research programs
2. Impacts on training future weed scientists
3. Impacts on private industry

Discussion: 1) Impacts on university programs.

Discussion centered around concerns expressed by several people that many university administrators saw biotechnology as an avenue to capture additional research dollars and result in patentable developments that could lead to new sources of revenue. This trend appears to be occurring at the expense of existing positions in weed science, other areas of crop protection and plant breeding. Many people felt that this attitude has swung too far in favor of biotechnology.

It was a general consensus that the field of biotechnology is exciting and will yield many new developments in the future. However, development of these advances will be expensive and will still require more traditional programs to transfer the new technology to the inducer. Scarificing existing programs to strengthen efforts in biotechnology does not appear to be in the best interest of university clientele. Good communication between various disciplines including university administrators and those involved in biotechnology is needed to set direction and target appropriate areas of research for the greatest benefit to be obtained.

2) Impacts on training future weed scientists. The weed scientist of the future will have to have training in many areas. It was agreed that training programs should continue to include traditional areas as well as emphasizing areas associated with biotechnology (genetics, biochemistry, plant physiology, etc.). Preparing students with broad backgrounds to deal with new technology that will compliment existing products as well as deal with technology that is completely new in its approach will be important for the future.

3) Impacts on private industry. Advancements from the area of biotechnology will become the commercial products of the 1990's and beyond. It is believed that the new technology will compliment existing products as well as lead to new and better ways to protect crop plants from disease, insect and weed pests in the future. It appears unlikely that changes in the manner in which business is done will be necessary. There will still be a need for the field research representative and university personnel to take the new technology from the laboratory and fit it into existing agronomic systems along with marketing and extension personnel to reach the farmer.

Recommendations:

1. WSWS should encourage better communication between weed scientists, university administrators and those involved in biotechnology to set direction and target appropriate areas of research. Recognition that universities will continue to need existing programs to help transfer new advances to the inducer is critical.
2. WSWS should encourage graduate programs to include heavy emphasis on subject areas involved in biotechnology as well as more traditional subjects.
3. WSWS should encourage better communication between private industry and universities making sure that there is a clear understanding of the direction and form of future commercial products as well as reinforce the need for traditional programs to move these new technologies from the lab to the field.

Summary of Project 6 Discussion, Aquatic Ditchbank and Noncrop Weeds

Winn Winkyaw, Salt River Project

Modern and Future Techniques in Aquatic Weed Control

A. New Herbicide Studies Update - Nate Dechoretz

Current work involves fluridone, fluridone plus copper, sulfonylureas (particularly Londax), preliminary work on certain techniques such as drawdown, ponded treatments and time of application as it relates to environmental effects and propagule production.

B. Light Techniques - Lars Anderson

Experimental work on photointerruption plots continues on the Potomac River. As part of an integrated management program, this technique has reduced hydrilla propagules up to 60%. Work will continue in 1987 on pondweeds in irrigation canal systems.

C. Biocontrol of Water Hyacinth - Ed Theriot

Studies by the Army Corps of Engineers have introduced several insects on water hyacinth, including two weevils and a fly. It is expected that at least a four-insect complex will be needed to effectively manage water hyacinth.

D. Future of Grass Carp in the West - Panel Discussion with Lars Anderson, Randall Stocker and Rich Tiery

Some needs that were outlined from this panel discussion included:

1. Try to include update information from all groups that are working on the grass carp in the west, including Colorado, Oregon, California, Washington, Nevada and New Mexico. Not all of these states are active in WSWS or WAPMS.
2. Development of appropriate stocking rates based on needs of the water users.
   a. correct type of vegetation
   b. areas not suitable for fish
   c. good water management to keep fish in an area and alive
3. Management techniques for cooler waters and flowing versus static waters.
   a. management in dewatered areas
   b. overwintering in ditches
   c. integration potential with herbicides

Summary of Project 7 Discussion, Chemical and Physiological Studies

Frederick J. Ryan, USDA Aquatic Weeds, University of California, Davis

The meeting was conducted from 2:00 to 4:00 p.m. on March 11, with a maximum of 67 people in attendance (attendance sheet attached). Only two of the subjects originally proposed were covered due to limits of time and other constraints. The topics discussed were: human health hazards associated with the handling of 2,4-D and the role of integrated pest management in weed science.

Chairperson Ryan started the discussion with a few comments on the importance of unbiased and factual reporting on scientific matters of public concern. Dr. Wendell Mullison, Dow Chemical Company and the industry Task Force on 2,4-D, presented an analysis of the Kansas Farm Worker Study, a retrospective report linking the handling of 2,4-D with elevated incidence of non-Hodgkin's lymphoma (NHL). It was pointed out that there are puzzling anamolies in the data; the incidence of NHL is not correlated with farm size or number of years of application of the herbicide, and the incidence of NHL as higher before the introduction of 2,4-D, among others. An EPA-sponsored review of the study concluded that there was no link between the handling of 2,4-D and NHL (3 reviewers); one reviewer agreed with the conclusions of the report. Further studies are warranted and are underway both in the United States and other countries. A decision will be made in April, 1987, on whether 2,4-D should be classified as a carcinogen, although as a member of the group pointed out, it is now on the hazardous materials list. Concern was expressed during the discussion that this topic was being treated with *some amount of sensationalism by the press.*

There was a break in the program after this discussion, at which time the election of the new chairperson-elect was carried out. The discussion in the second part of the session was concerned with new developments in integrated pest management. Dr. Edwin Theriot of the U.S. Army Corps of Engineers reviewed the work on biocontrol of emergent aquatic weeds, which has reduced some of these weeds to the status of "incidental plants." It was noted that submerged aquatic weeds are now of major concern and that it may be possible to control these with biological agents as well, either with genetically modified pathogens or with modified epiphytic flora. There was some discussion of the perception in the media of the release of genetically modified pathogens or epiphytes and especially the possibilities of problems arising from sensationalized accounts of this work. A suggestion was made that the Western Society of Weed Science set up a task force to investigate and recommend action in the area of press treatment of emerging technologies in weed control. It was noted that current work in Montana is concerned with narrowing the host range of the endemic pathogen Sclerotina in order to use it as a biocontrol agent for certain undesirable plants. Other discussion concerned the possibility that field releases of novel organisms might be conducted outside the U.S. in countries with less-strict environmental regulations.

Bruce Maxwell, Oregon State University, discussed a new conceptual approach to integrated pest management which is being developed there to quantify interaction effects of forest species in field situations. Different experimental designs allow one to vary independently, density, proportion and spatial arrangement. Using the reciprocal yield law, the different components of interactions can be measured: four species interaction in a single plot has been analyzed. There was discussion of the applicability of greenhouse data to the filed situation and vice-versa. The session concluded with a discussion of the definition of IPM in the context of weed science. The importance of understanding all components of a site and their interactions was emphasized in attempting to make intelligent predictions of the effect of management practices on the composition of communities of plants.

Brinkman moved and Stephen Miller seconded a motion to accept the research report. Motion carried.

Education and Regulatory Section Report

Bob Callihan stated the section was very informative. Larry Mitich gave a paper of the weed losses in the western states, and the report will be in the 1987 proceedings. Celestine Lacey talked on the Noxious Weed Trust Fund in Montana and the successes they are having with the program. The identification and dissemination of new weed species information between states is very cumbersome. The APHIS program is not effective and extremely difficult to operate.

Bert Bohmont talked on the applicator training and certification program and indicated it was effective and basically meeting its objective.

Bob Callihan recommended to the Executive Committee to study the most effective means of putting weed information and new weed species identification into the Research Progress Report.

Bob Callihan moved and Alex Ogg seconded a motion to accept the Education and Regulatory Report. Motion carried.

WSSA Representative Report

Pete Fay stated that the WSSA projected a loss of $12,665 in 1987. The WSSA meeting changed from a luncheon banquet to an evening banquet, and the response was very promising. Approximately 2000 individuals attended the annual meeting in St. Louis. The Executive Committee discussed the fact that there are too many concurrent sessions, may have to reject some papers and that papers should not be a progress report. It was recommended to encourage and increase participation in the poster session.

Fay moved and Phil Westra seconded a motion to accept the WSSA report. Motion carried.

CAST Representative Report

Lowell Jordan presented the report and stated there will be several new task forces formed which are: risk assessment, groundwater, the Kansas epidemiological study on 2,4-D and several others. The Science of Food and Agriculture magazine circulates 160,000 copies. The WSWS television project proposal was discussed, and CAST does not have the time or funds available to pursue such a project. The President of CAST will spend approximately one-third of his time in Washington DC this year. CAST has a 10% increase in its dues for the next fiscal year.

Jordan moved and Bob Callihan seconded a motion to accept the CAST report. Motion carried.

Resolutions Committee Report

Barbra Mullen presented three resolutions to the membership at the business meeting.

RESOLUTION I

WHEREAS, the facilities and arrangements for the 40th meeting of the Western Society of Weed Science are of excellent quality and efficiently organized; and

WHEREAS, the organization and content of the program for this meeting are of excellent quality and of prime importance to the Society's continued progress.

THEREFORE, BE IT RESOLVED, that the Western Society of Weed Science expresses its sincere thanks and appreciation to Chairperson Loal Vance and members of the 1987 Local Arrangements Committee; to the Management of the Hotel for their efforts; to Chairperson Larry Mitich and members of the Program Committee; and the various Sectional Chairpersons for developing a well-organized, timely and excellent program.

Wells moved, Larry Mitich seconded a motion to accept Resolution I as read. Motion carried.

RESOLUTION II

WHEREAS, the Department of Health and Human Services, the National Cancer Institute and the Medical Center, University of Kansas have published an epidemiological study (S.K. Hoar et al. Jour. Amer. Medical Assn. 256(9):-1141-1147) linking herbicides, especially 2,4-D, with increased cancer rates, and

WHEREAS, the Environmental Protection Agency (EPA) has announced plans for a possible review of 2,4-D, and its safety, as a result of the Kansas Study, and

WHEREAS, the Northwestern Weed Science Society, at their 41st Annual Meeting in Williamsburg, Virginia, requested that the Council for Agricultural Science and Technology do a critique and summary of the Kansas Study and other epidemiological studies on 2,4-D, as to their accuracy and scientific merit.

NOW THEREFORE IT BE RESOLVED, that the members of the Western Society of Weed Science support this resolution as submitted by the Northeastern Weed Science Society.

Wells moved and Jim McKinley seconded a motion to accept Resolution II as read. Motion carried.

RESOLUTION III

WHEREAS, noxious weeds infest over 21.7 million acres of public and private range land in western states;

WHEREAS, the productive management of range land for livestock, recreation, watershed and wildlife values is essential to the Western United States;

WHEREAS, these values are being destroyed or impaired on millions of acres of range land in the western United States by the invasion of introduced noxious weeds;

WHEREAS, noxious weed invasion is increasing the cost of food and fiber production in the United States;

WHEREAS, the containment and control on range land is dependent on the cooperation of private, state and federal land managers;

WHEREAS, current funding for cost-share programs through counties and states for weed control on private lands is severely limited;

NOW, THEREFORE, BE IT RESOLVED that the members of the WSWS support this resolution which urges federal land management agencies to continue to cooperate in coordinated weed control efforts and that the USDA through the Agriculture Stabilization and Conservation Service (ASCS) and other divisions begin to assist in such efforts by developing a cost-share program for weed control on private range lands which are part of cooperative state, federal and private weed control project areas.

There was considerable discussion on the Resolution wording as to public and/or private lands or all lands, etc. Wells moved and George Beck seconded a motion to accept Resolution III as read. Motion carried.

Fellows and Honorary Members Committee Report

President Evans recognized the two new fellows selected, Alex G. Ogg, Jr. and Jean H. Dawson and the honorary member selected, Norm Akersson.

Placement Committee Report

Stephen Miller presented the report and indicated there was very little activity in the placement room. This has been the fewest number of job announcements in recent years.

Miller moved and Dick Comes seconded a motion to accept the placement report. Motion carried.

Site Selection Committee Report

Tom Schwartz presented the report and stated the site for 1991 is:

Stouffer Madison Hotel
515 Madison Street
Seattle, WA 98104
March 12-14, 1991

Hotel confirmation has been made in Fresno, CA for the March 8-10, 1988, meeting. The site is: Centre Plaza Holiday Inn, Fresno, CA. Single room rates are $62 per night and double room rates are $72 per night.

Schwartz moved and Harvey Tripple seconded a motion to accept the site selection report. Motion carried.

Tom Schartz also thanked Elanco Products Co. for the excellent breakfast before the business meeting and thanked the following chemical companies for providing the complimentary coffee and soft drink breaks for the entire meeting. The companies are: FMC, Cyanamid, DuPont, Monsanto, Sandoz, Ciba-Geigy, BASF, PPG, RP-UC, Rohm & Haas, Dow, ICI, Nor-Am, Stauffer and Hoechst Roussel.

Finance Committee Report

LaMar Anderson stated that the Society was approximately $2,321 in the black for 1986. There is approximately $40,000 in bank assets at this time. The exact dollars may vary some at this time due to registration income and expenditures for this meeting. Two higher than normal expenditures for 1986 were $1,000 for audio visual expenses at the San Diego meeting and $1,000 to CAST for increased distribution of their magazine.

WESTERN SOCIETY OF WEED SCIENCE
Financial Statement
March 8, 1986 - March 6, 1987

	1987-87
Income	
Registration, Annual Meeting	
Registration, San Diego (154 x $30)	$ 4,620.00
Preregistration, Boise (171 x $25)	4,275.00
Spouse preregistration, Boise (8 x $20)	160.00
Tour	250.00
Dues, members not attending annual meeting, 95	475.00
Extra luncheon tickets	120.00
Current year's Research Progress Report Sales	2,526.52
Current year's Proceedings Sales	2,850.63
1987 Research Progress Report advance sales	1,356.00
1987 Proceedings, advance sales	1,500.00
Sale of back issues of publications	260.50
Payment of outstanding invoices, previous year	51.25
Coffee break donations	1,100.00
Total fiscal year income	$19,544.90
Expenditures	
Annual meeting incidental expenses, last year	2,387.73
Annual meeting incidental expenses, current year	750.99
Luncheon, annual meeting	4,799.81
Guest speaker expenses	200.00
Graduate student room subsidy	450.00
Graduate student paper awards	286.05
Business Manager honorarium	1,000.00
CAST dues	560.00
CAST program development	1,000.00
Tour	330.00
Research Progress Report, publication costs	2,838.60
Proceedings, publication costs	4,024.95
Postage	927.33
Newsletters, printing costs	293.10
Office supplies	386.86
Refunds	90.00
Program, printing costs	650.00
Total fiscal year expenditures	$20,975.42
Fiscal year operational balance	-1,430.52
Interest on checking	336.00
Interest on saving certificates (matured)	3,415.70
	$ 2,321.18
Assets	
Savings certificates	$35,000.00
Check account balance	9,959.15
Cash on hand	50.00
	$45,009.15

David Cudney reviewed the financial status of the WSWS. The committee found the financial records to be in good stead. The statements were well organized, accurate and the annual summary was well done and represented the fiscal status of the society. LaMar is to be commended on his accuracy and diligence.

Cudney moved and Dean Swan seconded a motion to accept the finance report. Motion carried.

Student Paper Committee Report

Dave Cudney thanked the committee for doing an excellent job. Celestine Lacey will be chairman for 1988. Cudney expressed his thanks to all the participants and indicated all the presentations were excellent. It is unfortunate that only three individuals can be selected as winners. The winners are:

Third Place: E.S. Davis, The Degradation Rate of AC 222,293
Co-authors: G.M. Fellows and P.K. Fay
Montana State University

Tie-First and Second Place:

E.R. Gallandt, The Rate of Dissipation of FMC 57020 from Soil. Co-authors: P.K. Fay and E.S. Davis
Montana State University

D.W. Johnson, Fresnel Lens Solarization for Weed Control.
Co-authors: J.M. Krall and R.H. Delaney
University of Wyoming

Dave Cudney moved and Tom Schwartz seconded a motion to accept the student paper report. Motion passed.

Necrology Report

Donn Thill asked for a moment of silence for deceased friends and society members, especially Lambert Erickson who passed away this year.

New Business

WSWS President's Trip to Washington, D.C.

President Evans discussed his trip Washington, D.C. last summer and felt the trip was worth the time and effort. All society presidents are asked to go to Washington and provide a coordinated effort for weed science. President Elect Mitich will be travelling to Washington on May 11 to represent the WSWS. The WSSA will pay for the transportation expenses for all regional society presidents.

Harvey Tripple moved that WSWS pay the other expenses (room, meals, misc.) incurred by the president on his trip to Washington, D.C. George Hittle seconded the motion. Motion carried.

Amendment to the Constitution

Paul Ogg presented the Constitution Amendment which is:

CURRENT:

ARTICLE VII - STANDING COMMITTEES

SECTION 1. THERE SHALL BE NINE STANDING COMMITTEES: PROGRAM, FINANCE, RESOLUTIONS, LOCAL ARRANGEMENTS, NOMINATIONS, PUBLIC RELATIONS, PLACEMENT, NOMINATIONS OF FELLOWS AND HONORARY MEMBERS AND SITE SELECTION APPOINTED BY THE PRESIDENT WITH THE ADVICE AND CONSENT OF THE EXECUTIVE COMMITTEE.

CHANGE:

SECTION 1. THERE SHALL BE TEN STANDING COMMITTEES: PROGRAM, FINANCE, RESOLUTIONS, LOCAL ARRANGEMENTS, NOMINATIONS, PUBLIC RELATIONS, PLACEMENT, NOMINATIONS OF FELLOWS AND HONORARY MEMBERS, SITE SELECTION, AND AWARDS APPOINTED BY THE PRESIDENT WITH THE ADVICE AND CONSENT OF THE EXECUTIVE COMMITTEE.

ADD:

SECTION II. THE AWARDS COMMITTEE SHALL CONSIST OF A CHAIRPERSON AND TWO ADDITIONAL MEMBERS. TERMS OF OFFICE OF THIS COMMITTEE SHALL BE AS IN SECTION 3 ABOVE.

Paul Ogg moved and Tom Schwartz seconded a motion to accept the constitutional changes. Motion carried.

President Evans asked for any other new business which should be brought up at this time. Evans once again thanked the members and officers for their diligence and support during his year as President. He passed the gavel and responsibilities onto the new President, Larry Mitich.

President Mitich presented a plaque to John Evans on behalf of the society in appreciate and dedication for serving as President.

Steven Miller moved and Harvey Tripple seconded a motion to adjourn meeting. Motion carried. Meeting adjourned at 8:50 a.m.

1987 Honorary Member
Western Society of Weed Science

Norman B. Akesson

Norman B. Akesson was born in Grandin, North Dakota. He earned his B.S. in Agricultural Engineering from North Dakota State University in 1940 and his M.S. in the same field from the University of Idaho in 1942. Upon receipt of his M.S. degree, and after further training by the U.S. Navy, he conducted research on mines and torpedoes for the Navy for five years. In 1947 he accepted the position of Junior Engineer in the Agricultural Engineering Department at the University of California, Davis, where he worked until his retirement in 1984. He advanced from the rank of assistant professor to full professor in only eight years at U.C. Davis.

Norm is recognized nationally and internationally for his expertise on delivery systems for agricultural pesticides, and the effects of meteorological events and physical characteristics of spray particles on the dispersion of pesticides. He has been instrumental in the development of systems and techniques that reduce drift of herbicides, especially when applied by aircraft. His expert testimony at hearing concerning herbicide drift has led to more realistic regulations by California and several other states than would have been adopted otherwise. He has consulted with numerous producers of agricultural chemicals, foreign governments, various agencies of the United Nations and state government agencies concerned with the application and regulations of pesticides. He has authored or co-authored more than 300 articles on his research.

Norm is active in a host of professional societies that are concerned with agricultural pests, engineering and agricultural aviation. He was President of the Pacific Region of the American Society of Agricultural Engineers in 1966-67 and has served as Associate Editor for the American Society of Agricultural Engineers since 1983. He was a founder member of the Weed Science Society of America and of the California Weed Control Association, where he served as President in 1965-66. He served on numerous committees of several professional societies during his career, including Chairperson of the Task Force on Agricultural Aviation sponsored by the Council for Agricultural Science and Technology. His peers recognized his expertise by electing him a Fellow in the American Society of Agricultural Engineers in 1975.

Currently, Norm is Professor Emeritus of Agricultural Engineering and Agriculture Engineer in the Agricultural Experiment Station, U.C., Davis. He is also a private consultant.

1987 Fellow
Western Society of Weed Science

Alex G. Ogg, Jr.

Alex G. Ogg, Jr., was born and raised on a family farm in Worland, Wyoming. He earned his B.S. in Agriculture, with honor, from the University of Wyoming in 1963, his M.S. in Farm Crops from Oregon State University in 1966 and his Ph.D. in Botany from Oregon State University in 1970. He "earned his way through college" by working part or full-time for the Agricultural Research Service, the University of Wyoming and the Pesticide Regulation Division of USDA in various aspects of weed management.

Alex was a Research Plant Physiologist for the Agricultural Research Service at Prosser, Washington, from 1969 until 1984. He established a new research project at Prosser, where he developed principles and practices of weed management systems in horticultural and specialty crops. In 1984 he transferred to Pullman, Washington, where he is a Supervisory Research Plant Physiologist and heads a team of ARS weed scientists devoted to the development of weed management systems for non-irrigated crops in the Pacific Northwest.

He has authored or co-authored more than 70 publications on weeds and their control. While at Prosser, he conducted extensive research on weed management in asparagus, potatoes, sweetcorn, mint, grapes, hops, tomatoes and tree fruits. Results of his research on the characterization of black night shade and related species are used widely by other scientists. Alex was a pioneer in the development of the technology for applying herbicides through sprinkler irrigation systems, and he is recognized nationally and internationally for his expertise in this field. As the Western Regional Liaison Representative for weed science to ARS's minor use pesticide program for eight years, he conducted and coordinated numerous research projects associated with that program.

Alex was the USDA Representative on the Weed Science Society of America delegation that lectured and reviewed weed research in China in 1984. In 1985, he received the "Friend of the Mint Industry" Award from the Washington Mint Commission and a Certificate of Appreciation from the Washington Asparagus Association for his research on weed management systems for these crops. He received a Certificate of Merit and cash award from USDA for his valuable contributions to the minor use pesticide program.

Alex has been active in the Washington State Weed Conference, Western Society of Weed Science and the Weed Science Society of America. He has served in many offices and on numerous committees of all three societies, including President of the Washington State Weed Conference in 1975 and President of WSWS in 1981-82. Currently he is Western Society of Weed Science Representative to WSSA, Associate Editor of the Weed Technology Journal, Chairman of the WSSA Outstanding Young Scientist Subcommittee and a member of several other committees.

1987 Fellow
Western Society of Weed Science

Jean H. Dawson

Jean Dawson was born and raised on a farm at Stacy, Minnesota. He earned his B.S. in Agriculture from the University of Minnesota in 1955, his M.S. in Agronomy from the University of California at Davis in 1957, and his Ph.D. in Farm Crops from Oregon State University in 1961.

He has been a weed scientist with the Agricultural Research Service at Prosser, Washington, for his entire professional career, beginning in 1952. Since 1972, he has been Research Leader for the Weed Science Unit at Prosser, which in 1985 was expanded to become the Weed, Soil and Water Management Research Unit.

Jean's principal areas of research have dealt with weed-crop ecology, herbicide application technology and biology and control of the parasitic weed dodder (for which he is a world authority). His discovery that certain soil-applied herbicides are absorbed primarily by shoots, rather than by roots, was a major breakthrough in our understanding of herbicide action and had a practical significance concerning placement of herbicide in relation to weed emergence. Based on basic work in these areas, he developed integrated weed management systems for sugarbeets, field beans and alfalfa. He also developed the concept and holds the patent on techniques involved in using herbicide-treated seeds for weed control in the immediate zone surrounding crop plants. He has authored more than 120 publications, including five book chapters, on his research.

Over the past 12 years, Jean has had several short-term assignments as a teacher and researcher in several South and Central American countries at the invitation of the Food and Agricultural Organization of the United Nations and Oregon State University's International Plant Protection Center. For the past five years, he has taught part of the Purdue University course on herbicide action.

Jean has been active in the Washington State Weed Conference, Western Society of Weed Science and the Weed Science Society of America. He has served as President of the Washington State Weed Conference, Research Chairman of the WSWS and Vice President and President Elect of WSSA. He is currently President of WSSA. He has served on numerous committees of these societies as well as having served as Western Editor of WEEDS TODAY, Editor of the WSSA Newsletter and Associate Editor of WEED SCIENCE. He was elected a Fellow of WSSA and an Honorary Member of the Washington State Weed Conference in 1982. In 1981, Jean received the Director's Award for Special Achievement from USDA for "innovative research and leadership in development of basic knowledge of weed crop interrelationships, mode of action and methods of herbicide application."

W E S T E R N S O C I E T Y O F W E E D S C I E N C E

CONSTITUTION AND BY-LAWS

With revisions and additions as adopted
by the membership on March 12, 1987

CONSTITUTION

ARTICLE I-Name

Section 1. The name of this organization shall be the "Western Society of Weed Science," hereinafter called the "Society." The Society area shall include the states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

ARTICLE II-Objectives

The objectives of the Society shall be:

Section 1. To foster cooperation among state, federal and private agencies in matters of weed science in the Society area.

Section 2. To support the Weed Science Society of America and foster state and regional organizations of persons and agencies interested in weed control.

Section 3. To aid and support commercial, private and public agencies in the solution of weed problems.

Section 4. To foster and encourage education and research in weed science.

Section 5. To support legislation governing weed control programs and weed research and education programs.

Section 6. To assist in the development of uniform weed control and eradication legislation and weed seed quarantine legislation and regulations.

ARTICLE III-Membership

Section 1. Membership shall be open to anyone interested in the objectives of the Society. Two types of membership are provided (a) active and (b) honorary.

Section 2. Active members are individuals who are interested in weeds or their control and who have paid their annual dues to the treasurer. Active members may attend all Society meetings, vote on Society matters, hold office and receive official notices of all meetings.

Section 3. Honorary members are members selected from outside the Society who have significantly contributed to the field of weed science and who are elected by two-thirds majority of the Executive Committee. Honorary members shall receive all publications and announcements of the Society but will not be eligible to vote or hold office.

ARTICLE IV-Officers and Executive Committee

Section 1. The officers of the Society shall be:

(1) President
(2) President-elect who serves as Program Chairperson
(3) Secretary

Section 2. The Executive Committee shall be composed of:

The President
President-elect
Secretary
Immediate Past-President
The Representative to WSSA
Chairperson of the Research Section
Chairperson of the Education and Regulatory section
One member chosen at large by the President with the consent of the Executive Committee

Section 3. The President, President-elect and Secretary shall begin their duties at the close of the regular business meeting at which they are installed and shall remain in office until the close of the next regular Society business meeting. Other members of the Executive Committee shall begin their term at the close of the meeting at which they are installed, except the Representative to WSSA whose term is described in ARTICLE IV, Section 5 of the Constitution.

Section 4. The Chairperson of the Research Section and Chairperson of the Education and Regulatory Section shall serve a one-year term beginning at the close of the business meeting at which they become chairpersons.

Section 5. The Society Representative to the Weed Science Society of America shall serve three years beginning at the Weed Science Society of America Business meeting in the year following his appointment by the President with advice and consent of the Executive Committee.

Section 6. The Executive Committee may elect a Treasurer-Business manager to serve as they may direct.

Section 7. The Executive Committee may select a Society Representative to the Council for Agricultural Science and Technology (CAST) to serve as they direct. The Representative to CAST shall serve three years, beginning after the CAST winter meeting at which the election is announced.

ARTICLE V-Society Sections

Section 1. In promoting a full exchange of ideas and information on weed science and to facilitate programming of meetings, there shall be two general sections as follows:

(1) The Research Section, and
(2) The Education and Regulatory Section

Section 2. These two sections may have sectional programs, project meetings and informal discussions of research reports and other pertinent information. Such meetings shall be at the regular meeting at a time designated by the Program Committee.

Section 3. The Chairperson of each of these sections shall be a member of the Society Executive Committee and shall be elected as stated in Article VI, Section 3.

ARTICLE VI-Election of Officers

Section 1. The Nominating Committee shall be appointed by the President, with the advice and consent of the Executive Committee. They shall present their nominations for each office to be filled to the Executive Committee for approval before presenting the nominees to the membership for election by ballot. No member's name shall be placed on the ballot without that member's consent. All candidates for office shall be selected from the Society's membership and shall be elected by the majority of the members voting. In case of a tie vote, the winner shall be determined by flip of a coin in the presence of both nominees or their representatives at a meeting of the Executive Committee.

Section 2. The terms of office shall be as follows: The officer moving through the office of President-elect, President and Past-President shall be a member of the Executive Committee for a three-year term, the Secretary shall serve a one-year term but shall be eligible for renomination as a secretary or as any other officer.

Section 3. The Chairperson-elect of each of the two sections shall be elected by the Society and serve a one-year term. Following this, they shall succeed as Chairperson of their section for an additional one-year term. The Chairperson-elect shall serve as Chairperson if the Chairperson is unable to serve his/her term.

Section 4. If an elected officer cannot serve the full term, the vacancy shall be filled for the interim by appointment by the President with the advice and consent of the Executive Committee, unless otherwise provided for in this constitution. The President-elect shall serve as President if the President becomes unable to serve. This service shall not constitute his/her term as President. In case both the President and President-elect are unable to serve, the most immediate Past-President who is willing to serve shall serve as interim President until new officers are elected by the members.

ARTICLE VII-Standing Committees

Section 1. There shall be ten standing committees: Program, Finance, Resolutions, Local Arrangements, Nominations, Public Relations, Placement, Nominations of Fellows and Honorary Members, Site Selection and Awards appointed by the President with the advice and consent of the Executive Committee.

Section 2. The Program Committee shall consist of the President-elect as Chairperson, the two Section Chairpersons and such other members appointed by the Program Committee Chairperson as required to give all phases of weed science adequate representation.

Section 3. The Finance Committee shall consist of a Chairperson and two members. Term of Office of this committee shall be three years, established to expire alternately so that at least two members continue over each year. The member serving his/her second year of the term shall serve as Chairperson.

Section 4. The Resolutions Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

Section 5. The Local Arrangements Committee shall consist of a Chairperson and others as needed.

Section 6. The Nominating Committee shall consist of a Chairperson, Immediate Past-President and two rotating members. Terms of this committee, excluding the Immediate Past-President, shall be as in Section 3 above.

Section 7. The Public Relations Committee shall consist of a Chairperson and others as needed. Terms of office of this committee shall be at the discretion of the President.

Section 8. The Placement Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

Section 9. The Committee for Nominations of Fellows and Honorary Members shall consist of three Fellows of the WSWS appointed by the President with advice and consent of the Executive Committee. Terms of office of this committee shall be as in Section 3 above.

Section 10. The Site Selection Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

Section 11. The Awards Committee shall consist of a Chairperson and two additional members. Terms of office of this committee shall be as in Section 3 above.

ARTICLE VIII-Dues

Section 1. The amount of dues and the method of collecting such dues shall be determined by the Executive Committee.

Section 2. In the event of the dissolution of the Western Society of Weed Science, the physical assets shall be sold, and after payment of all debts, money possessed by the Society shall be given prorated on a membership basis without let or hindrance to agricultural education institutes in the states listed in Article I, Section 1, by the Executive Committee holding office at the time of dissolution.

ARTICLE IX-Meetings

Section 1. Meetings shall be held at such times and places as may be determined by the President in consultation with the Executive Committee.

ARTICLE X-By-Laws

Section 1. The Society may adopt By-Laws.

ARTICLE XI-Amendments

Section 1. The Constitution and By-Laws may be amended by majority vote of the members present at any regular meeting.

BY-LAWS

ARTICLE I-Duties of Officers

Section 1. The President shall be the executive officer of the Society. He/she shall act as Chairperson of the Executive Committee, carry out the spirit of the Constitution and the decisions of the Executive Committee, appoint designated officers and committees and perform other usual duties of that office. He/she may confer if, in his/her opinion, a member of the Society has demonstrated distinguished service, the Presidential award of Merit. Presentation of this award must have majority approval of the Executive Committee.

Section 2. The President-elect shall perform the duties of President if he/she cannot serve; serve as Chairperson of Program Committee; develop program outlines of the Society meetings; assign responsibilities to Program Committee; issue calls for papers; advise Executive Committee of program status one month before the meeting; and present a copy of the program to the Business Manager for publication.

Section 3. The Secretary shall prepare minutes of Society and Executive Committee meetings, prepare and maintain an up-to-date list of officers including Executive Committee, all standing committees and special committees and perform other duties when designated by the President.

ARTICLE II-Duties of Treasurer-Business Manager

Section 1. The Treasurer-Business Manager will receive, manage and disperse monies of the Society in accordance with prescribed policies and instructions of the Executive Committee, maintain financial records and records of property, prepare records for annual audit and meet with designated auditors, maintain supplies of Proceedings and Research Progress Reports, receive and fill orders for above publications and collect payments for same, maintain standing orders and mailing lists for distribution of publications and arrange for and consummate publications for the Society. The Business Manager may be financially compensated for services rendered as decided by majority vote of the Executive Committee.

ARTICLE III-Duties of WSSA Representative

Section 1. The WSSA Representative shall serve on the Executive Committee of WSSA and shall act as liaison between the Society and WSSA. He/she will keep WSSA informed of all activities and actions of the Society and will in turn keep the Society informed of all activities and actions of WSSA.

ARTICLE IV-Duties of Member-at-Large

Section 1. The Member-at-Large shall maintain liaison with the President and other officers of the Society and shall bring to the attention of the Executive Committee the various concerns of the members of the Society. The Member-at-Large shall perform shall perform other duties delegated by the President and the Executive Committee.

ARTICLE V-Duties of CAST Representative

Section 1. The CAST Representative shall represent the Society, present ideas and proposals from the Society to CAST and recommend persons from the Society for participation in CAST activities.

ARTICLE VI-Duties of Immediate Past President

Section 1. The Immediate Past-President shall serve on the Executive Committee and on the Committee for Nominations of Fellows and Honorary Members, and shall maintain close liaison with the President in an advisory capacity.

ARTICLE VII-Duties of Standing Committees

Section 1. The Program Committee shall develop the program for the meetings of the Society. The President-elect, who is Chairperson, shall delegate duties to members as he/she deems advisable (see duties of President-elect).

Section 2. The Finance Committee shall analyze the financial conditions of the Society and recommend, if needed, immediate and long-range plans for sound growth of the Society, recommend budget policies, recommend policies regarding registration fees and prices of publications, audit the financial accounts at least annually and make a report to the Society.

Section 3. The Resolutions Committee shall develop resolutions and recommendations regarding the general field of weed science within the Society area and put into writing important recommendations that the Society would promote and encourage; they shall report to the annual meeting.

Section 4. The Local Arrangements Committee shall make arrangements for the conduct of an efficient Society meeting. They shall work in concert with the Program Chairperson in designating meeting rooms for each section and arranging for an Executive committee meeting room, Placement Committee headquarters, and space and tables for registration. The Committee shall be responsible for providing or arranging typewriters and personnel for registration, projectors, screens, microphones and other equipment as designated by the Program Chairperson.

Section 5. The Nominations Committee shall nominate candidates for the offices of President-elect, Secretary, Chairperson-elect of the Research Section, Chairperson-elect of the Education and Regulatory Section and WSSA Representative when necessary. Such candidates shall be contact and cleared as set forth in ARTICLE VI of the Constitution.

Section 6. The Public Relations Committee shall take every feasible opportunity to inform the scientific community and the general public of the activities and benefits of the Society and of weed science in general. Any statement which may be construed as reflecting policy of the Society should be approved by the President before release.

Section 7. The Placement Committee shall provide at each annual meeting of the Society a registration service to make information available to potential employees and employers in cooperation with the Weed Science Society of America.

Section 8. The Committee for Nominations of Fellows and Honorary Members shall prepare nominations for these awards under the provisions of ARTICLE III, Section 3 of the constitution, and ARTICLE X, Sections 1 and 2 of the By-Laws. They shall prepare biographical data for publication in the Proceedings and shall work with the Public Relations Committee in preparation of news releases concerning the award recipients.

Section 9. The Site Selection Committee shall make all arrangements in all matters pertaining to the reservations of facilities for future meetings. They shall select the city and hotel and, after receiving approval from the Executive Committee, they shall finalize business agreements between the Society and the Local Arrangements Committee for the site at the earliest possible date.

ARTICLE VIII-Duties of the Section Chairpersons

Section 1. The Chairperson of the Research Section shall organize sectional and project meetings of those engaged in research in the Society to exchange information and ideas for improvement of research in weed science. He/she shall solicit and assemble papers for the Research Progress Report from research workers for publication by the Society each year. The Chairperson may delegate to the Chairperson-elect part of his/her duties as may be wise.

Section 2. The Chairperson of the Education and Regulatory Section shall organize sectional meetings of those engaged in this phase of weed science in the Society for exchange of information and improvement of the work. He/she shall solicit program reports of education and regulatory work in weed science for publication in the Society Proceedings. The Chairperson may delegate part of these duties to the Chairperson-elect.

Section 3. The Chairperson-elect of each of these Sections may attend Executive Committee meetings but cannot vote.

ARTICLE IX-Publications

Section 1. *Proceedings and The Research Progress Report shall be* published annually. Proceedings will consist of reports and papers given at the meeting, reports of the Standing Committees and special committees, minutes of the business meeting and reports from the Research and the Education and Regulatory Sections. Research Progress Reports shall be available at the annual meeting. Other publications may be authorized from time to time by the Executive Committee.

ARTICLE X-Fellows and Honorary Members

Section 1. Fellows of the Society are members who have given meritorious service in Weed Science and who are elected by two-thirds majority of the Executive Committee. Not more than two Fellows shall be selected each year. A cumulative list of Fellows shall be published each year in the Program and in the Proceedings.

Section 2. Honorary Members shall be selected as set forth in ARTICLE III, Section 3 of the Constitution. A cumulative list of Honorary Members shall be published each year in the Program and in the Proceedings.

Section 3. All Fellows, upon retirement and Honorary Members shall receive publications of the Society and complimentary registration and luncheon privileges at all Society meetings which they attend. Persons selected as Honorary Members prior to 1974 shall be listed annually in the Program and in the Proceedings under the heading, Fellows (formerly Honorary Members).

ARTICLE XI-Rules of Order

Section 1. Business at all regular meetings of the Society shall be conducted according to Robert's Rules of Order.

ARTICLE XII-Quorum

Section 1. All members of the Society in good standing who are present at any regular meeting shall constitute a quorum.

ARTICLE XIII-Authorization

Section 1. The adoption of this Constitution and By-Laws shall render null and void all previous rules and regulations of this Society.

Membership List of the Western Society of Weed Science, May 1, 1987

Edward B. Adams
WSU Cooperative Extension
N 222 Havana
Spokane, WA 99202

Harry S. Agamalian
Univ. Calif. Coop. Extension
118 Wilgart Way
Salinas, CA 93901

Agri-Turf Supplies, Inc.
P.O. Box 4248
Santa Barbara, CA 93140

Renan Agüero
Oregon State University
4120 NW Gamma Pl #1
Corvallis, OR 97330

Norman B. Akesson
Agricultural Engr. Dept.
University of California
Davis, CA 95616

Jack Aldridge
Nor-Am Chemical Company
P.O. Box 728
Sonora, CA 95370

Donald G. Alexander
Washington State Dept. Agr.
406 General Adm. Bldg. AX-41
Olympia, WA 98504

Harold P. Alley
1121 Reynolds
Laramie, WY 82070

Madeline Ames
California Dept. Food & Agr.
1362 Monarch Lane
Davis, CA 95616

J. LaMar Anderson
Plant Science Department
Utah State University
Logan, UT 84322-4820

Lars W. J. Anderson
USDA/ARS Aquatic Weed Research
Botany Department
University of California
Davis, CA 95616

Monte D. Anderson
Hoechst-Roussel Agri-Vet Co.
South 11611 Keeney Road
Spokane, WA 99204

W. L. Anliker
Ciba-Geigy Corporation
811 S.E. 97th Avenue
Vancouver, WA 98664

Mike Ansolabehere
Chevron Chemical Company
5910 N. Monroe
Fresno, CA 93722

Arnold P. Appleby
Crop Science Department
Oregon State University
Corvallis, OR 97331

Richard N. Arnold
NMSU Agr. Science Center
P.O. Box 1018
Farmington, NM 87499

Jon H. Arvik
Monsanto Agr. Products Company
24551 Raymond Way, Suite 285
El Toro, CA 92630

Robert Auge
USDA/ARS, 215 Johnson Hall
Washington State University
Pullman, WA 99163

Alvin A. Baber
DuPont Company
673 Rosecrans Street
San Diego, CA 92106

Richard W. Bagley
MAAG Agrochemicals R&D
P.O. Box X
Vero Beach, FL 32961-3023

Richard B. Bahme
AgriDevelopment Company
3 Fleetwood Court
Orinda, CA 94563

Oakford G. Bain
American Cyanamid Company
838 E. Bedford
Fresno, CA 93710

John L. Baker
Fremont County Weed Control
County Court House, Basement
Lander, MT 82520

Robert B. Balcom
4720 44th Street N.W.
Washington, DC 20000

Dan A. Ball
University of Wyoming
P.O. Box 3354, Univ. Station
Laramie, WY 82071

Ben Barstow
525 E. Viola
Casa Grande, AZ 85222

Paul G. Bartels
Dept. of Plant Sciences
University of Arizona
Tucson, AZ 85721

Brooks Bauer
Sandoz Crop Protection
20592 Ayers Avenue
Escalon, CA 95320

Garth Baxter
Forest Service, USDA
324 25th Street
Ogden, UT 84401

George H. Bayer
Gilmore, Inc.
121 East Buffalo
Ithaca, NY 14850

K. George Beck
115 Weed Research Lab.
Colorado State University
Ft. Collins, CO 80523

Lance Beem
Union Carbide
1329 Silverado Drive
Modesto, CA 95356

Carl Bell
Univ. Calif. Coop. Extension
Court House, 939 Main
El Centro, CA 92243-2870

Wayne S. Belles
Sandoz Crop Protection
1240 Joyce Rd
Moscow, ID 83842

Warren E. Bendixen
University of California
624 West Foster Road
Santa Maria, CA 93455

Kyle D. Bennett
Brigham Young University
500 W. 865 North #7
Provo, UT 84601

Sheldon Blank
Monsanto Company
3805 S. Dennis
Kennewick, WA 99337

Hans Bodingbauer
Gilmore, Inc.
5509 Murray Road
Memphis, TN 38119

Bert L. Bohmont
116 Weed Science Bldg
Colorado State University
Fort Collins, CO 80523

Dale W. Bohmont
Bohmont Consultants
Box 3032
Reno, NV 89505

Steven Bowe
Sandoz Crop Protection
112 S. Howard
Roselle, IL 60172

Ed Bowles
Licensed P.C.A.
3979 North Drexel Avenue
Fresno, CA 93726

Rick Boydston
USDA-ARS
Box 30, IAREC
Prosser, WA 99350

Steve Bradburn
Lincoln County Noxious Weed Bd.
Box 241
Davenport, WA 99122

William S. Braunworth, Jr.
Department of Horticulture
Oregon State University
Corvallis, OR 97331

Ronald G. Brenchley
Mobay Chemical Corporation
Rt. 1, Box 31
Ashton, ID 83420

High C. Bringhurst, Jr.
Salt Lake County
1814 W. 6020 South
Salt Lake City, UT 84118

Bart Brinkman
Sandoz Crop Protection
5130 2nd Avenue S.E.
Salem, OR 97306

John H. Brock
Division of Agriculture
Arizona State University
Tempe, AZ 85287

Jonathan Brown
Norpac Foods, Inc.
4755 Brooklake Rd. N.E.
Salem, OR 97305

Carl Buchholz
Ciba-Geigy Corporation
12413 Wide Hollow Rd.
Yakima, WA 98908

Daniel C. Burkhart
Dupont Agricultural Products
2126 A Haven Rd.
Wilmington, DE 19809

Stephen T. Burningham
Utah Department of Agriculture
350 N. Redwood Rd
Salt Lake City, UT 84116

Ronald J. Burr
Rhone-Poulenc, Inc.
13446 Waldo Hills Drive S.E.
Sublimity, OR 97385

Larry C. Burrill
Crop Science Department
Oregon State University
Corvallis, OR 97331

Leslie N. Burrough
Sublette County Weed & Pest
Box 729
Pinedale, WY 82941

Robert H. Callihan
Plant, Soil & Entomol. Science
University of Idaho
Moscow, ID 83843

David Cammack
University of Idaho
Box AA
Aberdeen, ID 83201

Thomas Camp
Aquatic Management Company
P.O. Box 14516
Phoenix, AZ 85063

Mick Canevari
Univ. Calif. Coop. Extension
420 S. Wilson Way
Stockton, CA 95205

John Cantlon
DuPont
348 East Fairbrook
Boise, ID 83706

Keith Cargill
Turlock Irrigation District
333 East Canal Drive
Turlock, CA 95381

Steven J. Carlson
American Cyanamid
104 Raymond Place
Boise, ID 83704

Vanelle Carrithers
Dow Chemical Company
Rt. 1, Box 1313
Davis, CA 95616

John Cenarrusa
Blaine County Weed Control
Box 165
Carey, ID 83320

Jon P. Chernicky
Univ. Arizona Coop. Extension
820 E. Cottonwood Ln, Bldg C
Casa Grande, AZ 85222

William J. Chism
Plant Path, Phys, & Weed Sci.
Virginia Tech
Blacksburg, VA 24061

Ostin A. Chivinge
Crop Science Department
University of Zimbabwe
Box 167
Mt. Pleasant, ZIMBABWE 303211

M. Dale Christensen
Ciba-Geigy Corporation
1951 Chateau Ct.
Walnut Creek, CA 94598

M. Brent Chugg
Del Monte Corporation
P.O. Box 59
Franklin, ID 83237-0059

Lawrence Clement
Univ. Calif. Coop. Extension
2000 W. Texas Street
Fairfield, CA 94533

William T. Cobb
Lilly Research Labs
815 S. Kellogg
Kennewick, WA 99336

Donald R. Colbert
American Cyanamid Company
2133 Jackson Street
Lodi, CA 95240

Floyd O. Colbert
Lilly Research Laboratories
7521 W. California Ave.
Fresno, CA 93706

Elizabeth Cole
Forest Science Department
Oregon State University
Corvallis, OR 97331

Arlo Coleman
ITD - Division of Highways
P.O. Box 97
Rigby, ID 83442

John W. Colgan
Mobay Corporation
Box 4913
Kansas City, MO 64120

Craig Collins
Collins Agr. Consultants, Inc.
Rt. 2, Box 344
Hillsboro, OR 97123

Ron Collins
Collins Agr. Consultants, Inc.
Rt. 2, Box 344
Hillsboro, OR 97123

Dale R. Comer
Nor-Am Chemical Company
135 W. Walnut Avenue
Visalia, CA 93277

Richard D. Comes
USDA/ARS
P.O. Box 30
Prosser, WA 99350

Julie Concannon
Crop Science Department
Oregon State University
Corvallis, OR 97330

Gilbert E. Cook
DuPont Company
S. 303 Barker Rd.
Greenacres, WA 99016

Fred G. Corbus
4633 N. 42nd Place
Phoenix, AZ 85018

Deborah K. Cowan
Union Carbide Agr. Products
1881 Seventh Avenue
Sacramento, CA 95818

James Pete Cox
1698 N. Hornet
Fresno, CA 93727

Garvin Crabtree
Horticulture Department
Oregon State University
Corvallis, OR 97331

Roe D. Crabtree
E. 11613 4th Avenue
Spokane, WA 99206

A. S. Crafts
Botany Department
University of California
Davis, CA 95616

Ron P. Crockett
Monsanto
17004 NE 37th Circle
Vancouver, WA 98682

Jim Crosby
DuPont Company
5508 70th Street
Lubbock, TX 79424

David W. Cudney
Univ. Calif. Coop Extension
Batchelor Hall, UC Riverside
Riverside, CA 92521

Alan W. Dalrymple
Plant Science Division
Box 3354 Univ. Station
Laramie, WY 82071

Lee C. Darlington
BASF Wyandotte Corporation
4609 Englewood Avenue
Yakima, WA 98908

Edward S. Davis
Plant & Soil Science Dept.
Montana State University
Bozeman, MT 59717

Jason C. Davison
Nevada Coop. Extension Service
569 Court Street
Elko, NV 89801

Jean H. Dawson
USDA/ARS
P.O. Box 30, IAREC
Prosser, WA 99350

Boysie E. Day
43 Western Drive
Richmond, CA 94801

Nathan Dechortez
USDA Aquatic Weed Research
Botany Department
University of California
Davis, CA 95616

Howard Deer
Extension Pesticide Specialist
Utah State University
Logan, UT 84322-4620

Brian D. Deeter
Union Carbide
2155 S. 14th Avenue #17
Yuma, AZ 85364

Steven A. Dewey
Plant Science Department
Utah State University
Logan, UT 84322-4820

Thomas C. DeWitt
PPG Industries, Inc.
1530 E. Shaw Ave. Suite 117A
Fresno, CA 93710

Mike Dial
Plant, Soil & Entomol Science
University of Idaho
Moscow, ID 83843

Phil Diener
Oregon State University
2410 NW Rolling Green
Corvallis, OR 97330

Joseph M. DiTomaso
Plant & Soil Science Dept.
Montana State University
Bozeman, MT 59717-0002

Len Dobbins
FMC Ag Chemicals
11128 John Galt Blvd
Omaha, NE 68137

William W. Donald
USDA Metabolism & Radiation
Research Lab
Fargo, ND 58105

Joseph E. Dorr
Ciba-Geigy Corporation
5510 Birdcage St., Suite 110
Citrus Heights, CA 95610

Robert Downard
Plant Science Department
Utah State University
Logan, UT 84322-4820

Brian Drew
Crop Development Center, Rm 316
University of Saskatchewan
Saskatoon, Saskatchewan
CANADA S7N 0W0

Dan Drummand
University of Idaho
P.O. Box 2307
Twin Falls, ID 83301

James H. Dukes, Jr.
Forest Science Department
Oregon State University
Corvallis, OR 97331

Robert Dunlap
Union Carbide Agr. Products Co.
3239 E. Vartikian Avenue
Fresno, CA 93710

Ken W. Dunster
Union Carbide Ag Products Co.
P.O. Box 2188
Fremont, CA 94536

Donal P. Dwyer
Nor-Am
266 S. Monroe
Fresno, CA 93726

Charlotte Eberlein
Agronomy Dept., 404 Borlaug
Univ. Minnesota, 1991 Buford C.
St. Paul, MN 55108

Matthew Ehlhardt
Hoechst Roussel Corporation
29 Violet Lane
Ione, CA 95640

Roeland Elliston
Crook County Weed & Pest Dist.
P.O. Box 7
Sundance, WY 82729

Clyde L. Elmore
Botany Department
University of California
Davis, CA 95616

John O. Evans
Plant Science Department
Utah State University
Logan, UT 84322-4820

Richard Evans
Plant, Soil & Entomol. Science
University of Idaho
Moscow, ID 83843

Peter Fay
Plant & Soil Science Departme
Montana State University
Bozeman, MT 59717

John Fenderson
Sandoz Crop Protection
Box 47
Kiowa, KS 67070

Raquel Ferdandez
Oregon State University
3930 NW Witham Hill Dr, Apt 4
Corvallis, OR 97330

Mark A. Ferrell
Plant Science Division
University of Wyoming
Box 3354, Univ. Station
Laramie, WY 82071

Kirk J. Finn
ITD - Division of Highways
P.O. Box 97
Rigby, ID 83442

Albert Fischer
Oregon State University
P.O. Box 771
Corvallis, OR 97339

Duane G. Flom
Plant, Soil & Entomol. Science
University of Idaho
Moscow, ID 83843

Scott Fluer
Meagher County
Box 309
White Sulphur Springs MT 59645

R. A. Fosse
1601 E. French Camp Rd.
Manteca, CA 95336

Gus Foster
Sandoz Crop Protection
812 East Elizabeth Street
Ft. Collins, CO 80524

Ron J. Frank
E.I. DuPont
1205 N. 123 Street
Omaha, NE 68154

Virgil H. Freed
Agricultural Chemistry Dept.
Oregon State University
Corvallis, OR 97331

James S. Freeman
Cascade County Weed Control
521 1st Avenue N.W.
Great Falls, MT 59404

Mark Fricker
Turf Seed, Inc.
P.O. Box 250
Hubbard, OR 97032

Dean Gaiser
Dow Chemical
E. 15407 Mission Ave, Suite 200
Veradale-Spokane, WA 99037

John Gallagher
6301 Winthrop Drive
Raleigh, NC 27612

Eric Gallandt
Plant & Soil Science Dept.
Montana State University
Bozeman, MT 59717

R. T. Galvin
Idaho Transportation Department
P.O. Box 2A
Shoshone, ID 83342

Jack Gant
ITD Division of Highways
P.O. Box 8028
Boise, ID 83707

Luis Garcia-Torres
Crop Science Department
Oregon State University
Corvallis, OR 97331

Allen Gardner
Cache County Weed Control
P.O. Box "C"
Logan, UT 84321

Leland A. Gardner
Jefferson County Weed Control
Courthouse, Rm 34
Rigby, ID 83442

Don R. Gargano
Pennwalt Corporation
51 Anne Marie Ct.
Hollister, CA 95023

David Gealy
USDA/ARS, 215 Johnson Hall
Agronomy & Soils Department
Washington State University
Pullman, WA 99164

Gene Geiser
ITD, Bureau of Aeronautics
3483 Richenbacker
Boise, ID 83705

G. Pat Gentry
BASF Corporation
48 Woodleaf Court
Novato, CA 94947

J. L. Glasgow
Stauffer Chemical Company
P.O. Box 760
Mt. View, CA 95119

Todd Glass
IDT, Bureau of Aeronautics
3483 Rickenbacker
Boise, ID 83705

Jean A. Gleichsner
Crop Science Dept., Rm 323
Oregon State University
Corvallis, OR 97331

Bill Gluck
BASF Corporation
100 Cherry Hill Road
Parsippany, NJ 07054

Susan Going
Bannock County Weed Control
5500 South 5th
Pocatello, ID 83204

George Gowgani
Crop Science Department
California Poly State Univ.
San Luis Obispo, CA 93407

Mary B. Graham
Horticulture Department
Oregon State University
Corvallis, OR 97331

James C. Graham
Monsanto Company, C3SC
800 N. Lindbergh Blvd
St. Louis, CO 63167

John M. Green
Unit #44
3411 South Camino Seco
Tucson, AZ 85730

Mary J. Griffin
Sandoz Crop Protection Corp.
341 East Ohio Street
Chicago, IL 60611

Robert Gunnell
Yielder Drill
P.O. Box 99
Arimo, ID 83214

Tip Haagsma
Dow Chemical Canada Inc.
P.O. Box 1012, Modeland Rd.
Sarnia, Ontario
CANADA N7T 7K7

Irving Hackett
Range, Wildlife & Forestry Dept
Univ. of Nevada, 1000 Valley Rd
Reno, NV 89512

Lloyd C. Haderlie
Univ. Idaho Res & Ext. Center
P.O. Box AA
Aberdeen, ID 83210

Delane M. Hall
Power County Weed Control Unit
P.O. Box 531
American Falls ID, 83211

Donald H. Hall
Brea Agricultural Services, Inc
Drawer I
Stockton, CA 95201

L. K. Hall
Idaho Transportation Dept.
P.O. Box 2A
Shoshone, ID 83352

Simon K. Hall
American Cyanamid
Box 400
Princeton, NJ 08540

Sandra Halstead
Agronomy Dept., 1575 Linden Dr.
University of Wisconsin
Madison, WI 53706

K. C. Hamilton
Plant Sciences Department
University of Arizona
Tucson, AZ 85721

Jack V. Handly
Dow Chemical Company
Rt. 1, Box 1313
Davis, CA 95616

Lawrence F. Hanlon
Bureau of Land Management
3380 Americana Terrace
Boise, ID 83702

Charles A. Hanson
Field Agr. Chem & Tech. Serv.
P.O. Box 9303
Whittier, CA 90608

Ronald H. Hanson
Union Carbide
8172 Pollard Avenue
Fair Oaks, CA 95628

L. T. Hargett
Sandoz Crop Protection
341 East Ohio Street
Chicago, IL 60611

Jonathan J. Hart
Botany Department
University of California
Davis, CA 95616

W. A. Harvey
14 Parkside Drive
Davis, CA 95616

E. Stanley Heathman
Plant Sciences Department
University of Arizona
Tucson, AZ 85721

Eugene Heikes
716 Garfield
Fort Collins, CO 80524

Larry W. Hendrick
BASF Corporation
15 Seventh Avenue
Mine Hill, NJ 07801

Gamal Heneidi
235 Bread & Milk Street
Coventry, CT 06238

Ray C. Henning
Chevron Chemical Company
1052 E. Shaw Avenue
Fresno, CA 93710

Ann Henson
DuPont Company
926 Yucca Ct.
Longmont, CO 80501

Charles P. Kicks
Rhone-Poulenc, Inc.
1643 W. Swallow Rd.
Ft. Collins, CO 80526

R. C. Hildreth
1031 White Gate Rd.
Danville, CA 94526

James E. Hill
Agronomy & Range Sci. Extension
University of California
Davis, CA 95616

Larry K. Hiller
Horticulture & L.A. Dept.
Washington State University
Pullman, WA 99164-6414

George F. Hittle
Wyoming Dept. of Agriculture
P.O. Box 4101
Cheyenne, WY 82003

Mike D. Holsten
Idaho Transportation Dept.
P.O. Box 4700
Pocatello, ID 83201

Jodie S. Holt
Botany & Plant Sciences Dept.
University of California
Riverside, CA 92521

James C. Hull
Franklin County
Rt. #3, 2887 E. Cub River Rd
Preston, ID 83263

Neil Humburg
6615 Evers Blvd.
Cheyenne, WY 82009

C. R. Hunt
Bob Hunt Associates
1514 Meadowlark Drive
Great Falls, MT 59404

Chuck Huston
Agronomy Dept., Johnson Hall
Washington State University
Pullman, WA 99163

Charles E. Jackson
Uniroyal Chemical Company
7112 E. Alluvial
Clovis, CA 93612

Nelroy Jackson
Monsanto Agr. Products Company
24551 Raymond Way, Suite 285
El Toro, CA 92630

Stott Howard
Washington State University
1468 Memorial Highway
Mt. Vernon, WA 98273

Larry S. Jeffery
Agronomy & Horticulture Dept.
Brigham Young University
Provo, UT 84602

Lynn Jensen
Oregon State Univ. Extension
710 SW 5th Avenue
Ontario, OR 97914

James I. Jessen
Stauffer Chemical Company
Box 889
Glendive, MT 59330

David W. Johnson
University of Wyoming
1020 1/2 Kearney Street
Laramie, WY 82070

Douglas L. Johnson
Cascade County Weed Control
521 1st Avenue NW
Great Falls, MT 59404-2885

Keith D. Johnson
DuPont Company
P.O. Box 2558
Bismark, ND 58502

Steven B. Johnson
Rhone-Poulenc
Route 2, Box 2154, Roza Drive
Zillah, WA 98953

Blaine Jones
Utah State Univ. Extension
160 N. Main
Nephi, UT 84648

Carl E. Joplin
Mobay Chemical Corporation
Rt. 7, Box 7165-D
Nampa, ID 83651

Lowell S. Jordan
Botany & Plant Sciences Dept.
University of California
Riverside, CA 92521

Patricia Joseph
ITD Division of Highways
P.O. Box 8028
Boise, ID 83707

Donald N. Joy
Uniroyal Chemical
4205 Barge Street
Yakima, WA 98908

Larry K. Justesen
Carbon County Weed & Pest Dist
P.O. Box 1126
Rawlins, WY 82301

Mike Kawate
Oregon State University
1500 Sheridan, Ap. 3
Prosser, WA 99350

J. Phillip Keathley
Keathley Agricultural Services
25330 S. Ruess Road
Ripon, CA 95366

Bruce Kelpsas
Northwest Chemical Corporation
4560 Ridge Drive, NE
Salem, OR 97303

Harold M. Kempen
Univ. California Coop. Ext.
P.O. Box 2509
Bakersfield, CA 93303-2509

Jack M. Kennedy
Monsanto Company, C3SC
800 N. Lindbergh Blvd.
St. Louis, MO 63167

Dan Kidder
Univ. Idaho Coop. Extension
1330 File Avenue E.
Twin Falls, ID 83301

David L. King
Sandoz Crop Protection
975 California Avenue
Palo Alto, CA 94304-1104

Wayne O. King
Horticulture Department
Oregon State University
Corvallis, OR 97331-2911

Jim Klauzer
Rohm & Haas Company
5750 West Jarvis Avenue
Niles, IL 60648

Mary M. Kleis
130 New Street
Bridgeton, NJ 08302

Ron Kolb
University Hall, Rm 131
2199 Addison Street
University of California
Berkeley, CA 94720

Jeffrey C. Kollenkark
Ciba-Geigy
5381 N. McCall
Clovis, CA 93612

Don L. Kosteff
Fremont County Weed & Pest
County Courthouse
Lander, WY 82520

David A. Kovack
University of Idaho
1528 East "B" Street
Moscow, ID 83843

Bill Kral
DuPont Company
1739 Julie Lane
Twin Falls, ID 83301

James M. Krall
University of Wyoming
Route #1, Box 374
Torrington, WY 82240

W. B. Kremer
ITD - Division of Highways
P.O. Box 97
Rigby, ID 83442

Celestine Lacey
Montana Department of Agric.
Capitol Station
Helena, MT 59620

Fred N. Lamming
Fremont County Weed & Pest
County Courthouse
Lander, WY 82520

Arthur H. Lange
Herbicide Research Institute
9400 S. LacJac
Reedley, CA 93654

Tom Lanini
Botany Department
University of California
Davis, CA 95616

Lawrence W. Lass
Plant, Soil & Entomol Sci Dept.
University of Idaho
Moscow, ID 83843

Gary A. Lee, Director
Idaho Agr. Experiment Station
College of Agriculture
University of Idaho
Moscow, ID 83843

Richard D. Lee
Box 3AE
New Mexico State University
Las Cruces, NM 88003

Philip W. Leino
Univ. of Idaho Research Center
P.O. Box AA
Aberdeen, ID 83210

John Lindquist
Montana State University
Box 964
Bozeman, MT 59715

Kenneth W. Linville
Ball Research
P.O. Box 1411
East Lansing, MI 48823

Joan Lish
Plant, Soil & Entomol. Sci.
University of Idaho
Moscow, ID 83843

Dennis Loosli
ITD - Aeronautics Bureau
3483 Rickenbacker
Boise, ID 83705

Kelly Luff
PPG Industries
6809 Leisure Lane
Nampa, ID 83651

Allan J. Luke
Union Carbide Ag. Products Co.
P.O. Box 12014
Res. Triangle Park, NC 27709

Earl E. Lukkes
Big Horn Weed & Pest Control
355 East 5th
Lovell, WY 82431

Rodney G. Lym
Agronomy Dept., P.O. Box 5051
North Dakota State University
Fargo, ND 58105

Monique M. Mackasey
Dow Chemical
P.O. Box 1706, 3406 Bent Oak Dr.
Midland, MI 98640

Kevin A. Madsen
University of Wyoming
506 1/2 South 8th Street
Laramie, WY 82070

R. J. Marrese
Hoechst-Roussel Agri-Vet Co.
Rt. 202/206 North
Somerville, NJ 08876

Hamid Mashhadi
Plant Science Deparmtent
Utah State University
Logan, UT 84322-4820

Garry D. Massey
653 E. Dovewood
Fresno, CA 93710

Lowry Massie
IDI Americas, Inc.
Concord Pike
Wilmington, DE 19897

Bruce Maxwell
Forest Science Department
Oregon State University
Corvallis, OR 97331

Terry Mayberry
Nor-Am Chemical
Rt. 1, Box 218
Pendleton, OR 97801

Paul G. Mayland
Hoechst-Roussel Agri-Vet Co.
2962 Southgate Drive
Fargo, ND 58103

Donald A. McCall
Monsanto
800 N. Lindbergh Blvd, C3SC
St. Louis, MO 63167

John F. McCarthy
NACA
1155 15th Street NW
Washington, DC 20005

Hugh McEachen
South Columbia Basin Irr. Dist.
P.O. Box 96
Mesa, WA 99343

Daniel McGrath
Oregon State Univ. Extension
3180 Center St. NE, Rm 160
Salem, OR 97301

W. B. McHenry
Botany Department, Extension
University of California
Davis, CA 95616

James R. McKinley
Union Carbide
424 Aero View
Yakima, WA 98908

Mary McKone
Dow Chemical
1001 S. 24th St. W, Suite 115
Billings, MT 59102

Wayne K. McNeil
American Cyanamid
P.O. Box 400
Princeton, NJ 08540

Charles Melton
Rhone-Poulenc Inc.
1247 W. Millbrae Avenue
Fresno, CA 93711

Robert J. Meyer
Weed Control Mgt. Inc.
156 Pasatiempo Drive
Bakersfield, CA 93305

Reao H. Mickelson
Caribou County Weed Control
159 South Main
Soda Springs, ID 83276

Stephen D. Miller
Plant Science Division
University of Wyoming
Univ. Sta. Box 3354
Laramie, WY 82071

Tim Miller
Plant, Soils & Entom. Sci. Dept
University of Idaho
Moscow, ID 83843

Larry W. Mitich
Botany Department
University of California
Davis, CA 95616

Allen Mooney
Campbell County Weed & Pest
Box 191
Gilette, WY 82716

Jim Moore
Idaho Transportation Department
P.O. Box 2A
Shoshone, ID 83301

Gaylin F. Morgan
Morgan & Myers
146 E. Milwaukie
Jefferson, WI 53549

Don W. Morishita
Kansas State University
S.W. Kansas Experiment Station
Eminence Route
Garden City, KS 67846

Sud Morishita
Bonneville County Weed Control
605 N. Capital
Idaho Falls, ID 83402

Larry A. Morrow
Nu Chem. Ltd.
NW 2010 Friel
Pullman, WA 99163

Howard L. Morton
USDA/ARS
2000 E. Allen Road
Tucson, AZ 85719

George Mueller-Warrant
USDA-ARS, Crop Science Dept.
Oregon State University
Corvallis, OR 97331

Barbra Mullin
Montana Dept. of Agriculture
920 North Benton
Helena, MT 59601

W. R. Mullison
Consultant
1412 North Parkway
Midland, MI 48640

Greg Munden
Idaho Transportation Dept.
P.O. Box D
Coeur d'Alene, ID 83814

Glen A. Mundt
Yellowstone, International
P.O. Box 957
Billings, MT 59103

Tom J. Neidlinger
Rohm & Haas Company
13016 NE Pacific Court
Portland, OR 97230

W. Richard Neilson
PPG Industries, Inc.
2852 Viejas View Place
Alpine, CA 92001-9535

Jim Nelson
Plant & Soil Science Dept.
Montana State University
Bozeman, MT 59717

Marlyn J. Nelson
Bingham County Weed Control
P.O. Box 583
Blackfoot, ID 83221

Michael Newton
Forest Science Department
Oregon State University
Corvallis, OR 97331

Dale W. Nicol
ICI Americas, Inc.
17629 Magnolia
Shafter, CA 93263

Richard S. Nielsen
American Cyanamid Company
2727 W. Bluff Ave., #108
Fresno, CA 93711

R. Scott Nielsen
Spokane County Weed Board
N 222 Havana Street
Spokane, WA 99202

Robert F. Norris
Botany Department
University of California
Davis, CA 95616

Francis E. Northam
Plant, Soil & Entom. Sci. Dept.
University of Idaho
Moscow, ID 83843

Alex G. Ogg, Jr.
USDA-ARS
215 Johnson Hall
Washington State University
Pullman, WA 99164

Paul J. Ogg
American Cyanamid Company
3619 Mountain View
Longmont, CO 80501

Richard Old
Plant, Soils & Entom. Sci. Dept
University of Idaho
Moscow, ID 83843

Ben Oller
Mobay Chemical Corporation
1900 N. Gateway Blvd, Suite 152
Fresno, CA 93727

Phillip D. Olson
Hoechst-Roussel
3867 Van Dusen
Riverbank, CA 95367

Deborah R. Orcutt
Botany & Plant Science Dept.
University of California
Riverside, CA 92521

Steve Orloff
University of California
1110 West Ave. J Rm 5
Lancaster, CA 93534

Gregory L. Orr
Plant Pathology & Weed Science
Colorado State University
Fort Collins, CO 80523

Jack P. Orr
University of California
4145 Branch Center Rd.
Sacramento, CA 95827

John E. Orr
ICI Americas, Inc.
2018 Coloma Way
Boise, ID 83712

Charles E. Osgood
BASF Corporation
1134 Chickadee Drive
Boise, ID 83709

Karen W. Ott
Stauffer Chemical Company
P.O. Box 760
Mt. View, CA 94042

Jack Otta
Rhone-Poulenc, Inc.
RR 2, Box 85
Volga, SD 57071

Joe L. Pafford
Elanco
3131 S. Vaughn Way, Suite 111
Aurora, CO 80014

Harlan L. Palm
DuPont Company
83 S. Devinney Street
Golden, CO 80401

Robert H. N. Park
E.I. duPont de Nemours
2180 Sand Hill Rd., Suite 240
Menlo Park, CA 94025

Robert Parker
Washington State University
IAREC, Box 30
Prosser, WA 99350

James V. Parochetti
USDA Extension Service
South Bldg. Rm 3347 ES
Washington, DC 20250

Robert R. Parsons
Park County Weed & Pest Control
P.O. Box 626
Powell, WY 82435

Chris S. Payne
Union Carbide Agr. Products Co.
Rt. 3, Box 6499
Twin Falls, ID 83301

Dwight V. Peabody
Rt 1, Box 1917
Lopez, WA 98261-9801

John O. Pearson
BASF Corporation
1384 Greenborough Drive
Roseville, CA 95661

Daniel Peek
Crop Science Department
Oregon State University
Corvallis, OR 97331

Phil J. Petersen
DuPont
2366 Rolling Hills Drive
Clarkston, WA 99403

Irvine L. Phillips
Experimental Farms Co.
P.O. Box 68
Greenfield, CA 93927

Michael Ponozzo
ITD - Division of Highways
P.O. Box 837
Lewiston, ID 83501

Bob Pope
Stauffer Chemical Company
1391 S. 49th
Richmond, CA 94804

Richard T. Powell
ITD - Division of Highways
P.O. Box 8028
Boise, ID 83707

Tim Prather
University of Idaho
1317 Orchard Avenue
Moscow, ID 83843

Malyn Poulson
University of Idaho
Box AA
Aberdeen, ID 83210

C. L. Prochnow
Stauffer Chemical Company
11509 N.E. 3rd Avenue
Vancouver, WA 98685

L. Joe Purchase
American Cyanamid Company
18947 E. Mercer Drive
Aurora, CO 80013

Warren G. Purdy III
Brea Agricultural Service, Inc.
Drawer I
Stockton, CA 95201

Mickey Qualls
Cenex Research
374 Dodson Rd
Ephrata, WA 98823

Steven R. Radosevich
Forest Science Department
Oregon State University
Corvallis, OR 97331-5704

Dan W. Ragsdale
1487 Whispering Pines
St. Louis, MO 63146

Phillip Rahn
Monsanto
800 N. Lindbergh Blvd.
St. Louis, MO 63167

Patrick Rardon
E.I. duPont, Stine Lab
Box 30
Newark, DE 19711

Dennis Rasmusson
Monsanto Chemical Company
900 N. Broadway, Suite 212
Minot, ND 58701

Thomas A. Reeve
Utah State Univ. Extension Serv.
Courthouse, Rm 201
Manti, UT 84642

Roy Reichenbach
1269 Sweetwater Rd
Douglas, WY 82633

Mark Reid
Agronomy & Soils Department
Washington State University
Pullman, WA 99163

Carlos Reyes
Crop Science Department
Oregon State University
Corvallis, OR 97331

Jesse Richardson
Dow Chemical USA
P.O. Box 881
City of Industry, CA 91747-0881

Richard S. Riddle
Stauffer Chemical Company
3729 Oak Ridge Drive
Yuba City, CA 95991

James D. Riggleman
DuPont Co., Agchem. Products
Walker's Mill Bldg
Barley Mill Plaza
Wilmington, DE 19898

J. E. Rinard
Idaho Transportation Department
P.O. Box 7129
Boise, ID 83703

John Rinehold
Agricultural Chemistry Dept.
Oregon State University
Corvallis, OR 97331

Mark A. Risley
American Cyanamid Company
701 S. 48th Ave., M-4
Yakima, WA 98908

Stacey R. Roberts
Agronomy & Range Sci. Extension
University of California
Davis, CA 95616

Don E. Robinson
Lilly Research Labs
P.O. Box 708
Greenfield, IN 46140

R. Barry Rogers
Innovative Equipment Inc.
1510 Hilliard St. E.
Saskatoon, Sask.
CANADA S7J 0G4

Edward M. Rose
Agricultural Consultant
12150 E. Kings Canyon Rd.
Sanger, CA 93657

J. Malone Rosemond
Monsanto Company
7806 Madison Avenue, #146
Fair Oaks, CA 95628

Claude Ross
FMC Corporation
4343 Redbird Ct.
Loveland, CO 80537

Louis Russo
Sandoz Crop Protection
1610 W. Sierra Avenue
Fresno, CA 93711

Frederick J. Ryan
USDA/ARS Aquatic Weeds
Botany Department
University of California
Davis, CA 95161

Donald J. Rydrych
Oregon State University
Box 370
Pendleton, OR 97801

Doug Ryerson
Monsanto Ag Products Company
1201 10th Ave. S., Suite 206
Great Falls, MT 59045

Eric S. Sachs
Monsanto Ag Products Company
723 E. Locust, Suite 120
Fresno, CA 93710

John L. Saladini
2612 Stephenson Drive
Wilmington, DE 19808

Carol Sattler
University of Idaho
Box 247
Troy, ID 83871

James E. Saxton
Bear Lake County Weed Control
P.O. Box 218
Paris, ID 83261

William C. Schaffers
Oregon State University
4781 Drift Creek Rd. SE
Sublimity, OR 97385

Roland Schirman
Wash. State Univ. Coop. Ext.
202 S. Second
Dayton, WA 99328

John T. Schlesselman
Rohm & Haas Company
726 E. Kip Patrick Drive
Reedley, CA 93654

Jerry Schmierer
Univ. California Coop Extension
Memorial Bldg.
Susanville, CA 96130

Galen L. Schroeder
Sandoz Crop Protection
1233 4th St. North
Fargo, ND 58102

Manfred Schroeder
BASF
229 Lake Road
Morristown, NJ 07960

Tim W. Schultz
Adams County Noxious Weed Board
210 W. Broadway
Ritzville, WA 99169

Thomas K. Schwartz
Union Carbide Ag. Products Co.
26 W. Dry Creek Circle, Suite 460
Littleton, CO 80120

Edward E. Schweizer
USDA,ARS Sugarbeet Prod. Res.
1701 Center Avenue
Fort Collins, CO 80526

Allen C. Scoggan
Mobay Chemical Corporation
1900 N. Gateway Blvd, Suite 152
Fresno, CA 93727

Clarence Seely
University of Idaho
430 Lewis
Moscow, ID 83843

M. Segovia
Idaho Transportation Dept.
P.O. Box 2A
Shoshone, ID 83352

Warren C. Shaw
1907 Edgewater Parkway
Silver Springs, MD 20903

David A. Shields
BASF Corporation
10181 Avenue 416
Dinuba, CA 93618

Thomas H. Shrader
U.S. Bureau of Reclamation
700 E. San Antonio, Rm B-318
El Paso, TX 79901

Edwin E. Sieckert
Monsanto
2415 Rockingham Cir.
Lodi, CA 95240

Tena R. Skeen
Grant County Noxious Weed Board
P.O. Box 1115
Ephrata, WA 98823

Darryl E. Smika
USDA-ARS Great Plains Res. Sta.
P.O. Box K
Akron, CO 80720

Randy L. Smith
Rohm & Haas Company
4407 N. Forestiere
Fresno, CA 93722

Carol Somody
Ciba-Geigy Corporation
P.O. Box 18300
Greensboro, NC 27419

Leslie W. Sonder
California Dept. Food & Agric.
1220 N Street, Rm A357
Sacramento, CA 95814

Ronald E. Sosebee
Range & Wildlife Mgt. Dept.
Texas Tech University
Lubbock, TX 79409

David F. Spencer
USDA/ARS Aquatic Weed Res. Lab.
Botany Department
University of California
Davis, CA 95616

Phillip Stahlman
Fort Hays Experiment Station
Route 2
Hays, KS 67601

Gil Stallkneck
Montana So. Agr. Res. Center
748 Railroad Hwy
Huntley, MT 59037

Mark Stannard
Plant & Soil Science Department
Montana State University
Bozeman, MT 59717

Kevin Staska
Hoechst-Roussel Agri-Vet Co.
1812 Terrace Drive
Minot, ND 58701

Sam Stedman
Univ. Arizona Extension Serv.
1320 N. Arbor
Casa Grande, AZ 85222

James F. Stewart
Nor-Am Chemical
68 N. Cindy
Clovis, CA 93612

Vern R. Stewart
N.W. Agr. Res. Center, MSU
4570 Montana 35
Kalispell, MT 59901

Loyd L. Stitt
Field Seed Mgt.
1085 Johnson Place
Reno, NV 89509

Richard M. G. Stoltz
American Cyanamid Company
506 W. Tenaya Avenue
Clovis, CA 93612

Amy E. Stowe
Botany & Plant Sciences Dept.
University of California
Riverside, CA 92521

Larry T. Stowell
Mycogen Corporation
5451 Oberlin Drive
San Diego, CA 92121

William Stump
Plant Science Division
University of Wyoming
Box 3354 University Station
Laramie, WY 82071

Dean G. Swan
Agronomy Department, 173 Jsn.
Washington State University
Pullman, WA 99164-6412

Jerry Swensen
Plant, Soil & Entom Sci. Dept.
University of Idaho
Moscow, 83843

Mark G. Sybouts
Sandoz Crop Protection
351 Pippin Drive
Fallbrook, CA 92028

Karin Tanphiphat
Crop Science Department
Oregon State University
Corvallis, OR 97331

Larry Tapia
University of Idaho
P.O. Box 3574
Moscow, ID 83843

Thomas A. Terry
Weyerhaeuser Company
505 N. Pearl Street
Centralia, WA 98531

Paul L. Thayer
Lilly Research Laboratories
P.O. Box 814789
4404 Beltwood Pkwy S.
Farmers Branch, TX 75234

Edwin Theriot
US Army Corps of Engineers
Environ. Lab, Waterways Exp Sta
Vicksburg, MS 39180

Donn C. Thill
Plant, Soil & Entom Sci. Dept.
University of Idaho
Moscow, ID 83843

James M. Thomas
FMC Corporation
219 N. 65th Place
Yakima, WA 98908

Lafayette Thompson, Jr.
Editor, WSSA Newsletter
1142 E. Maynard Rd.
Cary, NC 27511

W. T. Thomson
Monterey Chemical Company
P.O. Box 5317
Fresno, CA 93755

Bruce Thornton
1507 Peterson
Fort Collins, CO 80521

Tom Threewitt
Ciba-Geigy Corporation
RR 3
Larned, KS 67550

Joan S. Thullen
U.S. Bureau of Reclamation
P.O. Box 25007, D-1522
Denver, CO 80225

Jeff Tichota
Sandoz Crop Protection
4949 S. Syracuse Pkwy, #3700
Denver, CO 80237

Barry Tickes
Univ. Arizona Extension Serv.
1047 4th Avenue
Yuma, AZ 85364

Frank Tietjens
BASF Corporation
10181 Avenue 416
Dinuba, CA 93618

Thomas C. Tillett
Rhom & Haas Company
1520 E. Shaw Ave, Suite 119
Fresno, CA 93710

F. L. Timmons
1047 North Caribe
Tucson, AZ 85710

D. C. Tingey
653 East 400 North
Logan, UT 84321

James M. Torell
Plant Science Department
Utah State University
Logan, UT 84322-4820

Alan Towson
Rhone Poulenc Inc.
3423 Raindrop Ct.
Boise, ID 83706

Dan Toya
Stauffer Chemical Company
Rt 1, Box 328 F
Warden, WA 98857

Paul Tresham
Wilbur Ellis Company
P.O. Box 609
Umatilla, OR 97882

Harvey D. Tripple
Monsanto Agric. Products Co.
Meridian Office Bldg
9785 Maroon Circle, Suite 110
Englewood, CO 80112

Stuart A. Turner
Stuart W. Turner & Co.
P.O. Box 10539
Bainbridge Island, WA 98110

Stuart W. Turner
Stuart W. Turner & Co., Inc .
P.O. Box 10539
Bainbridge Island, WA 98110

Kai Umeda
American Cyanamid Company
4531 West Gail Drive
Chandler, AZ 85226

Union Carbide Agric. Products
Library
P.O. Box 12014
Res. Triangle Park, NC 27709

R. Phillip Upchurch
College of Agriculture
University of Arizona
Tucson, AZ 85721

Bernal E. Valverde
323 Crop Science Department
Oregon State University
Corvallis, OR 97331

L. A. Vance
Idaho Dept. of Agriculture
120 Klotz Ln
Boise, ID 83701

Tim C. Vargas
Varco Ag Research & Consulting
180 West 100th North
Jerome, ID 83338

Ron Vargan
Univ. California Extension Serv
328 Madera Avenue
Madera, CA 93637

Kurt C. Volker
ICI Americas Inc.
7610 Scenic Drive
Yakima, WA 98908

Ronald E. Vore
P.O. Box 306
Beulah, WY 82712

Al Wageman
Canyon County Weed Control
Rt 9, Box 423
Caldwell, ID 83605

John D. Walker
Farm Crops Department
Ricks College
Rexburg, ID 83440

Ted R. Warfield
FMC Corporation
11128 John Galt Blvd
Omaha, NE 68137

Lloyd C. Warner
Lilly Research Laboratories
130 Palmer Drive
Fort Collins, CO 80525

Roderick W. Warner
E.I. duPont Company
502 Montain View Drive
Bozeman, MT 59715

Jim Warnock
Rt. 2, Box 105, Finch Rd
Walla Walla, WA 99362

G. F. Warren
1130 Cherry Lane
W. Lafayette, IN 47906

Jack W. Warren
Mobay Corporation
P.O. Box 97
Beavercreek, OR 97004

L. E. Warren
5623 Greenbrae Rd.
Sacramento, CA 95822

Steven D. Watkins
ICI Americas Inc.
2210 Lorie Lane
Yuma, AZ 85365

Cliff Watrin
ICI Americas Inc.
996 Coomwell Avenue
St. Paul, MN 55114

Max Ray Webster
Willamette Exporting, Inc.
1321 NW 17th Avenue
Portland, OR 97209

Philip Westra
Plant Path & Weed Science
Colorado State University
Fort Collins, CO 80523

Barbara H. Wells
Oregon State University
1703 College Street
Philomath, OR 97370

L. Doug West
Rohm & Haas Company
7250 Riverwind Way
Sacramento, CA 95831

Steve Whisenant
Botany & Range Sci, 401 WIDB
Brigham Young University
Provo, UT 84602

Diane White
Forest Science Department
Oregon State University
Corvallis, OR 97331

Ralph E. Whitesides
Agronomy & Soils Department
Washington State University
Pullman, WA 99164-6420

Tom Whitson
University of Wyoming
P.O.Box 3354, Univ. Station
Laramie, WA 82071

David M. Wichman
Central Research Station
Montana Ag. Exp. Station
Moccasin, MT 59462

Duke C. Wiley
BASF
95 Signature
Woodland, CA 95695

Roger W. Willemsen
Rhone Poulenc, Inc.
P.O. Box 5416
Fresno, CA 93755

Ray D. William
Horticulture Extension
Oregon State University
Corvallis, OR 97331

M. Coburn Williams
USDA, Biology Department
Utah State University
Logan, UT 84322-4563

Blacke D. Willis
Brigham Young University
1505 N. Canyon Rd. #7
Provo, UT 84604

Linda L. Willitts
ICI Americas Inc.
104 Prospector Court
Folsom, CA 95630

C. Barry Wingfield
United Agr. Services
P.O. Box E
Greeley, CO 80632

Sandra Wingfield
Agrisan
P.O. Box 323
Eaton, CO 80615

Winn Winkyaw
Salt River Project
Water C&M (X Cut)
P.O. Box 52025
Phoenix, AZ 85001

James M. Witt
Agricultural Chem. Dept.
Oregon State University
Corvallis, OR 97331

Jeff L. Wright
Idaho Transportation Dept.
P.O. Box 4700
Pocatello, ID 83201

Frank Young
USDA/ARS Johnson Hall, Rm 215
Washington State University
Pullman, WA 99164

David L. Zamora
Plant, Soil & Entom Sci Dept.
University of Idaho
Moscow, ID 83843

Paul J. Kloft
Collins Agr. Consultants Inc.
Rt. 2, Box 344
Hillsboro, OR 97123

Bob Spinney
Crop Science Department
Oregon State University
Corvallis, OR 97331

Robert L. Zimdahl
Weed Research Laboratory
Colorado State University
Fort Collins, CO 80523

Louis C. Hearn
ICI Americas Inc.
P.O. Box 3959
Visalia, CA 93278