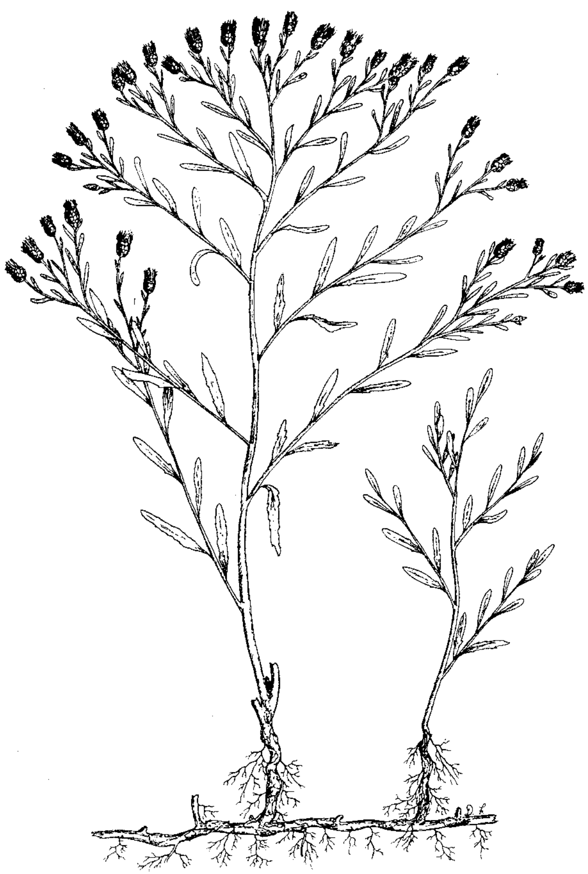

1973

PROCEEDINGS
of
THE WESTERN SOCIETY OF WEED SCIENCE

VOLUME 26

March 13, 14, 15, 1973

Spokane, Washington

WESTERN SOCIETY OF WEED SCIENCE
1972-1973

Executive Committee

President . . . . D.E. Bayer
Botany Department
University of California, Davis, California

President-Elect . . . . D.L. Burgoyne
E.I. duPont Co.
701 Welch Road, Palo Alto, California

Secretary . . . . G.A. Lee
Department of Plant Science
University of Wyoming, Laramie, Wyoming

Treasurer-Business Manager . . . . J.L. Anderson
Plant Science Department
Utah State University, Logan, Utah

Chairman Research Section . . . . J.O. Evans
Plant Science Department
Utah State University, Logan, Utah

Chairman-Elect Research Section . . . . E.E. Schweizer
Crops Research Labs.
Colorado State University, Fort Collins, Colorado

Chairman Extension and Regulatory Section . . . . S. Heathman
Extension Weed Specialist
University of Arizona, Tucson, Arizona

Chairman-Elect Extension and Regulatory Section . . . . A.H. Lange
San Joaquin Research and Extension
Parlier, California

Immediate Past President . . . . A. Appleby
Crop Science Department
Oregon State University, Corvallis, Oregon

Representative WSSA . . . . K. C. Hamilton
Department of Agronomy
University of Arizona, Tucson, Arizona

Member at Large . . . . W. R. Fisher

Standing Committees

Finance Committee . . . . W. L. Gould, Chairman
J. H. Dawson, G. Massey

Resolutions Committee . . . . W. L. Anliker, Chairman
H. L. Morton, H. M. Kempen

Nominations Committee . . . . H. P. Alley, Chairman
P. E. Heikes, K. W. Dunster

Local Arrangements Committee . . . . K. Wallace, Chairman

Program Committee . . . . D. L. Burgoyne, Chairman
J. O. Evans, S. Heathman

Western Society of Weed Science

PROGRAM AND TABLE OF CONTENTS

Presidential Address—A Look Into The Immediate Future

David E. Bayer[1]

I would like to share a few ideas with you that we as individuals and as a Society should be considering. These ideas are not new nor did they originate with me. Some of us are concerned with them now and many, if not all, of you will be in the future.

I am referring to the increasing tendency of state legislators to step-in and attempt to regulate the use of pesticides by passing laws. As the urban percentage of our population increases and the rural population decreases, the support for agriculture and agribusiness also decreases. Unless these people are made aware of the problems and have confidence in the people associated with agriculture and agribusiness they are easy prey to alarmists and other individuals providing information regardless of source. Too often today individuals make statements without assuming responsibility for their statements.

Legislators as well as other governmental employees are very much aware of the need for agricultural expertise in deciding questions and setting-up protocol. We as individuals involved with pesticides must overcome our reluctance to have more rigid restrictions placed on us by Federal and State Governments. There are 3 major aspects to these questions or problems:

1. We should be aware of what are the problems of concern.

2. We should be aware of the position and perspectives of the opposition.

3. We should approach the problem on the basis of political favor.

Possibly chemical or farm organizations have been reluctant to provide the individual with the know how to work with the public or they felt they had better things to do. Farmers are losing or have lost their political power and now must, in a manner of speaking, rely on what is given them.

It offers a unique advantage for those of you in states that have not initiated licensing and educational programs. However, if you wait, your legislature will surely dictate a program for you and then the chances of having something that you can live with will be lessened.

We should not wait to be forced into upgrading our profession. By taking the leadership we can have a voice in how and when it is going to be done. Why wait for a mandate. Wouldn't it be better to work for voluntary upgrading that would be more-or-less uniform from state to state. This would allow greater convenience for those individuals working across state lines.

Scientists at present have less than an admirable reputation in the eyes of the public. Therefore, I believe, you the local individual is in a better position to provide information to individuals and groups. This approach has many ramifications even extending into our Universities and Experiment Stations. Don't be surprised when you find your College of Agriculture or Experiment Station no longer able to continue the type or amount of research with which you are familiar. It seems inevitable that industry and commodity groups are going to have to pay for more of the research on their products. This carries with it the connotations at least that these parties are going to have a stronger voice in the research conducted as long as they supply the money. Industry needs certain types of information for registration and will be primarily interested in funding only these needs. Many administrators are designing their facilities as problem solving research task forces rather than the old discipline approach to research.

Now is a critical time in establishing policy on many aspects of our industry. Just because some chemicals, uses, or practices have been exempt in the past is no guarantee they will remain in this status forever. By taking an active role at this time we can influence the eventual outcome.

[1]Department of Botany, University of California, Davis 95616.

Regulations and Administrative Enforcement At The Federal Level

Donald W. Moos

Until enactment of the Federal Environmental Pesticide Control Act of 1972 pesticide regulation was carried out under the Federal Insecticide, Fungicide and Rodenticide Act of 1947. Reviewing very briefly, the focus of the old FIFRA was on the control of pesticide products shipped in interstate commerce through registration of products with EPA. Registration with the Federal Government required a showing on the part of the applicant that the product was effective for its intended use and that it was "safe" to use in accordance with its labeling.

The major vehicles for enforcing the Act were to cancel the registration of a product subsequently found to be harmful to humans or the environment, thus removing the product from interstate commerce or, in the case of imminent hazard, to suspend the registration with or without recall of a product.

Under the 1947 FIFRA, appeal to an order of suspension or cancellation was more often than not a lengthy process under which the registrant could sequentially request a scientific advisory committee and a quasi-judicial public hearing. The entire procedure could in a major case run on for several years.

In addition, authority was provided to invoke penalties for interstate shipment across state lines of misbranded and mislabeled products. The latter authority concerned itself largely with the actual composition of the product as shipped compared to the registered formulation and as such was largely a consumer protection provision rather than an environmental protection provision.

In summary, the 1947 FIFRA permitted EPA to control what products could be supplied to users through channels of interstate commerce, but provided no authority for influencing how they were actually used by the final consumer, nor could it control the supply of products manufactured and used in the same State.

Also, once registered, a product's use was available to all consumers and sale and use could not be restricted for products which were highly dangerous when used in a manner inconsistent with the label or damaging to the environment.

The new Federal Environmental Pesticide Control Act of 1972 completely revised the FIFRA of 1947 to provide the missing authorities over use and intrastate products. The provisions take effect at various dates from immediately upon enactment which was October 21, 1972, to four years after enactment at which time all provisions will be fully in effect.

EPA authority now covers marketing and use both inter- and intra- state. The use of any registered pesticide in a manner inconsistent with label instructions is prohibited, effective immediately and civil and criminal penalties are provided. Farmers (private applicators) can be fined up to $1,000 or given 30 days in prison or both upon criminal conviction for a knowing violation of the Act and are also liable to civil penalties of up to $1,000 on their second and subsequent offenses. Any registrant, commercial applicator, wholesaler, dealer, retailer, or other distributor who knowingly violates the Law is liable to a $5,000 civil or $25,000 criminal fine or one year in prison or both. These criminal penalties are now in effect. The civil penalties provisions will be effective as soon as policy and procedures are developed.

Control of the supply of pesticides into the market is continued through the registration procedures which remain from the old FIFRA with two major changes. First, products in intrastate commerce will be brought under Federal registration, with certain limited authority remaining with the States, allowing them to be more restrictive than EPA in regulating sale or use of specific pesticides if certified by the Administrator; also, to register pesticides formulated for use within the State to meet "special local needs" subject to the Administrator's review.

Second, registration is made more selective by providing two use categories–General Use and Restricted Use. A pesticide may be classified under either or both depending upon the uses involved. General Use pesticides may be used by anyone. Those placed in the restricted use category may be used only by, or under the supervision of, certified applicators or under such other conditions as the Administrator may require by regulations to protect man and the environment.

EPA has two years, until October 1974, to develop standards for classification and by 1976 must classify all pesticides as to general or restricted use.

States will certify applicators for use of restricted pesticides under standards to be promulgated by the Administrator. The Act allows four years for implementing certification provisions. Federal standards must be set forth by EPA by October 1973, and the Governor of each State has until 1975 to submit certification program plans to EPA in accordance with these standards. Such plans are to be approved by the Administrator within one year of submission.

The Act requires that the State plan

- designates a responsible State agency
- contains assurances that such agency has or will have the legal authority and qualified personnel to carry out the plan, and
- the State assures it will devote adequate funds to the administration of the plan, report to the Administrator as he may require, and follow EPA standards for certification.

EPA may assist States financially in the training and certification of applicators through contracts and grants-in-aid.

EPA and Regional assistance to States to assure that they have necessary legal authority to implement certification programs and to help in the development of adequate plans is a priority item. In addition, financial adequacy of states must be ascertained in order to develop appropriate financial assistance programs.

Several other areas of particular interest are:

The new law requires that pesticide manufacturing plants must be registered with EPA one year after enactment. Information on the types and amounts of pesticides produced distributed and sold must be submitted upon registration of the plant and updated annually. An EPA agent may enter and inspect such an establishment and take samples.

Limited authority has been expanded under the new law for issuance of experimental permits to allow for gathering of data under field conditions to assist in registration of a product. The authority to issue experimental permits may be delegated to a State.

The new law requires EPA to make information available to the public. The Administrator must publish in the Federal Register a notice of each registration application received if it contains a new active ingredient or entails a changed use pattern and allow 30 days for any interested party to comment and publish notice of denial and reasons, therefore, if an application is rejected.

The Administrator is required to develop procedures and regulations for the storage and disposal of pesticide containers and excess chemicals. It is important to note that EPA is legally responsible for accepting for disposal, only those pesticides which have been suspended and subsequently cancelled. Regulations and guidelines are currently being drafted to implement this section.

Deputy Administrator, Bob Fri, established an agency-wide task force on November 7, 1972, to explore policy and technical issues, make recommendations and develop regulations. Membership includes representatives from Regions 5 (Chicago) and 10 (Seattle) as well as Headquarters. The task force at its first meeting developed a subgroup procedure to deal with major, longer run sections of the Act. Of course, certain sections required that regulations be developed on a more immediate time frame and these are moving forward on the basis of specific assignments subject to task force review. Subgroups were named and began to function early in January.

The intent of the Agency to most effectively implement this Act is to obtain maximum input from interested parties prior to the publication of proposed regulations in the *Federal Register* for comment, and here we need your cooperation. We want comments from the Regions, States and special interest groups such as manufacturers, users and environmentalists.

We need to stimulate State participation and later provide proper advice and assistance to the States in development of their State legislation and programs. State legislatures will need to consider in many cases new legislation to permit them to operate in concert with Federal laws. The Regions have a key role in assuring that a thorough airing of issues is achieved.

Summarizing the effective dates of major sections of the Act of concern to Regions and States, effective now are the Use penalties which I mentioned previously. In addition, Stop Sale, Use, Removal and Seizure provisions are included. Indemnities in certain instances are also provided.

Regulations which need to be produced almost immediately are those concerned with statutory appeals, disposal of excess chemicals and containers, and Federal/State emergency exemptions.

In the longer term–

Within one year EPA must (1) *Issue standards for certification of applicators,* and (2) *regulations for*

– *Experimental Permits*
– *Registration of Establishments*
– *Requirements for Books and Records*

Within two years EPA must issue

– *Standards for Classification of Pesticides*
– Regulations for registration of products under the new Act, including intra-state products now currently registered with the States

As I alluded to earlier, EPA does not intend to wait a full two years before implementing registration provisions. We will consider restricted use registrations for products cancelled during the past two years on sufficient showing of benefit, absence of alternatives, adequate control over bootlegging for other uses, and supply of sufficient new evidence supporting special uses. I do not wish to imply that such reregistration will be easy–it won't. A substantial case will be necessary and in many cases a hearing will be necessary prior to consideration of such registrations.

Second, it is our intent that States not register products for intra-state use which have been suspended or cancelled for noncompliance with the 1947 FIFRA or the 1972 amendments. This includes DDT, mercurials, Mirex, Aldrin/Dieldrin, the predacides 1080, cyanide, strychnine, and thallium.

We will, during the two-year period, identify other classes of chemicals which will be brought under Federal registration to effectuate an orderly transition. We must bring some unknown but presumably large number of intra-state products under Federal registration. Here, there is a need for the Regions to assist us in determining specific intra-state registration which exist.

By three years after enactment, State plans for certification programs are to be submitted.

By four years, the whole Act must be implemented

– All pesticide products must be registered according to classification
– States must be capable of certifying all applicators. cators.

Now let me summarize the major provisions of the Act which affect the States and then principal elements of Regional programs directed toward helping us to implement the FEPCA. These five sections relate to major areas of delegation authorized in FEPCA.

– Applicator certification
– Experimental Use Permits
– Emergency Exemptions
– State Registration
– Cooperative Enforcement

Applicator Certification provisions allow the States to develop programs to handle certification in accordance with Federal standards and under a plan acceptable to the Administrator. In order to participate, a State must have the authority to carry out such a program. Some States already have authority for commercial applicator programs but we know of none for private applicators who are also covered by the FEPCA. Our Regions should work with States to assure authority exists or is obtained. Since standards will not be issued until Fall of 1973, such authority should be broad rather than specifically tied to classes of applicator, educational levels, etc. to the extent possible with such details to be covered by State regulation.

Financial assistance to States is authorized in the form of contracts to encourage the training of certified applicators and through Grants-in-aid to assist States in developing and administrating State programs for training and certification. The 1974 budget request provides for about $1.0

million to be used to assist States in this area. It also provides for additional manpower to EPA Regions to advise and assist States. Taken in the context of 50 states, obviously $1 million will not provide for across-the-board training contracts. In FY 74, we will be looking to initiate training contracts with a few states already having acceptable plans and facilities. We will be looking to the Regions to help identify needs and allocate efficiently funds in this area as well as evaluating requirements for future years.

The FEPCA provides that Experimental Use Permits may be issued to applicants in order to obtain information necessary to register a pesticide. This section also provides for the establishment of temporary tolerances under the FIFRA, an authority previously available only under the Food, Drug and Cosmetic Act. The Administrator may, by regulations, authorize any State to issue experimental use permits subject to plan provisions identical to delegation of certified applicator authority.

The Administrator may exempt any Federal or State agency from any provision of the Act for emergency conditions. Also under the new Act, public officials are not exempt from the penalty provisions relating most importantly to use of a pesticide in a manner inconsistent with its labelling or which has been suspended or cancelled.

It is our intent to provide such exemptions only on a very limited basis, thus public officials who have often in the past used pesticides for unregistered uses will need to look to having registrations. These provisions become effective with regulations currently under development.

The Act reserves to the States limited registration authority. Since most states now have a registration program, the question of duplicative registration looms large as a policy issue. Under conditions of the new Act, dual registration would appear unnecessary and wasteful and perhaps should be discouraged.

States may also impose more stringent requirements but may not impose additional requirements for labelling or packaging.

States may also register products for special local needs if certified to do so by the Administrator.

In this area, Regions can profitably determine state intentions to become certified and ascertain types of "special local needs" considered necessary by states.

Finally, I emphasize my earlier remarks that we intend, as stated in our January *Federal Register* notice, that states do not issue intra-state registrations for products containing the same active ingredients previously cancelled or suspended Federally. Many states have requested clarification and your assistance will be helpful in stating this position in response to their questions.

The *General Pesticide Program Strategy* can best be characterized as a flexible, middle of the road approach for the next two years. The new law offers EPA new choices of direction at this time. Limited resources and significant mandated tasks will generally restrict program choices in the short-term to preparing the soundest possible base for implementation of the new law.

However, this does not mean we should not continue to move ahead in known problem areas.

There are two forms of technical assistance required, to EPA and to the States.

We have an urgent need to have clear documentation of current State laws, registration procedures and certification requirements as part of a comprehensive State profile both now and expected for the near future. Divided authority requires too that the Regions identify for us and the key officials responsible for pesticide activities in the States so we can all deal with the correct parties. Assessment of State resource and program capabilities to carry forward State responsibilities under previously addressed sections must be evaluated and needs for the future identified for orderly implementation of the new Bill to occur.

And finally we must help the States to prepare for cooperative implementation. A major pesticide strategy direction is to move toward decentralized responsibility, particularly on broad scale programs of applicator training certification and experimental use permits. States will need assistance in legislative and programmatic development.

Emphasis must be given to helping states solve identified current problems of pesticide and container disposal, accidents, and promoting safety in use of pesticides. Accelerated effort needs to be given to obtaining cooperative programs of accident and incident reporting and investigation and to support state efforts. Headquarters will continue to provide guidance and summary reports, but only the Regions can develop the supportive information channels required to make this system successfully serve us and the states.

[1]Deputy Administrator, EPA, Region 10, Seattle, Washington.

The Effect of the Federal Environmental Pesticide Control Act On State Pesticide Programs

Errett Deck[1]

You have just heard the federal viewpoint on the Federal Environmental Pesticide Control Act. I will present the state viewpoint—and it will be different.

During the past three years I spent hundreds of hours representing the interests of the Federal Environmental Pesticide Control Act. During that time there was a total of 15 drafts requiring review and response. I believe the final draft, as agreed to by the Conference Committee, is tough legislation; I say this in spite of critical articles to the contrary in the New York Times and the Washington Post; in spite of comments to the contrary by Senator Hart of Michigan and Senator Nelson of Wisconsin.

There will be some difficult times ahead. For example, regulations will be proposed by EPA that will be violently opposed by those to be regulated; deadlines will be reached, such as the 4 years for implementation of state certification plans without all states qualifying; the reclassifying of all pesticide formulations, including *intrastate* products, into general and restricted use categories will not only be a tremendous undertaking for EPA and industry but EPA will have strong pressures on where to draw the line between the two classifications; similar controversies will be unavoidable in determining standards under state plans for certifying the private applicator, that is the grower; and finally, there will be the battle of money, both federal and state, for implementing and coordinating this national program.

Let me quote from a memo I sent to state pesticide control officials following passage of the 1972 amendments to FIFRA: "This memo covers in detail the 15th and final draft of the federal pesticide Act. Some may question the need for certain provisions in the Act, but at this point such deliberation is academic. This legislation grants EPA broad and flexible authority to regulate pesticides in order to provide for the protection of man and his environment. No other pesticide bill presented in Congress was as workable. With responsible enforcement, EPA can accomplish the purposes of the Act without undue interference with the country's ability to control pests, or undue hardship on the producers or users of pesticides. The answers now depend on the administration of the Act by EPA."

When the regulation of pesticides was taken away from the United States Department of Agriculture, with the creation of EPA, December 2, 1970, passage of new pesticide legislation was imminent. The stage had been set by a molding of public opinion for a number of years, an increased interest and concern by members of congress, and a commitment made by the administration.

Was there a need for new legislation? The best method for regulating the distribution of pesticides to the user, and to his application of pesticides, was control at the state level. Regulation of the storage and sale of pesticides; of those individuals giving pesticide recommendations to the user; and of those applying pesticides commercially was a responsibility of the states. However, at least 20 states were not effectively restricting pesticide usage and some of these states used pesticides extensively. In the past few years a number of states have stepped up their pesticide programs. But too many reacted with too little, too late. It is interesting to speculate whether or not Congress would have taken such pre-emptive steps in the federal Act if all states had established effective pesticide programs. But this is only speculation. The fact is, the states did not get the job done and Congress acted.

The 1972 amendments to FIFRA are the Law of the Land–what now? EPA has the "big club" but there are a number of provisions in the Act and in the Congressional Record which give EPA some flexibility and an opportunity to work with the states. State agencies are closer to, and can be more responsive to, problems within their own state, whether they be pest control, health, or environmental problems. As a state control official, with an understanding of agricultural problems, I was encouraged by the indicated desire of EPA officials, including David Dominick, Asst. Administrator in charge of Categorical Programs, to cooperate . . . to work with state officials and others in establishing standards, developing regulations, and implementing enforcement of the Act.

This willingness to work with state agencies and other interested groups, such as user groups and industry, was emphasized at a federal-state meeting held by EPA September 29, and at briefing sessions held by EPA with user, industry, and environmental groups on November 9. EPA requested suggestions on regulations required by the new law.

Of particular interest to me was an EPA proposal handed out at the November 9 briefing. To quote . . . "The agency is considering the creation of a special exception so that where the registration of a product has been cancelled in the last two years, or an application for registration has been denied, the manufacturer or formulator may, prior to the general implementation of Sec. 3, apply for registration as a restricted-use pesticide if it can be shown that other restrictions can be placed on its use and can be enforced so as to insure that there will not be unreasonable adverse effects on the environment." This proposal was made official in the January 9 Federal Register.

This provides a mechanism for obtaining approval for essential uses in states that are already enforcing restrictions on use, such as will eventually be required under the federal Act.

In the prior presentation on Federal Regulations, it was emphasized that under FIFRA, EPA was left an "all or nothing approach" in order to protect the public. With no control over use, and with no means to classify the more hazardous pesticides as restricted use pesticides, EPA was forced to cancel some old registrations and to refuse to approve some new registrations.

With all the good intentions in implementing the Federal Act, what is happening in March 1973? Let me cite DDT as an example. I may be discussing actions against an insecticide at a Weed Science Society meeting, but don't forget that some uses of herbicides such as 2, 4, 5-T; paraquat; and amitrol have been questioned also.

On December 13, 1972 a restricted use registration application for limited essential uses of DDT was submitted to EPA. The restricted use label for 12 minor uses in the state of Washington was jointly sponsored by a registrant, the Washington State Department of Agriculture, and Washington State University. This application was responsive to all the implied criteria of EPA, determining the essentiality of the uses, outlining research in progress for alternate methods of control, current monitoring data indicating negligible levels of DDT in our Washington environment, data indicating a level of use of less than 10% of prior peak use, and tight control over use through a system of licensed and tested dealers, licensed and tested pest control consultants, a user permit system to control purchase and use, and for some uses an area evaluation of pest levels by Washington State University specialists prior to approval of permits. With no response, indeed a reluctance of EPA staff to even discuss the problem, I confronted EPA with the situation at the February meeting of the Mrak committee. A few comments from the last page of my presentation:

"There were many statements made by EPA officials during consideration of the Federal Environmental Pesticide Control Act that cancellations were the only alternative under FIFRA when labeling restrictions weren't complied with. Controls over use would allow EPA to register the more hazardous pesticides in the restricted use category. The Administrator, in his closing remarks before the House Committee on March 25, 1971, made such a statement as did the Assistant Administrator for Categorical Programs in his statement before the Senate Committee on March 7, 1972.

"My concern about 1973 is not a "Johnny come lately interest." As mentioned earlier, this committee received a copy of my July 26, 1972 letter to EPA on the impending crisis; a crisis of not recognizing needs for minor crops or minor uses. Enclosures included letters beginning in 1971 from Dr. Madsen, Dean of the Washington State University College of Agriculture, to EPA.

"I hope that the desired response to this registration request will evaluate (1) the essentiality of the uses requested, (2) the ability of the state to control this limited use, and (3) the competence of the members of our control board, the Directors of the Departments of Ecology, Agriculture, and Health, and the Dean of the College of Agriculture of Washington State University to fairly consider the benefit risk ratio of these uses in their state. We do not believe this evaluation need involve questions of legal authority. We are not challenging EPA's authority to refuse registration. We are seeking a speedy review under new authority to register, provided in a new law which places a great deal more responsibility on EPA to expedite local needs.

"In September 1972, the California Director of Agriculture and the Oregon Director of Agriculture wrote letters to the Administrator of EPA, calling attention to state control of the use of DDT and to a limited number of essential uses for each of their states. EPA has not responded.

"By deferring answers to questions raised last fall until the 1973 season is upon us, anything but a favorable and timely action will deny the restricted use of DDT for essential uses.

"We in state government are out on the front firing line! The cutworms will soon be crawling. Our major DDT formulator in Washington state has been advised by his attorney not to reregister a state label for 1973 until EPA clarifies its position."

There still has been no official response on the policy for existing stocks of DDT and no response to our registration application.

I did not come here to talk about any particular chemical. I am pointing out what may be a basic problem with government—let me return to my remarks to the Mrak committee regarding the DDT issue:

"I am concerned that certain growers, particularly growers of minor or specialty crops will needlessly suffer severe economic loss because the government I am a part of, has taken away the ammunition they need to defend their property . . . an action which in no way considered the local environment they live in or the lack of relevance between their limited use and needs, and the major war of issues and principles taking place thousands of miles from their homes. Many of these individuals have never heard of the Federal Register, let alone read it. They have no resources to travel to Washington, D.C. or to hire competent legal representation to oppose the very attorneys their tax dollars support. No matter how big, good government needs to evaluate, respond to, and represent the interest of these individuals."

The answer is that the federal government must be capable of making decisions on the basis of fact, considering all sides of the issue, without taking an advisory position; and, equally important, delegate some authority and decision making to their cooperating regulatory agencies in state government. Recently, we made a state decision on picloram (Tordon) use in Washington. We have registered this herbicide for restricted use on rangeland and permanent pastures.

I will now discuss state pesticide legislation. Fifty states have legislation requiring the registration of all pesticides distributed in their state. I serve on the EPA subgroup to write regulations for the registration of pesticides. Under issues to be considered by our subgroup, this question was asked: "To what extent, if any, may states have *duplicatory* registration programs?"

EPA has made the following statement: "The question of duplicative registration looms large as a policy issue. Under conditions of the new Act, dual registration would appear unnecessary and wasteful and perhaps should be discouraged."

My answer to the registration issue is as follows:

First for background information—the FEPCA amendments to FIFRA specifically pre-empt state pesticide authority in three areas: (1) A state may not permit the sale or use of any pesticide prohibited by the federal Act; (2) A state may not require different or additional labeling from that required by the federal Act; and (3) A state may not require different packaging than required by the federal Act. The two latter are to prevent states from interfering with the interstate commerce of nationally distributed products. Even in these areas of specific pre-emption, the Act does not prohibit a registrant from requesting, and an authorized state from granting, a labeling or packaging requirement for intrastate use differing from the federal registration when there is need for special labeling or packaging that is different from the nationally distributed product.

Recognizing that there is no legislated responsibility for EPA to pre-empt a state's authority to register pesticides distributed within its borders (50 states now have such authority) it may still be beneficial for EPA to also recognize that state registrations do not duplicate the federal registration process. The two registration programs are complementary and mutually beneficial. The pesticide industry is the only party burdened by the state registration programs and the public is the obvious benefactor. It will be the responsibility of the delegated state agencies to convince industry of the benefits of continuing current programs and to defend, to their own legislators if necessary, the need for continued authority. Some states will no doubt decide to discontinue current state pesticide responsibilities voluntarily.

It is important to EPA and essential to state pesticide programs that states continue, under state legislated authority, to register *(license)* pesticide products to be distributed in their states for the following reasons:

1. States continue to need a complete and current record and file–(usually on an annual basis) of those pesticide products and labeling to be distributed and used *in the state*. The EPA records of approximately 40,000 products distributed somewhere in the nation will not fill the states' need for daily reference nor provide EPA with information relative to where a pesticide is distributed and used.

2. Without a program for registering all products distributed in the state, a state could not maintain the expertise to register products and labels for special local needs as provided for in the Federal Act.

3. Without records of labels in use, the states could not have an effective enforcement program to regulate use and to certify applicators. Pesticides classified for both general use and restricted use will present additional regulatory problems.

4. States assist EPA in evaluating labeling. States may become aware of problems not originally apparent in test evaluations. The use of Dicamba on turf within the dripline of trees is an example. Hundreds of labeling problems have been brought to the attention of PRD through the years by state registration personnel.

5. Many state programs have depended all, or in part, on fee money obtained from their registration activity. Loss of this revenue would place an even greater responsibillity on EPA to fund state cooperative programs. In the future, if federal funds are cut, state programs could be destroyed completely. Most states have developed, with few problems, programs which have allowed them to register *intrastate* pesticides. If EPA were to pre-empt the current registration function, the expertise to evaluate local needs would be lost.

6. Without registration records of products distributed in the state, it would be difficult to evaluate the necessity of use restrictions and the availability of alternate materials.

7. Small local formulators who, in the past, have registered only state labels will need assistance and guidance from state officials. Often personal contact can assist a registrant in preparing his registration application, saving unnecessary correspondence.

Another question asked the subgroup was, "How broadly should we construe Section 24(c) on state registration of pesticides to meet special local needs? What is meant by "special local needs?"

Without going into the reasons, let me comment that I believe special local needs should cover not only such minor crop uses as lentils, carrot seed, and rhubarb; the need for quick reaction to new economic pest problems such as the greenbug on wheat, the crane fly on pasture and turf, and the pea leaf weavil on dry peas–but also must include economic needs such as assistance to the small manufacturer who formulates for distribution within a short radius of his plant, providing a useful service to his customers; for example, fertilizer-pesticide mixes and fungicide-insecticide mixes.

The Federal Act provides that EPA, in cooperation with the states, will regulate the use of pesticides through the certification of applicators who use restricted use pesticides and by making it an unlawful act "to use any registered pesticide in a manner inconsistent with its labeling." This immediately leads to the question of what is meant by "a manner inconsistent with its labeling?"

In the Senate Agricultural Committee Report it was made clear that it was not the intention of the committee to prohibit any use which is in no way harmful and which has only beneficial effects on man and his environment. It was the committee's hope that proper administration of the labeling requirements and administrative interpretations of the law and labels by the Administrator would make it clear to users that such uses are not prohibited. The committee believed that the use of the word "inconsistent" should be administered in a way so as to visit penalties *only* upon those individuals who disregarded instructions on the label that would indicate to a man of ordinary intelligence that uses not in accordance with such instructions might endanger the safety of others or the environment. Thus, the uses of a general use pesticide registered for use on enumerated household pests to exterminate a pest not specified on the label would not be inconsistent with the labeling. On the other hand, using a pesticide for control of a pest in the home when labeled "not for use in enclosed areas" would be prohibited under this provision.

One of the most critical decisions to be made in the implementation of the new Federal Act will be the determination of standards and guidelines for classifying restricted use pesticides. The decision has been made that classification will be on a product-by-product and use-by-use basis, rather than by chemical. The law specifies that the acute toxicity criteria should be primarily related to dermal and inhalation toxicities. The measure of persistence should be measured on an evaluation of uses that will generally cause unreasonable adverse effects on the environment.

Some of the suggested general guidelines to serve as a fence between general and restricted use products are: any product with a dermal LD_{50} of 200 mg/kg or less; an acute inhalation LC_{50} of 2 mg/1 or less of dust or mist or 200 ppm or less of gas or vapor; or irreversible dermal or eye effects should be considered for the restricted use category.

The evaluation of the environmental risk is much more difficult. Some suggested numbers on acute toxicity that have been proposed are: all products which have a fish and wildlife toxicity of less than 10 mg/kg for mammals; less than 10 mg/kg for birds; less than 0.1 ppm for fish; and less than 0.01 ppm for aquatic invertebrates should be considered for the restricted use classification. In addition, in considering and evaluating hazard to the environment, the site of application is important. One proposal is that the aquatic environment is extremely sensitive, large block applications to forested lands are sensitive, the application to agricultural lands and rights-of-way are of intermediate significance, while applications to industrial lands present a minimal hazard to the environment.

Persistence, as a criteria for restricted use pesticides, relates to the pesticide and its breakdown products which have an unreasonable adverse effect on the environment for more than one year after the last application. In evaluating unreasonable adverse effects on the environment at the site of application the mobility of the pesticide must be considered.

Along with the problem of persistence, one must consider accumulation in the biotic food chains and the potential to migrate from the site of application. Products which degrade slowly or breakdown into potential toxic substances and have a potential to accumulate should be restricted.

It was the intention of the Classification and Labeling Committee of AAPCO that the suggestions we made to EPA, if followed, would result in a minimum number of restricted use labels. We believe that by restricting the number of products so labeled the significance of the restricted use classification will be more meaningful. We accepted the challenge that a great deal of improvement is needed in labeling formats. The restricted use classification should not be used as a means of solving this problem.

In the 1940's, a number of states enacted applicator laws to regulate commercial applicators and to regulate the use of certain pesticides such as herbicides causing drift damage and insecticides toxic to bees. This state legislation has been improved over the past 25 years.

The "Model State Pesticide Use and Application Act", as published in the Council of State Government's 1971 "Suggested State Legislation", Volume XXX, was the final step of a project initiated by the Association of American Pesticide Control Officials in 1968. This suggested legislation carried with it the input and approval of many federal, state, and industry groups who had taken time to review its mandatory and optional provisions. The consensus of opinion was that this proposed legislation provided regulatory authority inherently within the realm of the states' regulatory responsibility. Authority was provided to adopt regulations to adequately protect intrastate environmental values as well as provide the mechanisms for adequately controlling the pests with which we are confronted. The provisions were proven effective and workable in that every provision had been successfully implemented to advantage in at least one state.

Passage of the new Federal Act placed a responsibility on the Model Bill Committee to review the 1971 model state legislation. Congress, in drafting FEPCA, realized that states must play a major role in implementation of the Federal Act and provided for federal-state cooperative programs and for financial assistance. Wanting to facilitate and encourage these cooperative programs, our Association adopted an amended Model State Pesticide Use and Application Act as printed in the 1972-73 Official Publication (pages 50-65) in anticipation of the final passage of the Federal Act.

Following the singing of PL 92-516, I have repeatedly raised two questions: (1) Are the necessary authorities provided in our Model State Bills so that states can enter into federal-state cooperative programs as provided in the Federal Act? and (2) Is there any provision in either of the two Model State Bills which in itself is in direct legal conflict with PL 92-516? As an individual who has followed this legislation closely, and after personal discussion with many others who have worked on this legislation, I believe that: (1) Any state that has adopted most of the authorities provided in the Model Pesticide Control Act (pages 22-37 of the AAPCO 1972-73 Official Publication), and the Model Pesticide Use and Application Act, (pages 50-65), should be able, with appropriate regulations, to develop a state plan acceptable to EPA to certify applicators, issue experimental permits, register pesticides for special local needs, and enter into contracts and to accept grants-in-aid for training and for enforcement of federal-state pesticide programs. At the same time there are no authorities that in themselves are in direct conflict with Public Law 92-516.

With the intense interest in environmental and pesticide regulations, with the need to coordinate federal and state pesticide legislation, and with EPA's new responsibilities related to state programs, the Council of State Governments appointed a joint Federal-State Work Group to carefully review our AAPCO pesticide bills prior to the Council's endorsement and also in order to get significant input from EPA. Individuals on the Work Group have been most cooperative, but the task has not been an easy one.

Since the Federal Act is now the "law of the land", and we want any state legislation adopted in the future to be compatible with this Act, it was necessary to alter certain effective and workable provisions of the state model bill with awkward and complicated amendments.

The Council of State Governments had requested that I present this legislation and the AAPCO State Pesticide Control Act at their Second National Symposium on State Environmental Legislation in Washington, D.C., April 9. This whole endeavor has taken an unreasonable amount of time, but it is of prime importance to the many states now considering new pesticide legislation. The content of this suggested legislation may be one of the *deciding factors* on whether or not a state will implement a pesticide regulatory program. Without an effective state program EPA will have to assume the total program in that state. I believe that a cooperative federal-state program can be more effective, less expensive, and more responsive, benefiting the states' agriculture, local citizen, and industry constituents.

Yesterday I received a call from the Council of State Governments that the General Counsel of EPA was raising new issues such as federal "pre-emption" which could not be resolved in time for the Legislative Symposium. Once again the Agency will not give us a timely "yes" or "no" on an important issue.

I was asked this morning to say something about the standards for certification of applicators. We managed to convince the Congressional Committees that standards for certification should be different for commercial versus private (that is grower) applicators. Some people say a specific pesticide formulation presents the same risk no matter who applies it. This is an over-simplification of a complex problem. In advising EPA on implementing the new Federal Act, I represent agriculture, which includes users to be trained; and state agencies, which includes those responsible for the training. I am anxious that we do not get boxed in with requirements of extensive academic training as a prerequisite for a grower to obtain a permit to use a highly toxic pesticide which he has been using for many years.

The following statement is one I presented to EPA as part of a criteria and guideline on applicator standards:

"In many states standards for the certification of commercial applicators have been established since the 1940's whereas states have not found a need for certifying private applicators until now. The basic difference between the application of pesticides to the lands of another for hire, versus the application of pesticides to one's own land have dictated this historic difference in states' development of control over the use of pesticides.

"The *commercial* applicator, with his mobility and extensive area of operation, faces the liability of applying a broad spectrum of pesticides in large volumes often with high speed equipment. He and his employees face exposure to pesticides over extended periods of time. The commercial applicator is responsible to his customer for recommendations and proper application to eliminate unreasonable risk to the target application site, as well as adjacent crops or property. These responsibilities have resulted in state requirements for permits, licensing, examination, and establishment of financial responsibility for commercial applicators.

"The *private* applicator, concerned with the opinions of his neighbors and the community and with a desire to maintain the economic and aesthetic value of the environment in which his family resides, requires a narrower scope of regulation."

For the certification of private applicators we have suggested 3 optional methods of certification; the requirement to sign a register, obtain a user permit, or pass an examination. There should be ample flexibility for EPA to accept any state plan that will carry out the intent of the law.

In our state of Washington, we have a coordinated relationship between the land grand college (Washington State University) and the State Department of Agriculture. The University accepts primary responsibility for research and education and we accept the primary responsibility of providing inspection services, developing regulations as needed, and in enforcing them. Often we cooperate in joint programs, such as giving pesticide short courses and in developing pesticide handbooks for training and reference. We have distributed over 6,000 copies of our last edition of the Washington Pesticide Handbook.

I hope this close cooperation is taking place in all states. In Washington, we are including a third group in our pesticide program . . . the pesticide industry. Pesticide dealers have been licensed since 1961. The manager of each licensed outlet now has to be qualified by passing a comprehensive written examination. We delegate to these controlled outlets the responsibility of issuing seasonal pesticide users permits to those who are raising crops for which the pesticide is registered.

The system is working and is currently endorsed by all affected persons. If there is a serious violation of the trust we place on these people, the user can lose his permit to buy; the dealer can lose his license to sell.

In a few instances we are tying the need for a user permit to the need for pest control in an area. For example, occasionally we have a serious outbreak of cutworms in one of our important tree fruit areas. We have been depending on extension specialists to make the determination of when there is an economic or threshold infestation in a specific area which warrants the use of DDT. The Department then approves the issuance of user permits for that area. Now that we are licensing and testing commercial pesticide consultants, our Extension Service plans to utilize licensed industry experts as their scouts with our Department providing surveillance and regulatory authority.

We have not had the overuse or oversell on pesticides which I am told takes place in some other areas. The use of insecticides by our important tree fruit industry has been cut in half with improved materials and an integrated control program. The chemical industry must cooperate with the University recommendations and provide competent service to their applicator and grower customers. As for profits, it is better for the consultant to sell one barrel at a fair markup than 10 barrels of a pesticide priced at cost.

---

[1]Washington State Department of Agriculture, Olympia, Washington.

Compliance With Pesticide Regulations And Food Production

James L. Ammon[1]

When Mr. Burgoyne first asked if we might give a few comments regarding our position as a food processor and compliance with pesticide usage and regulations, reservations immediately went through my mind. What can we contribute to a group such as this that has not already been repeated. But we are concerned about proper pesticide use and regulations. Because of our concern with all pesticides my remarks will not be confined just to herbicides.

I feel one of the weaknesses that is exhibited by too many of us concerned and involved in the area of pesticides is that we will discuss the situation among ourselves but that is as far as we go. We must keep others, not involved, informed of our concern and efforts. We must continue to bring the facts and data out and evaluate them on their own basis and be realistic about it. If we have feelings regarding our situation, then we must speak out or our courses will be directed for us.

So if you will bear with me for the next few minutes, I would like to cover a few thoughts and feelings regarding this important area of pesticides—their safety, their use and their compliance with regulations for the protection of the public and the environment to maintain clean, wholesome and nutritious food for the consumer.

When the first surge of environmental emotionalism began and pollution was a general term to be used, references indicated that agriculture was going to become the whipping boy—a designation not earned and not justified. For example, investigations have shown that most of the river and lake pollutions in the United States was not from agriculture as has many of the other earlier references to pollution since been studied and original sources of the cause has been determined.

Former Director of Agriculture in Oregon, Walter Leth pointed out one of the facts most overlooked by many of those who are and have been talking and writing about environmental problems with reference to agriculture, is that the farmers themselves are fundamentally naturalists and environmentalists. They must use the natural resources at hand to make their livings. The farmers are as concerned about safeguarding those elements as anybody possibly could be and certainly they cannot be accused of not wanting to safeguard their own children and the people they employ.

We have read and heard about the shrinking wildlife numbers. But have these people making these comments stopped to realize that land for game and wildlife is shrinking each year as our cities, roads, airports and industries continue to expand over the country-side, yet reports show there *is more* game today than there was 30 years ago. It is now estimated that in a ten-year period, our losses to this problem of population growth in the United States is equal to the area of the State of West Virginia. This pressure has made it necessary for farmers to increase crop production on dwindling acreages. I mention this to indicate that we have some future potential problems to concern ourselves with during the time we are evaluating present problems.

In the use of pesticides the real enemies we face are the weeds, the bugs and the diseases we are trying to control—not pesticides as such. Mr. Leth pointed out that despite the fears and real problems they create, pesticides clearly are responsible for part of the well-being enjoyed by most people in the United States and the Western World. Control of some kind is essential because crops, livestock and people live in a potentially hostile environment.

Pesticides are used not only to produce more food, but also food that is virtually free of insects or damage from insects and diseases. How many of us have heard the comment from a person that he can eat around a worm-hole in an apple? Did that individual ever stop to realize how long that apple would hold up with damaged tissue? Would these apples with the damaged tissue be available to this person or some other consumer several months later? Or if you only saved the good ones, how many consumers would this kind of production practice be able to satisfy?

Mr. Raymond Coppock, communication specialist in cooperation with scientists of the University of California, Division of Agricultural Sciences on U.C. campuses at Berkeley, Davis and Riverside put out a publication titled "Pesticides—The Issues—The Alternatives" which I feel has keyed in on the important aspects of pesticide usage.

This publication points out that "pesticides are applied to an environment that includes pests, crops, people and other living things as well as air, soil and water. In such surroundings, using a pesticide is never a simple matter of applying a chemical that neatly removes only the pest species. For one thing, the pest population is not completely or permanently eliminated. Almost always there are at least a few survivors to re-create the problem later on. Also the pesticide often affects other living things besides the target species and may contaminate the environment.

"Many of the problems of pest control arise from these unwanted effects. Concerned scientists are worried about three particular kinds of problems associated with chemical pesticides—primarily insecticides:

1. Pesticide Resistance.
   The pesticide tends to become less effective as pests adapt to them. These pesticides may work well for a few years then lose their effectiveness and the ability of the pest to survive is passed on to the next generation.
2. Resurgences—Secondary Outbreaks
   Sometimes these pesticides aggravate pest prob-

lems in other ways. Repeated applications of broad-spectrum insecticides may create worse problems. Resistance may be part of the reason, but in many cases, predators are also lost either directly or by the elimination of their food supply. When this happens, surviving pests are released from both biological and chemical control and multiply to large populations–resurgence. A different pest previously doing no damage may also be released from natural control and buildup quickly– a secondary outbreak.

3. Some Pesticides May Have Adverse Effect on the Environment.

An influence on wildlife population can occur by changing its habitat–herbicides may eliminate nesting areas along roadsides or may greatly increase the wildlife carrying capacity of brushlands by creating open, grassy areas. Nearly all pesticide caused deaths and illnesses among people result from carelessness or accidents. Shortlived pesticides, which are more toxic and being required to replace the longerlived materials, that lingers on foliage presents problems to pickers, thinners and others. Longer re-entry time is used to offset this possible risk.

What amount of residue on food is safe probably never will be answered to everybody's satisfaction, but most scientists are convinced that the consumer is well protected."

The food industry is under strict supervision on pesticide usage and residue tolerances. Federal and state regulations have guidelines under which this is controlled. Quality of the food today is the highest it ever has been. The residues and tolerance in food are below tolerances established by the Federal and state regulations as is indicated by the market basket surveys. We have to prove a product is safe– it is not a question of it being harmful.

Regulations must apply to all users of pesticides–home owners included, in a sincere effort to control the environmental input of pesticides. In our business this is a must. For our company, only recommended materials and rates that are cleared are allowed to be used. Intervals between application and harvest are strictly adhered to. Each grower must record and have on file in the field department office before any of that product is accepted for processing a record of all pesticides used, rates, timing, how applied, etc. for that crop.

There is a need for pesticides and their proper uses. We recognize the need and importance of regulations and enforcements and certainly have no disagreements in this regard. Let's check the records also. Monitoring studies that are being carried on are showing no general buildup of pesticide residues. We must be realistic on our approach and decisions and let these be supported by scientific data and facts and not emotional feelings or pressures. We are in no way condoning misuse of pesticides or even of their use at all where they are not fully justified and where they might be of danger to people or other forms of animal life.

I have tried to briefly express our feelings to this pesticide area from the standpoint of the grower, the necessity for pesticide use and some of the concerns that are relevant without the use of these materials. I feel we must be realistic in our continued concern with the subject of pesticides.

Now I would like to direct some remarks regarding current concerns and procedures, as they appear to us, from the administration end–E.P.A. I would like to mention four points that are of real concern on pesticide evaluation and decisions.

1. The first is dealing with alternative materials or substitutes.

For example, the organic phosphates are being required as alternatives for D.D.T. These are shorter-lived materials. However, not all of these materials are equally effective even if they are all listed for control of a pest. There are variations in climatic conditions, crops produced, length of residual and the toxicity mode of the material to the pest. These are wider-spectrum insecticides. Are these materials creating situations as earlier mentioned, of resistance, resurgence and secondary outbreaks? These shorter-lived materials will very often require repeated applications because of their shorter life. Where does this material go? What is the long range effect to be expected? I think we have some real reason for concern.

2. The second point is the requests for comments on essential needs of a material.

Administration is very unrealistic on its time requirements and the information requested. A directive will be put in the Federal Register with a request that in 30 or 90 days to submit views or data on the following: A. Use pattern involved. B. Pests to be controlled (statement of damage or injury expected without the use of these chemicals). C. Data on environmental pollution (any available test results showing extent of environmental contamination expected from the use pattern involved). D. Possible substitutes (those now available; those being tested; and statement of efforts to find a suitable substitute).

Some of the requested data cannot be accumulated in this period of time. Then even after this is obtained and then submitted, later on a similar request comes through asking for the very same information. Are they even listening to us–how much effect does this information have on their evaluation and decisions?

3. The third area of question is the essential use lists.

Our area, as has many others, because there has been area cooperation, has been working with these materials for many years continually re-evaluating and maintaining only those with short residuals that will work in place of the longer residual materials. For example, in the case of DDT, a list of essential uses was established in Oregon where no effective substitute material was available. This was combined efforts of Oregon State University, State Department of Agriculture, processors and industry personnel. Cutworms, one of the pests listed, are damaging pests to the production of table beets. Sweet corn is also a crop that cutworms can have a serious damaging effect on at the seedling stage. Because of the cutworms history and cycle, it is not a problem that necessarily needs control each year and even in years of infestation it may be localized by geographical areas or portions of a field and treatments have been recommended only according to the need. However, when the cutworm appears there is high damage and the situation is desperate and there is no effective substitute.

This was the information that was submitted to EPA, as a matter of fact several times it was requested. This summer, Mr. Ruckelshaus issued a statement that general use of DDT would be banned. He indicated that nearly all of the domestically used DDT was on cotton, peanuts and soybeans. *Only a small amount* was used on other crops. The chief substitute which would replace DDT for most crop uses, methyl parathion, is a highly toxic chemical and constitutes a short-term danger to untrained applicators. Uses for health programs would not be barred.

As to Oregon's request for maintaining DDT for essential uses only, it got a passing comment in Mr. Ruckelshaus' statement, "The evidence concerning use of DDT to control cutworms is less clear-cut. Apparently cutworm infestation in the Northwest are sporadic and localized." One might get the feeling you are being penalized for being so realistic and concerned in evaluation of the essential needs or are they (administration) misinterpreting the importance of the need. If it is misinterpretation as to the importance of the need, remember this material was evaluated by learned people in these areas, then why was a request for further clarification not asked by administration instead of dropping it there?

What kind of cooperation is expected for these evaluations that are submitted or is any even really desired? Mr. Ruckelshaus also went on to say in this same comment "while it would be far easier simply to cancel or not cancel the registrations for these uses, I believe that environmental problems should be parsed with a scalpel and not a hacksaw. While EDF and my own staff urge cancellation on the ground that producers can easily shift to producing different crops, there is no evidence as to how long such transition might require."

This appears to be where there are gaps of communication. Our data and facts are submitted—but for what? Shifting of agriculture required in an area—can it be done? What effects does this have on available food supply of that commodity? Where is the realism?

Oregon's present Director of Agriculture, Irvin Mann proposed a plan for the controlled use of DDT on these essential uses when needed. It's a very realistic approach. He emphasized that agriculture must discipline itself to exist within the framework of environmental progress, but there are extreme cases when agriculture must have the support and trust of the public—"Agriculture in Oregon has worked hard for this trust. It doesn't intend to jeopardize its position with irresponsible acts, particularly in protecting the environment in which it must exist." What has been the response of Director Mann's efforts?

4. The final area I would like to mention that has effect on agriculture and that is for minor crops. It is unclear as to the mechanism or program to follow to obtain materials for use on these crops and there are many crops in this category.

They represent only minor resources available in establishing materials for clearance. What happens to these crops? How do we get protection for them? Do we shift areas until we finally find a place they will grow without problems—do we drop the crop or what?

These are some of the problems or complications that are faced by the producers of food products. We are not opposed to regulations and know the need for controls. We have been and continue to work with state universities, state regulatory agencies and federal regulations and are proud of our industry. We do not feel we need to be on the defensive but are actually and have been leading the way in protection of the public and environment and maintaining a clean, wholesome food product.

But there must be acknowledgement and consideration given to the research and scientific data and information that substantiates the requests that are important and necessary. There becomes a feeling at times that there is no value attached to these responses requested other than a formality. Where can any information be more valuable than when it is collected at the point of need by respected, dedicated and responsible people in their fields and yet action indicates that it is not being listened to or acknowledged.

Let's not let misunderstanding about pesticides, their functions, their uses, their safety and their needs be jeopardized by emotionalism.

The pendulum can only swing so far and I hope the initial wave has reached its apogee. I also hope that the momentum of elimination of many necessary materials will adjust to a proper perspective before we find ourselves shorted on needed pesticides without first having to go through disaster periods before this type of situation is recognized and rectified.

---

[1]Field Superintendent, Agripac Inc., P.O. Box 5346, Salem, Oregon.

"Beneficial Uses Of Herbicides In Our Environment"

R. W. Smith[1]

Because of a fashionable trend of the times we are going to handle our topic today in a little different manner. I am going to cover some generalities regarding the use of all herbicides and Mr. Floyd Holmes will present some specifics about our newest herbicide "Krovar".

When I say the trend of the times I simply mean that for the past several years "ecology", "pollution" and "environment" have become stock words and all too often mis-used, abused or distorted.

Due either to limited knowledge by some, but also to deliberate mis-interpretation by others, these subjects have become focal points for much controversy sometimes because the supporters are sincerely concerned but misguided sometimes for strictly senseless and no-basis-in-fact attacks and too many times because the field of ecology and environment have become popular causes and are milked dry of their publicity value by populists who by nature seem to require some kind of crusade as a part of their life style.

Regardless of the "whys" involved the situation is becoming more and more serious for those who are responsible for vegetation control programs and the related budgets.

There has been continuing evidence as reported in the press and other indications that governmental agencies ranging all the way from mayors and/or city councils up to and including the Federal level are being heavily influenced by impassioned pleas by psuedoecologists and amateur environmentalists. They have no compunction about glibly using half-truths and innuendos to distort actual facts to suit selfish purposes. They try to create a climate that ominously forecasts doom unless whole classes of chemicals are immediately banned. Most of you are aware of their success with DDT and 2-4-5-T.

Among the chemicals that have been attacked are some of the herbicides. The ones under attack are bound to have an effect on weed control programs. However, even more serious is the old domino theory. If one or two go, others may not be far behind.

One of our purposes here today is to present facts about herbicides that we hope may be helpful–if and when the exaggerated scare tactics come to your city or county and you find yourself forced to defend your position and refute the erroneous arguments submitted by the mis-guided do-gooders.

The reasons for the necessity to be alert for such attacks is probably obvious to us who work with herbicides. I am referring to all chemical compounds used to control vegetation.

Probably first and foremost is the unalterable fact that if we are not permitted to judiciously utilize chemical herbicides maintenance costs either go up several hundred percent or forced to drastically cut back your programs. This, in turn, creates a multitude of new problems. It doesn't take a very vivid imagination to visualize what will happen if we have to go to solely mechanical vegetation control methods 100% such as mowing, disking, or hand clearing, or of necessity let hundreds of acres go untended indefinitely until a city begins to have grasses creating fire potentials, unsightly growth, poor housekeeping, ragged appearance, and generally sloppy maintenance.

First, however, we do want everyone to understand a commercial position. Most chemical companies practice elimination of potential pollutants by their manufacturing plants, as rigidly and stringently as anyone, and are as concerned about pollution and conservation, clean air, and clean water and environmental stability as the most rabid supporter.

There is no question that industrial wastes and air pollution are bad. The proper preservation of some of our recreation and natural areas must be enforced, but the use of herbicides has nothing to do with these matters. Properly used they are not pollutants and do not contribute to deterioration of the environment.

Dangerous errors being made are those which almost automatically include herbicides in their arguments about air and water pollution.

I don't know whether it is simply because the words "weed killer" or "soil sterilant" sound deadly in themselves or whether it has simply become fashionable to attack anything of a chemical nature that will remove unwanted vegetation by other than natural or mechanical attrition.

Whatever the motivation the end result could be the same: complete reduction of our ability to control weeds except by strictly mechanical means. I cannot believe that any of you here today would endorse returning to that out-moded and costly practice.

Perhaps we can help provide some ammunition, in the event someone requires it, to combat well intended but poorly informed crusaders who are quick to do a lot of talking but offer little proof of their contentions.

Once upon a time someone, most likely a rejected lover who couldn't get anywhere with a beautiful girl, rationalized his failure by saying "oh well, beauty is only skin deep."

That may very well be true about human beauty but the world around us, our environment, is as deep as the water, as high as the sky, and as broad as our country. Each of us of course wants to enjoy better living through a better environment.

Actually there really isn't anything new about environment quality, it's just that recently much greater stress is being placed on improving our air, land and water. Many of us think the start is far too late and often by methods not wholly in the best interests of the country. So in our business it becomes only fair to ask "do herbicides contribute to the problem?" Let's look at them and their relationship to the environment; let's see how much of a culprit they really are.

Broadly speaking, and in the simplest terms, an herbicide is a compound used to inhibit or destroy the growth of unwanted vegetation. Unfortunately too many people erroneously think that herbicides do more harm than good and that the so-called balance of nature is being tipped the wrong way by their use. The general public, who are not intimately involved in weed control problems, most often hear only the "bad news" rather than the "good news" and hence may be inclined to mis-understand or ignore the overall benefits of properly used and applied herbicides. The real truth of the matter is this: nature's beauty can be enhanced by herbicides. When used properly herbicidal compounds improve the environment rather than harm it. It is not at all uncommon for those who do not fully understand to ask "why herbicides?" "why weed and brush control?" "What's the point?" "are they really necessary?"

Let's look at some of the facts that answer these questions. Uncontrolled vegetation can cause fires; smoke from such a fire pollutes the air; a carelessly flipped cigarette into roadside vegetation can start a raging fire that can threaten both life and property. A clean highway shoulder helps eliminate this problem. The past is full of stories of fires originating because of uncontrolled vegetation near main highways. In dry southern California this alone is sufficient reason to eliminate hazardous vegetation.

Weedy, neglected vacant lots are an open invitation to become litter beds, but when weeds and brush are controlled it not only reduces a serious fire hazard during dry periods but it also reduces the litter build-up. There is abundant proof that weedy lots accumulate litter. Litter must certainly be classed as pollution and an eyesore. Also litter is costly to clean up. There are many anti-litter campaigns the use of herbicides in strategic locations helps combat litter problems.

So herbicides actually and factually reduce air and land pollution and increase safety. Further, the concentration of pollen in the atmosphere is drastically reduced when noxious weeds such as ragweed are controlled before they produce pollen. This is a substantial benefit to asthma and other allergy sufferers, and ragweed is only one of many air pollutants that can effect people. This may seem minor to you who are not allergic. It is certainly major to anyone so afflicted.

A leading doctor writing on human hazards once said that "poison ivy is an extremely dangerous plant. Some people are more susceptible than others but no one is ever fully immune." I'm sure anyone having had a bout with poison ivy or poison oak will agree whole-heartedly. The best and surest way to get rid of poison ivy is to do it with specific chemicals. We can, therefore, add another dimension to weed control—health benefits.

Weeds and brush in drainage ditches or dry stream beds prevent free flow of water, contribute to flooding of valuable lands, and provide breeding areas for mosquitoes. Such conditions can be improved and kept clean by utilizing available herbicides. Without exaggerating, herbicides used in critical areas can almost be termed a type of disease prevention.

Most of the residual herbicides are relatively immobile in the soil profile and do not migrate or move in a lateral direction. By selecting the proper material, herbicides can be safely used on the banks and bottoms of irrigation and drainage ditches. "Karmex", for example, is the only herbicide registered for this use specifically. By clearing the weeds it helps keep weed seeds from entering fields and assists in maintaining a stable water flow. So here we have herbicides preventing crop contamination and reducing water waste.

If weed infestations are allowed to grow unchecked around food warehouses or grain elevators they will quickly provide a breeding place for rodents and insects which in turn can cause diseases and ruin foodstuffs. Of equal importance of course is the fire hazard uncontrolled vegetation creates. So again we have herbicides helping prevent disease, reducing fire hazards, and keeping food sources clean. It is an inexpensive and simple chore to remove unwanted vegetation and eliminate the problem.

Tall brush on utility rights of way if allowed to grow unchecked will eventually disrupt service. Additionally, the brush represents potential hazards to the workmen in several ways. One of which is dense brush and growth is an open invitation for snake populations. Removing or controlling unwanted growth helps insure better service to customers; it certainly is more attractive and allows freedom of movement while creating a safer working climate for employees. So we add more dimensions to herbicides: safety, appearance, and better service as a result of the use of herbicides.

Weed infestations have always posed rail maintenance problems. They cause track and equipment deterioration and they are very real fire hazards, this applies whether the growth is allowed to flourish near a bridge, on the main lines, or branch lines. If not checked they will be instrumental in forcing unscheduled delays in service, trackside fires, and personnel injury. Markers which are extremely important to an engineer must not be hidden by vegetation.

Weed control has long been recognized by the nation's railroads as being a vital part of their maintenance programs in keeping trestles clear of weeds and controlling vegetation along rights-of-way. So with the railroad we have herbicides importantly contributing to safety and efficient operations.

The same story is even more serious on the highways. In this age of more cars and higher speeds drivers must be given more reaction time to prevent collisions and crashes. Visibility is often hindered when weeds and brush take over. Light standards and highway markers must not be obscured. Good vegetation control means clear vision, better reaction intervals, and lower road maintenance. A cleared roadside helps protect deer and small game from suddenly springing from heavy growth and bounding in front of your car. It has long been observed that weeds can accelerate break up pavement edges if allowed to go unchecked. Clear visibility and safe driving conditions prevail when weeds are removed. There is no question that herbicides help make our highways safer reduce maintenance and replacement costs.

How about some of the less glamorous but equally critical situations? Weeds in any storage yard collect moisture and cause corrosion to equipment and materials. These areas are simple to keep weed free.

In lumber yards weeds not only attract pests but weeds allowed to grow unchecked and dry up will eventually cause a destructive fire. Weed-free lumber yards are not only safer but they get a fringe benefit in lower insurance rates.

If weeds get out of hand in playgrounds they can harbor snakes and rodents and objects that can injure children hide in high vegetation. Grounds maintenance is most difficult.

Any type of industrial area can have a weed problem if allowed to go untreated, but an annual application of a proper herbicide quickly solves the problem providing more safety and better appearance.

These examples give you some idea how herbicides, when properly utilized, contribute to a better and safer environment, but let's be completely fair and look still further. How hazardous are these chemicals in themselves? Is it conceivable that their inherent dangers out-weigh any value because they are too risky to handle? Just how toxic are they?

Since we do not presume to publicly evaluate other company's products, I must use my own company's products to illustrate some following points.

The relative toxicity of herbicides is measured by the acute oral LD 50. The "LD" means lethal dosage and the "50" means the amount of chemical administered orally in a single dose to cause the death of 50% of the test animals which are usually rats. It is expressed in milligrams of chemical per kilogram of animal body weight. The larger the LD 50 number, the more chemical it requires to cause death, and therefore, the safer the compound.

In addition the toxicity rating for chemicals is listed by numerical class from "1" to "5" according to the LD 50 figures. For example an extremely toxic compound would have an LD 50 of between "0" and "5" and would have a class rating of "1". As we go up the scale from a small LD 50 number to the larger numbers when a compound reaches the 5000 to 15000 LD 50 range and into the class "5" category they are considered as almost non-toxic. Again, the larger the number the less toxic a compound.

Now using these measurements aspirin and salt taken internally by millions every day probably by many of today would have a more hazardous rating than most herbicides. In other words, an amount of most herbicides would be less toxic than an equal amount of aspirin or salt. For example our herbicides and many others have an LD 50 greater than aspirin and have the same rating which ranges from slightly toxic to almost non-toxic. As an even better example a compound such as "Hyvar" X in the No. "5" class is considered almost non-toxic. A 150 pound man would have to swallow between one pint (16 oz.) and one quart (32 oz.) for it to be fatal.

You frequently hear rumors of injury to fish and wildlife by some compounds. The fact is compounds cannot be recommended and used for vegetation control until they have been evaluated for their toxicity to fish and wildlife. Most compounds today present no danger when used in accordance with label recommendations. Most companies are extremely conservative in this area.

For example, and again only as a specific illustration I will use a Du Pont product, "Hyvar" X has been tested for toxicity to fish and has been found that at extremely high concentrations such as 100 PPM for 24 hours it would not harm sunfish or trout. We still will not make any recommendations for its use for that specific purpose even though there is an indicated ample safety margin. However, if during an application to soil near water, if by accident "Hyvar" X were to enter the water, it would still take a uniform application of 1300 pounds per acre for it to approach 100 PPM in a pond 5 feet deep. This is a very remote possibility from an economics standpoint alone.

This term we use "parts per million" or as it is usually abbreviated "PPM'S" may seem somewhat vague. Perhaps I can clarify it for future reference. When you say 1 PPM you are saying or referring to a proportion the same as comparing 1 oz. of vermouth in 7800 gallons of gin, and that my friends would be one hell of a dry martini.

Actually there compounds that can be used safely near water supplies where fish are present. "Ammate" is registered for use adjacent to human water supplies. As to wildlife "Hyvar" X at 10,000 PPM had no effect on one week old mallard ducklings or bobwhite quail.

Another important consideration regarding herbicides is how risky is the material to handle? What about the dermal toxicity? In this case the compounds are also classed on a "1" to "5" basis and again the higher the number the less irritating the product. Most herbicides have a dermal rating of 4 or 5.

Of course we would caution against careless handling of any materials when pouring, scooping, or loading and to avoid breathing any of the dust. Proper safety equipment reduces hazards.

A few herbicides are volatile and winds can move them, or spray particles can be transported by wind, but this becomes a matter of choice of products and judicious application timing.

There are many herbicides that are Federally registered and approved to selectively weed many crops both food and fiber.

For many years than I can remember we have emphasized the importance of label reading and adherence. Herbicides do have precautions against misuse the same as medicines and should be followed as religiously. Generally no problems occur when the label is followed faithfully. Once in a while a citizen will observe the "brownout" that occurs when chemicals are applied to emerged vegetation and we get some static. This is why we recommend pre-emergence applications. People will seldom complain about preventing vegetation or complain about what they can't see.

There is still another area that comes in for its share of criticism and complaint and that is the cry that herbicides persist and accumulate and stay around forever rendering the soil infertile. When they do not comprehend the mechanism of herbicidal dissipation it is easy to misunderstand. Herbicides are basically degraded by the action of soil micro-organisms. They in reality attack the carbon molecule and break down the tiny herbicide particles and the weed and brush control compounds disintegrate and disappear. The length of time for this sequence is dependent upon the level of organism activity, the dosage level, the particular soil type, etc., but break-down they do. Although the micro-organism attack is the major method of break-down there is also some chemical decomposition, plant metabolism, and leaching-but-in the overall degradation these are minor factors and are only contributive.

We have tried to show the value of herbicides and their basic safety both to man and the environment. Despite the criticisms and scare tactics employed by some to paint a false and misleading picture what is the sum total? Herbicides can be beneficial in areas of safety, appearance, health, disease, pollution and costs.

As can be seen if the case is presented accurately. Herbicides touch many facets of our lives and unless misused their functions are beneficial.

You who are concerned with vegetation control can feel a certain pride that when the proper material is chosen and the proper application is made the herbicides you have used have contributed to greater beauty and safety.

We think the plus factors of herbicide use far outweighs any disadvantages and most importantly we must all try to help people understand this.

Again, you who use the tools of chemical vegetation control—when and where it is indicated for reasons of appearance, safety, or health—should not be required to defend your work against those who chose not to understand or those who may innocently truly not understand the role herbicides play in our agriculture, industry, and even private lives.

This does not mean that there are not isolated instances of abuse or misuse. It simply means that we who employ herbicides for certain critical purposes must be constantly trying to increase our knowledge of proper product usage.

On the other hand, those who ultimately benefit from your knowledge, either directly or indirectly, knowingly or unknowingly, must be made more completely aware at every opportunity of the sound reasoning behind your decisions to employ certain products—at certain times—in certain places.

It might be well to ask those who deliberately or innocently oppose herbicides to just for a moment consider the repercussions if, for example, no undesirable vegetation was eliminated or controlled for from 3-5 years. Think of the impact on farming, highways, railroads, ditches, and even closer to home, your own yards, gardens, and flower beds.

The manufacturer of these necessary and useful chemical compounds cannot do the enormous job of public education alone. It is everyone's job who is involved in undesirable vegetation control to help educate, enlighten, and convince the general public that an herbicide spray rig is not some kind of infernal machine specifically designed to create an imbalance of nature—nor a mortal enemy of sane ecological practices. In reality, it is more accurate to consider that spray rig as a helpful tool in achieving a –

"BETTER LIVING THROUGH A BETTER ENVIRONMENT".

[1]DuPont Company, Port Hueneme, California.

Auxiliary Chemicals Used With Pesticides

B. F. Fay and J. J. Melton[1]

When I first considered talking for a little while about the chemicals that are used with pesticides, I realized that, after some consideration, the subject was just entirely too vast to cover in my allotted time. I decided instead to center on some of the problems that can occur with pesticides and that are related to the chemicals that are used with them. To give it a title, I have decided to call these chemicals Chemical Auxiliaries. This is really an appeal to all who do field research related to pesticides to examine the physical aspects of the products with which they are working before they take them to the field. I would especially like you to remember that a great deal of what I show you that's taking place in laboratory glassware takes place just as well in the spray tank of your equipment. But it takes place unknown to you, in most instances, and ultimately manifests itself in poor results or in results that are non-uniform. I know personally of companies that have lost an entire season's field experience simply because they failed to look at the product before they took it out and performed their tests.

Obviously, I will not have time to go into any great detail. Anthony Jay in his recent book, "The New Communication", says that the purpose of a presentation is to arouse the curiosity of the audience and to stimulate their desire for more information and this desire can be satisfied in other ways and at other times. That's the theme that I'll take this morning.

In considering this subject, I became aware that our use of pesticides is similar in some respects to the martini. In a pesticide it is the active component in which we are interested; just as in the martini, it's really the olive that we are after, so our analogy starts with the olive and the active ingredients. The gin of the martini is merely a vehicle to get the olive to us in a useful form, and so the formulation is the vehicle to get the pesticide to its intended target in a useful form. And just as we modify the vermouth content of the martini to change its appeal to particular palates so we can use adjuvants to modify the effect or utility of various pesticides. Finally, if we have over-indulged in martinis, we have an antidote to relieve us of the after effects, and with activated charcoal we have a means of correcting for the over-use or misuse of pesticides.

Now, our first consideration this morning will be the gin of the pesticide (martini); that is, its formulation. I doubt that anyone knows how many types of formulations there are, but I would like to discuss just a few of the more common types.

The first of these is the wettable powder. Here we see it as the proportion of amounts of a typical wettable powder formulation. It contains somewhere in the range of 50% to 85% active pesticide, 1% to 3% of a wetting agent, 1% to 3% of a dispersing agent, and the balance or 10% to 45% of a clay carrier. The term clay is descriptive of physical state. It is not a chemical definition. Clay consists of fine particles that are plastic when wet and that become ceramic when fired. They are predominantly aluminum silicate. They vary in their physical properties as you can see from this slide where we have equal weights of four different types of common clays. You can see that some of them occupy substantially more volume than others. Because of our interest in the clays, they can be divided into two basic categories—the low sorptive clays, such as talc, pumice and *kaolin,* and the high sorptive clays such as bentonite, attapulgite and the diatomacious earths. There are a number of properties of the clays which become important in one application or another, but basically it all boils down to their sorptive capacities. And here we see a liquid pesticide that has been applied to a low sorptive kaolin clay and to a highly sorptive attapulgite. As you can see, the kaolin clay has turned lumpy and is unusable, but with the same amount of liquid pesticide on it the attapulgite still remains a free flowing powder. So where we are dealing with liquid-type components the highly sorptive clays are equally satisfactory. The chief component of the wettable powders is the wetting agent. The wetting agent is not critical to the performance of the wettable powder. The only one really concerned with the comparison between a good and a poor wetting agent is the ultimate consumer of the wettable powder, that is the farmer. He can see the difference in the ease of handling of this product. Chemically, the wetting agents are generally anionic in nature and consist of taurates, sulfates and sulfosuccinates and here we can see the effect of wetting agents. On the left, a poor wetting agent has been chosen for a given formulation, and on the right, the same identical formulation has been made but with a good choice of a wetting agent. You can see that as soon as the product with the good wetting agent is sprinkled on the water surface, it begins to wet and disperse, and becomes rapidly dispersed throughout the entire spray solution. Only after all of the product with the good wetting agent has become wet and dispersed, is the poor product even beginning to show signs of wetting and dispersing in the system.

The next component of the wettable powder is the dispersing agent. This is the chemical that serves to keep the wettable powder dispersed throughout the spray solution so that with some minimum amount of agitation the spray solution maintains its uniformity. Unlike the wetting agent, the dispersing agent can be critical to proper performance of a wettable powder, since if a poor choice is made, it may permit the wettable powder to flocculate. This flocculation may well be irreversible and if it is, the active wettable powder will tend to settle from the spray solution even with agitation and the result will be a non-uniform deposition of the pesticide. Lignosulfonates are the most common dispersing agents.

Flowables are essentially an extension of the wettable powder. They consist of a finely ground solid material in a liquid vehicle. The typical composition of a flowable consists of a substantial quantity of a solid pesticide along with a certain amount of clay generally to give some additional bulking property to the vehicle. There are three commonly used types of vehicles. One of them is oil, another is water, and the third is an emulsion which can be either water-in-oil emulsion or an oil-in-water emulsion dependingupon the particular needs of the system. A suspending agent is generally used. In the flowables using oil as a vehicle, chemically the suspending agents may be amine sulfonates or in some instances, nonionic surfactants. When water is used as the vehicle, the suspending agents will be essentially the same types of products that are used as dispersing agents in the wettable powders. No suspending agent is normally needed or used when an emulsion is used for the vehicle of a flowable. In water based flowables, thickeners are frequently used. These could be carboxymethl/cellulose or the attagel-type products. Their function is to change the rheology of the system to prevent or slow the tendency of the finely ground solid material to settle. In water based systems, an antifreeze, generally ethylene glycols such as used in your car radiator, is included as an antifreeze to prevent the destruction of the flowable properties under low temperature conditions.

Two problems are known to occur fairly readily with flowables. These are gelling of the entire flowable system or caking of all or major portions of the active ingredients in the bottom of the container. Here you see three formulations of the same active components. The bottle on the left, you can see, is a good flowable formulation, having the properties that are generally desired. The formulation perhaps had too much thickener or some chemical reaction took place. In any case, the entire formulation has gelled and has become difficult or impossible to remove from the container. But it is the formulation on the extreme right that is probably the worst problem of all because it is deceptive. Here you can see that it has separated into three distinct layers. The top layer contains some of the active pesticide and, of course, the vehicle and other chemical components and on the surface looks to be much like a normal flowable. The dark layer in the middle is a certain amount of separated vehicle containing no active components at all, and in the bottom, we have a mixture of clay and active pesticide that have formed a hard cake in the bottom of the container. The deception takes place here when the farmer shakes the container and the top two layers mix and the formulation appears to be uniform and usable and as frequently happens, a portion is poured off and used. It isn't until the container has been "emptied" that the farmer becomes aware that a goodly portion of what he bought and paid for is still in the container in a form that's essentially useless to him. In looking at flowable formulations from a research point of view, it's wise to check to make sure that you do not have most of the active material sitting on the bottom of the container in an unusable physical form.

This brings us to the most popular of all of the pesticide formulations, both with the manufacturer and with the farmer, and that's the emulsifiable concentrate or EC. It is popular with the manufacturer because the equipment to make it is simple and relatively inexpensive. It is popular with the farmer because it is the easiest to measure and handle and does not present the problems of abrasiveness and other things that are sometimes associated with wettable powder.

There are two broad classes of emulsifiable concentrates. Those of us that are in the business like to say that there are good emulsions and bad emulsions, but really these two classes are the so-called inverts, or water-in-oil emulsions, and the conventional or oil-in-water emulsifiable concentrates. There is a special class of oil-in-water emulsifiable concentrates that is called mayonnaise emulsions which are just an extension of the conventional type in a particular physical form. It is very similar in appearance to the invert emulsion. Here we see a comparison of the two. On the left, we have an invert emulsion being poured into a cone of water and on the right we have a mayonnaise emulsion receiving the same treatment. You can see that with some minimum agitation, the mayonnaise emulsion has dispersed and become a relatively stable oil-in-water emulsion, but in the invert emulsion system, there are still discreet particles of emulsion rotating in the water. When the stirring is stopped, you can see again that on the right we have a relatively stable conventional emulsion, but on the left, the invert emulsion has not dispersed at all in the water and would be unusable.

A typical emulsifiable concentrate looks like this. Here we see the relative proportions of each of the components and the finished product of a simple six pound gallon toxaphene formulation. It is this particular formulation that I'll show in the subsequent slides stressing the problems that can occur with emulsifiable concentrates. Typically an emulsifiable concentrate will contain something in the range of 60% by weight pesticide, 33% solvent and 7% emulsifier. In this particular instance, we have ½% of epichlorohydrin as a stabilizer.

The first component of the emulsifiable concentrate to merit discussion is the solvent. Here again, they are broken into two categories: polar solvents and non-polar solvents. The distinction between the two being that polar solvents have some ability to conduct electricity while non-polar solvents do not. Typically, polar solvents are things like water, acetone, alcohols, isophorone, misityl oxide and so on. Some non-polar solvents are things like xylene, toluene, kerosene, and of course, the aromatic petroleum solvents marketed under various trade names that are so widely used in emulsifiable concentrates.

The selection of a solvent is important for a variety of reasons. What it really boils down to is that it must be selected to be non-phytotoxic to desirable crops and to provide adequate solubility for the pesticide. Here we have two DDT formulations. The one on the left used a kerosene-type solvent, and, as you can see, the DDT over some period of time has separated from the formulation. The EC on the right, where xylene was used as a solvent contains exactly the same amount of DDT but is holding it satisfactorily in solution.

The use of polar solvents has several effects on the formulation. The first of these is that the product generally becomes more difficult to formulate primarily because polar solvents put a special demand on the emulsifier making it more difficult to select them properly. Polar solvents frequently have some water solubility or water may be soluble in them to some extent. This can lead to another undesirable effect. When this happens, unless we are extremely fortunate, or extremely careful, when such a formulation containing such solvents, is added to water, crystals of the pure toxicant may form and they may form very rapidly.

Here we have two formulations of DDT being poured into emulsion viewing tubes. The formulation on the left uses a mixture of xylene and acetone as the solvent system. The formulation on the right uses just xylene. As you can see, both of them are emulsifying properly and the emulsions look quite good. Now almost immediately after the emulsions have formed, if we take them and pour them through a 325 mesh screen we see this interesting phenomenon. The formulation containing the acetone-xylene solvent system seems to have a solid component in the emulsion. But the all xylene solvent system does not. After all of the liquid has drained through the screen, we can see that almost all of the DDT has crystallized out of the emulsion using acetone and xylene, but no solid separation occurred at all in the straight xylene system. This phenomenon does occur and occurs with products that are commercial and on the market now. The resulting problems are obvious. Because of the very, very fine particle size of the separated pesticide, it is often difficult to detect. If you are fortunate perhaps the crystals that form will be large enough to cause spray nozzle plugging and then you will know that this is occurring. But in other instances, the crystals do not plug the spray nozzles and you may never be directly aware of the fact that this has occurred. You may just wonder why you have gotten non-uniform results in your field test. Perhaps you have gotten excellent control in some areas and poor control in others. Or perhaps you have gotten no control at all with a compound that has shown good results in other places. This can occur because the crystals being relatively heavy settle out and you get slugs of them being deposited in certain areas and none at all in others; or, it may be that all of the material has crystallized out and that in its crystalline form it is not available to do its job on the target organism. In any case, it can be a serious problem and is one that needs to be considered in the fine art of formulation.

Emulsifiers may be ionic or nonionic in character. Most frequently blends of the two are used. The most common of the ionic emulsifiers are anionic and these for all practical purposes boil down to calcium or amine sulfonates. The nonionics may be the ester types such as the ethoxylated nonyl phenol products or they may be ester types like the ethoxylated fatty acids of fatty acid esters.

Emulsifiers are extremely important to the emulsifiable concentrates since they determine its ultimate performance under a wide variety of conditions. Most emulsifiable concentrates are designed to give adequate performance under so-called normal conditions. Normal conditions are generally considered to be 5 to 95 dilution ratio, that is, about a half-gallon of emulsifiable concentrate 15 gallons of spray solution, a water temperature of about 70°F., and a water hardness of something in the range of a 100to 300 parts per million. Generally speaking, something in the 100 to 150 range is normal for this area. In our laboratory and particularly for the purposes of these slides, we've used the following procedure. We've made identical emulsifiable concentrates in most instances. Portions of them are accurately measured into test tubes and then the contents of the test tubes are carefully and rapidly poured into emulsion viewing tubes as you see here. And then, for an overall view of what we show later in close-up, we see the emulsions forming in the viewing tubes which are supported in a particular type of rack. We've masked out portions of the rack and we are viewing most of these emulsions with a back-lighted situation such as you see here.

The first consideration that we want to look at is the effect of the emulsifier itself. Here we see two different levels of emulsifier being used in identical conditions. For those of you who are not familiar with evaluating emulsions, I should say that even though the emulsifiable concentrate may be dyed with an intense color as we have done here just to make it easier to photograph, a good emulsion will always appear white. As you are looking at these pictures a measure of the quality of the emulsion is the intensity of the color. The darker the red, the poorer the emulsion and vice versa. Here you can see in its initial stages the 2½% emulsifier is not doing a very good job compared to 6% of the same emulsifier in the same formulation. As it continues down the tube, you can see on the right where 6% emulsifier was used that a thick creamy white emulsion is forming while on the left where only 2½% was used that oil particles are visible and the emulsion is not really forming at all. As we finish pouring the emulsions, we see that on the left all of the emulsifiable concentrate has separated out as an oily layer, whereas on the right, we have a nice stable creamy white emulsion. And in 15 minutes, this difference is even more apparent and dramatic.

Now, so-called abnormal conditions are actually commonly encountered. The first of these that I would like to show you is the cold water condition. Here we have identical emulsifiable concentrates being poured into cold water on the left and normal water that is 70°F. on the right. Cold water will be found frequently in the early spring where a farmer is drawing water from a deep well or perhaps from a surface pond that is deep enough to remain cold for a considerable period of time after thaw. The cold water in this instance is at 40°F. which would not be unusual. You can see from the red color that the emulsion is not forming well in the cold water and in fact oil particles are readily discernible. After 15 minutes, you can see that virtually all of the emulsifiable concentrate has separated out as an oily layer in the cold water but under normal conditions we have a good, stable, usuable emulsion.

Now later on in the season when a farmer might be using field storage tanks for his water, water temperature could easily reach 120°F. as we see here on the left. Again, the 70°F. water is on the right. The situation appears to be identical to that with cold water, where the emulsion is not forming well at all under warm conditions. As it progresses down the tube, you can see that under normal conditions a fine emulsion is forming but it is just fading out completely in the warm water. In 15 minutes, we have even more severe separation than we did before showing all of the emulsifiable concentrate in an oily layer at the bottom of the tube of warm water, but again a fully satisfactory and usable emulsion under normal conditions.

In some areas of the country hard water that is substantially more than 150 parts per million is encountered. Water as hard as 2,000 parts per million as calcium carbonate is found in some parts of Ohio, in the Dakotas, northern Florida, and some parts of California. Here we see water of 1,000 parts per million on the left compared to water of 150 parts per million on the right with identical emulsifiable concentrates being added to them. In the 150 water the emulsion is almost completely formed and quite good looking, while in the hard water, it is very weak looking and does not have the spontaneity or as you can see here, the stability. After one hour, we have total separation in the hard water whereas in the normal water, a good, stable emulsion is still in evidence.

Extremely soft water occurs in several areas of the country. In the Southwest and in the Mississippi Delta, it presents its own peculiar problems. Here we have the identical formulations being poured into very soft water about 300 parts per million of sodium, on the left and our normal water on the right. Just as we saw with the hard water, the soft water emulsion is fading out. It looks quite poor, whereas the normal emulsion is certainly doing very well. Almost immediately, we see oil separation in the very soft water, but a good stable emulsion in the normal system. In an hour, separation is even worse than we observed in the hard water because in the soft water a substantial portion of the emulsifiable concentrate has become oily in nature.

The dilution of the emulsifiable concentrate in the spray tank can have a significant effect. We are looking at a very dilute emulsion, about 1 to 300 dilution. This would normally be encountered in orchard spraying or perhaps where we have added a pesticide to an irrigation system. The normal 5 to 95 dilution is on the right. You can see that the normal emulsion is forming nicely whereas the dilute emulsion, which we'd expect to be thinner anyhow, looks rather weak. The normal emulsion is fully formed while the dilute emulsion is still dispersing somewhat poorly. In an hour, you can see that virtually all of the dilute emulsifiable concentrate has separated—remember, it was only a little to start with, but under normal conditions, we have the good, stable, usable emulsion.

In aircraft spraying, for example, we frequently use much more concentrated emulsions. Here we are looking at the comparison between a 1 to 1 dilution on the left and the 5 to 95 dilution on the right. As the emulsion forms initially, a good portion of it is not emulsifying adequately as shown by the very deep red streaks. In 15 minutes, there is gross separation in the highly concentrated emulsion under normal conditions.

I will make a special plea that you determine that the formulation with which you are working is satisfactory under your test conditions. I have shown you a lot of problems that can occur. These are not necessary with the proper selection of surfactants and the use of the proper amount of surfactants. A single formulation can be made that will perform adequately under all these varied conditions. It's a more expensive type of formulation and it is difficult to develop, particularly for research samples. Therefore, it is entirely possible that at the early stages, where you may be looking at experimental compounds, that all of this work has not been done as it should have been for you. So it is wise to take a quick look to make sure that your efforts are not going to be in vain.

This brings us to the vermouth of our pesticide martini. The material used to modify it to our taste. In the case of pesticides, this, of course, means adjuvants. I have seen a number of definitions of the term "adjuvant". I hate to add to them but I have not been satisfied with those that I have seen, so I would like to offer this for your consideration. An adjuvant is a chemical that is applied in conjunction with an economic poison to modify its biological effect, to improve its deposition characteristics, or to enable it to be used under peculiar conditions. You'll notice that in this definition I have not limited adjuvants to spray tank additives since there are a number of truly adjuvant materials that can be formulated directly with the active pesticide. I have also purposely defined it in such a way that wetting agents as used in wettable powders or emulsifiers as used in emulsifiable concentrates fall outside the scope of this definition.

Adjuvants can and have been used with just about every type of economic poison, but for the purposes of our discussion this morning, I am going to limit my considerations to herbicides. I think that adjuvants can be divided into three major categories: the performance modifiers, the utility modifiers, and the spray modifiers.

In performance modifiers, the activators are best known. These are chemical compounds that increase the effectiveness of pesticide chemicals. Here we see a corn plot that has had two pounds of a triazine-type herbicide applied to it early post-emergence and you can see that the grass control has been something less than adequate. Now, when the identical treatment has had a half gallon per acre of an adjuvant added to it, we see this sort of result on an identical and adjacent plot. We have dramatically increased the effectiveness of the herbicide.

Certain adjuvants work well with some herbicides on some crops but not with other herbicides or on other crops. To illustrate that I would like to show you these slides. Here we have applied two pounds of chloroxuron post-emergence to soybeans in conjunction with the recommended ether-type of adjuvant. As you can see, we have gotten excellent weed control and good soybean growth. But when we take a universal (so-called universal-type) ester surfactant and use it with that same treatment, we discover that not only have we lost a good bit of the weed control but we've also caused considerable stunting of the beans. Then again, we can select the proper type of ester surfactants to use with the chloroxuron treatment and we see that again we get both excellent soybean growth and excellent weed control.

But when we take these same adjuvants and use them with diuron as we have here, you see that the so-called universal-type adjuvant that is shown on the left here did not work well at all with diuron in a non-selective type of application. Neither did the ester type that was so effective with the chloroxuron as you can see in the middle strip. But when we go to an altogether different type of ester adjuvant with the diuron, we see that we dramatically increase its effectiveness. What I am saying here is that it is absolutely essential that each adjuvant be considered under each particular set of circumstances of its use.

Some adjuvants will actually diminish or reduce the effectiveness of certain herbicides. Both MSMA and Paraquat are almost always utilized with an adjuvant. The most effective and convenient type of adjuvant for MSMA is a compatible type product which is generally anionic in nature. If you took this same type of adjuvant and used it with Paraquat, and I have seen this done, a chemical reaction takes place. Paraquat is cationic and will react with the anionic surfactant. The net effect is that a substantial portion of the Paraquat is tied up chemically and consequently its effectiveness is reduced.

I can't emphasize too strongly that it is unwise to assume that any adjuvant can be used across the board in all applications or for all purposes.

Another type of performance modifier is the safener. Both of these two center rows of potatoes have had a thiocarbamate herbicide logarithmically applied to them, starting with 9 lbs. per acre at the front of the row and decreasing to 9/10 of a pound per acre at the back. The spray solution used on the row at the left did not contain any adjuvant and you can see that substantial injury occurred to the potatoes until we get down to a relatively low level. Of course, the weed control has been more than adequate throughout, but the injury did occur. The spray applied to the row on the right contained ½% of an ester-type surfactant. As you can see, it has made the thiocarbamate herbicide completely safe at all levels for use on the potatoes.

There are chemical types of safeners as well as the surfactant types. Here we see a commercial product that again is for use with a thiocarbamate. The stunted row of corn has had six pounds per acre of Eptam applied to it without a safening agent. The healthy row next to it has had the recommended level of safening agent applied to it in conjunction with the six pounds of Eptam. Safening agents are not limited to the thiocarbamate herbicides. These just happen to be the best slides that I had available. We have seen them work well with a variety of other types of herbicides as well as with other economic poisons.

Physical problems can occur with the use of adjuvants. Here we see two containers, both of which contain a wettable powder type of herbicide and an adjuvant. The adjuvant used with the wettable powder on the left has caused a problem that we have come to call greasing. The adjuvant on the right was fully compatible and without problems. Greasing generally occurs when an adjuvant oil wets the finely divided solid particles in the spray tank and forms a non-dispersible type of film which adheres to the sides of the spray tank. Of course, the net result of this, besides being a nuisance of the farmer, is that a portion of the herbicide, of course, does not get applied to the crop as expected. In some instances, where people have been doing research on adjuvants, I have seen them select materials for study that are not even water dispersible. Because much of the work is done in opaque containers of some sort, this phenomenon does not become apparent and only surfaces indirectly with the poor results that have occurred.

Because these problems can occur and there are others that can occur, in each instance we recommend that you look at the compatibility of any given adjuvant with any given pesticide formulation before you take it to the field. This will help you avoid the heartache and headache of poor results.

The second class of adjuvants are the utility modifiers which makes the use of certain pesticides formulations possible under a wider variety of conditions than might be normally encountered. Of course, the best known of these are the compatibility agents. These are products that enable us to apply conventional emulsifiable concentrates in liquid fertilizer solutions. Here on the left we see alachlor which has been added to a 32-0-0 liquid fertilizer with obviously little success. The liquid fertilizer in the cylinder on the right had a compatibility agent mixed with it before the alachlor was added. As you can see we have obtained a usable emulsion of the herbicide in the liquid fertilizer solution.

Not all emulsifiable concentrates work well with any given compatibility agent in all liquid fertilizers. This whole area is full of potential problems and I cannot urge you too strongly to investigate the exact combination of ingredients that you intend to use before you put them in the spray tank.

There are other utility modifiers such as buffers which permit the use of phosphate-type insecticides in alkaline waters and anti-foam agents, which sometimes permit the use of particular formulations in equipment which because of particular design problems creates foaming problems.

The last of the adjuvants that merit discussion are spray modifiers. These are compounds that alter the character of the spray or the deposited film. I think that the best known of these is the spreader-sticker class of compounds. Spreaders, generally speaking, are straight surfactants which reduce the surface tension on the leaf surface, permitting a more uniform and rapid spreading of the spray. Stickers are generally film-forming compounds. They are oily or resinous in nature and are intended to give the spray a longer lasting effect.

The chemistry of these things is not well known. They are proprietary in nature and generally a product of the formulators art.

In California, it is common practice to use a reflective coating on tomatoes or walnuts to protect these crops from sun scald. This reflective coating is a white pigment. It disperses well in water and is easy to handle in spray systems.

Here we have two trays of tomatoes, both of which have been sprayed with equal amounts of a type of white pigment. The spray solution used on the top tray did not contain any adjuvant while that used on the bottom tray contained a well known spreader-sticker. I think that the difference in uniformity and quality of the deposit is certainly dramatic.

Another spray modifier that is achieving considerable publicity these days is the foaming agent. These are generally surfactants that are added to spray solutions to increase their foaming ability. They are generally straight surfactant type products. They are proprietary in nature and their chemistry is not generally public knowledge. They are compounds that are added to a spray system to increase its ability to foam. It generally requires the use of specially designed spray rigs to generate high foam levels.

These foams have some interesting properties. They are suggested for use to prevent the drift of pesticides, to permit longer contact of the pesticides with the target organism in a liquid state or to achieve a particularly accurate placement. Here we see the thickness and durability of the foam that can be generagted with a particular chemical in a particular type of equipment. Similar chemical and equipment shown here allows the accurate placement of the pesticide system on peculiar surfaces. Here we see the very careful placements of metered quantities of pesticide. And again here is another type of accurate placement in a drift-free manner.

However, there are some areas with the foaming agents that still require additional study. I would like to caution you about them. The first of these is that relatively little is known about the compatibility of many pesticide formulations with foaming agents. This is an area that needs further study. There are all types of potential problems that could be occurring in the spray tank. I suspect that what we are going to require eventually is a special formulation when a pesticide is required to be used in a foam system.

Another consideration is the fact that foaming agents are generally added at a level high enough to make them function additionally as adjuvants. Consequently there are potential problems that need study that are related to this possible adjuvant affect. There have been reported cases of injury with certain types of pesticides under certain conditions and these things need to be considered carefully before large scale application of foam becomes a practical reality.

Finally, I guess we all know that there are occasions on which we over indulge in martinis and by the same token, we sometimes have an overdose of pesticide. The result is that the area that has been over-indulged in pesticide is not suited for some particular use. This leads us to our final category of chemical auxiliaries, the adsorbents.

Activated charcoal is the best known of the agriculturally used adsorbents. By way of illustrating the type of effect that can be achieved with this type of compound, I would like to show you some turf plots where the soil was prepared and the recommended rate of bensulide, which is a relatively persistent herbicide, applied to them. Six weeks later the plots were reseeded with a variety of blue grass. That is a much shorter interval than is recommended by the manufacturer of bensulide but the purpose here was to illustrate that the proper use of an adsorbent can turn off the effect of a persistent pesticide.

Here you see the plot where the bensulide had been applied, then six weeks later reseeded, six weeks after seeding, this is the type of grass stand that we observed. But when 300 pounds per acre of activated charcoal had been applied to that same area just prior to reseeding, six weeks after the reseeding, we see a healthy and complete stand of grass.

Other adsorbents have been recommended and used for this type of application, among them are peat moss and manure. In this particular test series, we included peat moss to see what effect it would have. Here we have mixed peat moss with the top one inch of soil on a one to one basis and compared it to 200 pounds per acre of charcoal. As you can see, at least in this particular application, peat moss is essentially ineffective.

So then, we can say that with the proper selection of ingredients, properly mixed, served at the proper atmosphere, we can achieve the perfect martini. The same is true of pesticides, when properly formulated, used with the proper adjuvants and under the right conditions, we can get the intended effect. With martinis as with pesticides, if we have over-indulged, we always have the antidote that we can resort to under dire circumstances.

---

[1]Atlas Chemicals Division, ICI America, Wilmington, Delaware.

Persistence of Various Dinitroanilines under Irrigated and Desert Fallow Conditions

Gagnon S. A. and K. C. Hamilton[1]

A field and greenhouse study compared the persistence of seven dinitroanilines. Two field borders representing irrigated and fallow conditions were each treated in November 1971 with A-820, Dinitramine, CGA 10832, CGA 11607, CGA 14397, Nitralin and Trifluralin at .8 and 1.6 lb/a. Experimental design was randomized complete block with four replications. Soil was sandy loam, 60% sand and .6% organic matter. Incorporation by double disking to a depth of 4 inches immediately followed.

Soil from the test plots was sampled at 4-month intervals and planted in the greenhouse with sorghum. At 4, 8, and 12 months, a second depth, 4 to 8 inches deep was sampled. Measurements were made on shoot height and fresh and dry weights of shoots and roots. The flood irrigated border received 40 inches on a cotton schedule between the 4 and 12 month samplings. Rainfall over the 12 month test period was 17.5 inches, most of which was received between the 8 and 12 month sampling. The fallow border was comparatively dry throughout the test period except for over the rainy season.

Persistence of the herbicides were strongly influenced by moisture. No degradation occurred in either border between application and the 4-month sampling. This corresponds to our dry, cold conditions. Herbicide loss was greatest in the irrigated border between 4 and 12 months, losses in the fallow approximately equaled those found in the irrigated border at 8 months. Herbicide loss in the irrigated and fallow borders was related to the irrigation and rainfall received. No herbicide leaching was detected over the 12-month period in the irrigated border.

Most persistent of the seven herbicides was CGA 10832 and Trifluralin. Amchem 820 and Nitralin were the least persistent. Dinitramine was the most highly sensitive to moisture in its persistence. Prior to irrigation, Dinitramine was the most toxic herbicide. After irrigation or summer rain, loss was rapid resulting in little or no persistence at 12 months.

---

[1]Agronomy Department, University of Arizona, Tucson 85721.

Improving the Deposit Efficiency of Pesticide Sprays with LO-DRIFT™ Spray Additive

R. R. Johnson, R. J. Messinger and R. M. Dryden
Research Department, Agricultural Chemical Division
Amchem Products, Inc., Ambler, Pennsylvania 19002

Abstract: LO-DRIFT spray additive, a polyvinyl polymer liquid concentrate reduces aerial drift of pesticide spray droplets by increasing the droplet size. Field trials on several crop species indicate that LO-DRIFT spray additive does not affect the selectivity of herbicide sprays. LO-DRIFT uses conventional nozzle systems for aerial and ground application of pesticides. Rates of LO-DRIFT and spray pressures vary with the type of equipment and the coverage desired.

Plant Protection in the Middle East

R. L. Zimdahl[1]

During 1972 six four-man teams traveled to six different areas of the world. The teams were financed by US-AID and organized by the University of California at Berkeley. The purpose of the mission was to survey the plant protection problems in the countries visited and assess the ability of the country to solve the problems. Each team was required to submit a detailed report, to the project and US-AID, which included recommendations for solving some of the problems.

I was a member of the team that traveled to Turkey, Iran, Afghanistan, and Pakistan. This paper will deal with the weed control problems observed, the scientific research capability, the general plant protection area, and the suggestions my team made to deal with the problems identified.

---

[1]Weed Res. Lab., Dept. of Bot. and Pl. Path., Colorado State Univ., Fort Collins 80521.

Effects on Nematodes in Cotton from Herbicide Application

H. F. Arle and William W. Carter[1]

In a greenhouse study two herbicides of the dinitro aniline class were tested on cotton to determine whether these materials might affect the activity of root knot nematodes, *Meloidogyne incognita acrita.* The materials, a, a, a-trifluoro-2, 6 dinitro-N, N-dipropyl-p-toluidine (trifluralin) and N-sec-butyl-4-tertbutyl-2, 6-dinitro aniline (A-820) are chemically similar but are different in their effect on the secondary roots of cotton seedlings. At rates recommended for weed control trifluralin greatly reduces secondary root development in the zone of incorporation while A-820 has little effect on root growth.

The experiment was conducted in stainless steel glass-front boxes which were 12" wide and 3" deep. Trifluralin at .75 lb./A. and A-820 at 1.5 lb./A. were applied and incorporated with soil to a depth of 1 or 2 inches. All boxes were filled with untreated soil to within 4 inches of the top. Treated soil was then placed in various zones and thicknesses to fill the boxes. Cotton seed was planted at a depth of .5 inch along the glass. Water was added until soil was wettened throughout the profile. Boxes were placed at an angle of approximately 20 degrees to force root growth along the glass. After cotton emergence, nematodes were placed on the soil surface from where they migrated downward. Plants were harvested three weeks later at which time nematode activity above and below the zones of herbicide and fresh weight of top growth and roots were determined. Namatodes were affected by trifluralin as there was little or no activity noted on roots below the treated layers. Nematodes were more tolerant to A-820. Although root-knots were reduced, they were found in and below the treated zones.

Average Fresh Weight of Tops and Roots of Cotton

Treatment		Treated zone	Weight in grams Top	Root
Check		–	2.2	3.3
Trifluralin	.75	Top in.	1.7	1.3
Trifluralin	.75	Top 2 in.	1.6	1.5
Trifluralin	.75	Top 3rd – 4th in.	1.9	2.4
Trifluralin	.75	2nd in.	2.0	2.3
Trifluralin	.75	3rd in.	2.0	2.8
A-820	1.5	Top in.	2.2	2.4
A-820	1.5	Top 2 in.	2.3	2.4
Nematode check		–	2.5	3.0

Root-Knot Rating1

Treatment	lb./A	Treated zone	Above Chemical	Below Chemical	Entire Root
Check	–	–	–	–	–
Trifluralin	.75	Top 1 in.	–	0	–
Trifluralin	.75	Top 2 in.	–	0	–
Trifluralin	.75	3rd – 4th in.	50.6	Trace on 2 plants	
Trifluralin	.75	2nd in.	30.0	Trace on 1 plant	
Trifluralin	.75	3rd in.	50.6	Trace on 1 plant	
A-820	1.5	Top 1 in.	–	–	37.1
A-820	1.5	Top 2 in.	–	–	31.3
Nematode check		–	–	–	58.1

1 0 = No infection 1-25 = Trace to light 26-50 = Light to moderate 51-75 = Moderate to severe 76-100 = Severe infection

[1]Research Agronomist and Nematologist, Agricultural Research Service, U.S. Department of Agriculture, Phoenix, Arizona.

Organization of the State Educational Program For Pesticide Regulation In Washington

Otis C. Maloyy[1]

This subject was initially scheduled to be presented by Dr. Arlen Davison, Extension Plant Pathologist at the Western Washington Research and Extension Center, Puyallup. Dr. Davison has been effective in coordinating and developing the pesticide education program in Washington.

1. Prior to passage of the Washington Pesticide Control Act in 1971, W.S.U. Extension specialists had been involved in training of commercial spray applicators and operators to prepare them for the licensing exams.

   The main thrust of that program was in the form of shortcourses and special training programs. More recent efforts have included preparation of the "Washington Pesticides Application Handbook" in 1968 and its revision as the "Washington Pest Control Handbook" in 1971.

2. The Act of 1971 specified that all pesticide dealer-managers must be licensed by March 1, 1972 and that all pest control consultants must be licensed by March 1, 1973. Since the Act finally passed the legislature on May 3, 1972, there was less than a year in which to prepare for the dealer-manager licensing.

3. Although the Extension Service was not named or obligated by the Act, it does have a role and responsibility as the continuing education branch of the College of Agriculture. As such, there has been a close working relationship with the Grain and Chemical division of the Washington Department of Agriculture whose responsibility it is to implement the Pesticide Control Act.

4. In the early stages of planning for our educational role, various specialists from the Extension Service and the Department of Agriculture met to consider the content of the courses, who would teach, where courses would be held, and preparation of visual material, printed material, study guides and other teaching aids.

5. The philosophy that developed concerning Extension's role in training the pest control consultants, a category that would include some Extension personnel themselves, was that those Extension specialists and agents who would help in the training program wanted to be licensed by the time the short courses for industry consultants were held.

   It was also decided the training for Extension people would be concentrated along subject matter rather than commodity lines. The areas of Weed Science, Entomology and Plant Pathology were stressed.

   Two concentrated sessions were held for Extension specialists and agents in May 1972 and examinations conducted the same month by the Department of Agriculture. These examinations included Laws and Safety plus sections on Entomology, Weeds, Plant Pathology, Rodents and Livestock Insects.

   Having passed these exams (or those that apply) the Extension people were then in a better position from the standpoint of public relations and acceptability to teach pest control consultants.

6. After the training, examination and licensing of Extension personnel as public pest control consultants, plans were made for the training of pest control consultants. The classification is along commodity lines—ornamentals, tree fruits, field crops, etc.—rather than subject matter. In order to meet the needs of industry and to insure that industry had some input into the preparation of the examinations, meetings were held with the Department of Agriculture, Extension, and repre-

sentatives from industry. Questions were submitted by all three groups and the State Department of Agriculture prepared suitable commodity examinations.

The attitude of industry has been very positive. They have emphasized that they supported the idea of examination and licensing. They wanted the courses to be meaningful and not just "Mickey Mouse." They wanted the courses to be educational and not just a means to pass the exams.

This philosophy of not designing courses with the specific purpose and limited goal of passing exams is a very important point. In the early days of the spray applicators exams there apparently were some programs designed only to answer the questions on the exams. But the applicators themselves wanted more in-depth training and, over the years, the exams have been expanded and are now more difficult than were the original exams. It is likely that the dealer-manager and consultant exams will also be upgraded.

A gratifying experience to come out of this program has been that fieldmen, farmers, and others have asked for additional educational programs.

I'm not sure where we will go from here except that we will no doubt have to present the basic course from time to time for new people that want, or need, to become licensed. There will also be some expansion of the course content to take care of modifications and upgrading of the exams.

The Federal Environmental Pesticide Control Act may require some additional programs or new directions. One thing is certain—pesticide control regulations are here to stay and more organized education programs will be needed. States should try to anticipate their needs well in advance so that they will have plenty of time to organize and develop their programs.

[1]Extension Plant Pathologist, Washington State University, Pullman, Washington.

Comparison of Injection and Surface Application of Herbicides for Control of Field Bindweed and Resulting Crop Tolerances

I. W. Skelton, H. P. Alley and G. A. Lee[1]

Abstract. Preliminary experimental work showed that injection of fenac (2, 3, 6-trichlorophenylacetic acid), dicamba (3, 6-dichloro-O-anisic acid) and combinations of fenac + dicamba resulted in over 95% control of field bindweed *(Convolvulus arvensis L.).* These research results suggested that injection could be an alternative method for field bindweed control. Since comparative data between surface and injection application and resulting crop tolerance was not investigated, a study was initiated to make these comparisons. Herbicides used were fenac, dicamba, fenac + dicamba, and 2,4-D (2, 4-dichlorophenoxyacetic acid).

The study site was a dryland location heavily infested with field bindweed receiving 14 in. annual precipitation. Soil was a sandy clay loam with 1.4% organic matter and a pH of 7.4.

All treatments were made July 7, 1971. Surface applications were made with a truck mounted sprayer delivering a volume of 17 gpa. Injection applications were made through liquid fertilizer injection shanks 12 inches apart, 9 inches deep, delivering a volume of 30 gpa.

The experimental design was a split plot with 14 treatments, replicated 3 times. Corn, oats, beans, and fallow were subplots established in May, 1972. Ocular estimates of percent reduction of crop stand and vigor were made on July 17, 1972. Actual field bindweed counts were made on July 27, 1972.

Surface applications of fenac at 6.0 lb/A gave 85% control of field bindweed while the injection method of fenac at 6.0 lb/A resulted in 72% control. The surface application of the fenac at the 6.0 lb/A rate resulted in a 61% reduction in crop stand and 71% reduction in crop vigor as compared to fenac at 6.0 lb/A, injected, which resulted in 35% stand reduction and 60% vigor reduction.

Comparisons between surface and injection application of dicamba at 4.0 lb/A gave opposite results from fenac at 6.0 lb/A surface and injection applied. Dicamba at 4.0 lb/A, surface, gave 49% field bindweed control while the injection of the dicamba at the 4.0 lb/A rate resulted in 55% control. Reduction in crop stand and vigor for the 4.0 lb/A surface application was 11% for crop stand and 27% for crop vigor, while the reduction in crop stand was 31% and reduction in crop vigor was 54% for dicamba at 4.0 lb/A, injected.

A combination of fenac + dicamba at 2.0 + 2.0 lb/A, injected, resulted in 51% field bindweed control, which was not significantly better than fenac at 3.0 or 4.5 lb/A, injected, dicamba at 2.0 and 4.0 lb/A, injected, dicamba at 4.0 lb/A, surface, or 2,4-D at 2.0 lb/A, surface. Fenac + dicamba at 4.0 + 2.0 lb/A, injected, gave 69% control of field bindweed compared to fenac at 6.0 lb/A, injected, and dicamba at 6.0 lb/A, surface, which resulted in 82% control, respectively.

Corn resulted in the most competitive suppression of the field bindweed and exhibited the greatest tolerance to the herbicides over all treatments, rates, and methods of application.

[1]Plant Science Division, University of Wyoming 82070.

Subsurface Layering of Trifluralin With a Moldboard Plow For Field Bindweed Control

L. C. Warner[1]

Field bindweed *(Convolvulus arvensis)*, or morning glory as it is sometimes called, is one of the most difficult-to-control perennial weeds in the Western United States. The deep, extensive root system of bindweed enables it to compete in non-tilled areas as well as with almost every cultivated crop grown in this region.

A number of cultural and chemical means of controlling this troublesome weed has been used over the years with varying degrees of success. However, the heavy crop losses suffered annually testify that additional means of control are needed.

In 1970, Harry Agamalian[2] of the University of California demonstrated that TREFLAN^R (trifluralin, Elanco Products Company, Division of Eli Lilly and Company), when placed in a layer below the soil surface, provided superior control of bindweed as compared to the conventional practice of disc incorporation.

A straight spray blade devised by Kempen, Agamalian, and Lange, University of California, was found to be an effective implement for layering trifluralin below the soil surface. When this tool was operated to a depth of 5 inches, excellent bindweed control was obtained. Another successful implement used for subsurface layering trifluralin is the V-shaped blade. This specialized equipment, however, is not commonly found on most farms, and in order to employ the subsurface layering technique, the grower would be obliged to purchase or lease such implements.

Therefore, research was initiated to determine the feasibility of utilizing the moldboard plow, a piece of equipment that is readily available on most farms.

Methods

A bindweed site was selected near Boise, Idaho, that had been fallowed the preceding year in a futile effort to control this weed. In August, 1971, trifluralin at rates of 1 to 8 lb/A was layered 9 inches below the soil surface with a single bottom 18-inch, two-way moldboard plow operated at 2.5 mph. Two TK2 flood jet nozzles were mounted behind the share point and directed downward in such a manner as to spray the plow sole as it was momentarily exposed.

The top 9 inches of soil remained relatively dry during most of the growing season helping to prevent the reestablishment of the severed segments of bindweed in the soil above the treated layer. The area was not cropped and received approximately 12 inches of annual rainfall. Bindweed control readings were made at intervals approximately 2 and 14 months following application.

Results and Discussion

As shown in Table 1, trifluralin layered 9 inches deep with a moldboard plow at rates of 1 to 8 lb/A provided 94 to 98 percent control of field bindweed two months after application. Fourteen months after application, rates of 1 and 2 lb/A resulted in 82 to 86 percent control; while the 4 and 8 lb/A rates gave 96 and 97 percent control, respectively.

Table 1.

Bindweed Control Using Moldboard Plow SSL Trifluralin

Treatment	Rate lb/A	Percent Bindweed Control 2 Months	14 Months
Trifluralin 4EC	1	95	82
	2	94	86
	4	98	96
	8	97	97
Control	0	0	0

Although these data demonstrate acceptable control, the few bindweed sprouts not controlled were found emerging in the strips paralleling the plow line. These escaping bindweed plants resulted from skips or breaks in the trifluralin layer caused by an apparent insufficient overlap of the plow share. As indicated earlier, the experiment was initiated with a single bottom moldboard plow and perhaps too wide a cut was made, not providing severage of the bindweed at that point. If in normal plowing there is insufficient overlap of the plow share, a small extension could be welded to the rear of the plow share to insure a continuous trifluralin layer.

In subsequent research, modification of the equipment was made to insure a continuous spray pattern. This was accomplished with a 3-inch extension welded to the rear of the plow share permitting the required overlapping pattern. However, results of these studies will not be available until the summer of 1973.

The use of the moldboard plow to subsurface layer trifluralin offers some encouraging advantages and some interesting areas of investigation:

1. The purchase of a new piece of equipment is not necessary since the moldboard plow is readily available and slight modifications can be accomplished at a modest cost.
2. The application of trifluralin can be made during the normal plowing operation when the infestation may be easily observed. Therefore, the entire field need not be treated since the sprayer can conveniently be turned on and off as the bindweed patches are encountered.
3. The deep placement of trifluralin allows the grower to fallow the land with normal shallow tillage implements such as disc, rodweeder, and sweeps without disturbing the herbicide layer.
4. The trifluralin layer may be placed sufficiently deep (8 to 12 inches, normally) to offer the possibility of growing a crop while still controlling bindweed.

Studies are now in progress to investigate many of the aspects of the moldboard plow method for subsurface layering trifluralin.

[1]Plant Science Representative, Eli Lilly and Company, Boise, Idaho.

[2]Kempen, Harold M., 1972 Agricultural Extension Service Progress Report.

Training For Licensed Professionals In California

G. F. MacLeod[1]

We should review, at the risk of being repetitious, events leading to the current California system of licensing those who make recommendations for agricultural pesticide use. It is both truthful and trite to point out that the use of agricultural chemicals has been a particularly favored target in the rush to "clean up our environment". Despite the weird, hysterical, and often absurd pronouncements of the "eco-freaks" and "instant ecologists" there has been an increasing awareness on the part of most workers in agriculture of occasional unneeded, or even destructive, use of chemicals in food production.

These minor occurrences, blatantly, and often erroneously reported in the media, pamphlets and books, were blown out of proportion by overly-vocal small groups searching a cause. Thus a partially-informed public became sufficiently alarmed to add their pressures so that decision makers, often equally misinformed, were forced to listen and act.

Nor did the occasional accident add luster to our public image. It has not been too effective to wage defensive statistical warfare, to answer fancy with fact or to try and explain the cost-benefit ratio. With an inflamed public a *little* truth garnished with innuendo and emotion started demands for action. Most particularly with what "might" happen, added to the mystery of chemicals and agriculture with their health implications, a fire started which is not yet under control.

The amount of agricultural chemical usage in California warranted a study of what was going on and what could be done about sharpening our weapons. Two entomologists, from the Riverside campus of the University of California together with an Agricultural Commissioner were assigned the study task. The report by Deal, Barnes, and Finnel was carefully prepared and presented some needed suggestions.

This report formed the basis for Senate Bill 1021. With the combined aid from both the University and the California State Department of Agriculture the bill was drafted, passed, and signed into law.

The necessity of implementing the provisions of the law, which was well supported by the chemical industry, became the next order of business. The bill provided for the formulation of an Agricultural Pest Control Advisory Committee to act on an advisory group for the Director of the California State Department of Agriculture. The law stipulated representation on this committee must come from:

The University of California
The California State Colleges
Agricultural Pest Control Advisors
Licensed Pest Control Operators
The State Dept. of Public Health
The Department of Fish & Game
The Agricultural Chemical Industry
The State Department of Agriculture
(Producers as defined in Section 56110)

Accordingly each of the groups specified were contacted and asked to suggest the names of suitable representatives and alternates of their choice. This was done and the committee, which could not function officially until July 1, 1972, met in its first organization meeting. They elected a chairman and formed sub-committees to consider Qualifications, Training and Examinations.

At the outset there were several challenges. The immediate and continuous implementation of the law fell into three operational phases, the Crash, the Shakedown, and the On-going programs. First it became obvious that, while there was need for immediate action there should be no disruption of a functioning procedure then in existence. Nor was there time to prepare "instant" training or information materials, examinations and procedures in all the seven categories set forth in the laws.

The seven categories were:

Control of insects, mites and other invertebrates
Control of plant pathogens
Control of nematodes
Control of Vertebrate Pests
Control of weeds
Defoliation
Plant growth regulation

These were the technical areas in which some degree of competency was considered essential. The problem was to provide study materials upon which to base some form of examination and license in a very short period.

The Crash Program included a hurried survey to determine a few characteristics of potential licensees. A questionnaire was sent to all those who might conceivably be interested in taking examinations for a license. Mailing lists available from several sources were used and several thousand questionnaires were sent.

We were aware that some duplication and some non-applicable situations arose from this broadcast type of mailing. However the more than 2000 replies provided a more accurate picture of the target audience than we would otherwise have had. The results provided a rough picture for our procedures.

There is neither time nor space to make a detailed report of the survey, nor are we assured that the sufficiency of the survey data warrants such a presentation. As a rough guide an attempt was made to study the results and write a description of our average, or very general, theoretical man.

> He is a man in his forties who has had some college, maybe a degree. He has had 10 years of experience, mostly with insects, weeds, and plant growth chemicals. He is primarily a field salesman, perhaps a dealer's man or a ground rig operator. Most of his time is spent on deciduous fruits, field crops and vegetables. He wants to be examinned in all categories but hopes to get by insects, weeds, diseases, and nematodes anyway. He would like an evening refresher course near home or a correspondence course.
>
> While most of them live in large cities of the Great Central Valley, they work two or three times as many additional counties as the one in which they live.

It was decided that the first series of examinations for provisional licenses should cover elements common to all categories. Moreover, since safety and comprehension of existing laws or regulations were paramount, the first study guide was prepared and sent to all who were interested. The California State Department of Agriculture prepared an updating of the laws and regulations and the University of California selected the most important portions of its Safety Manual. The state department printed and distributed these study guides.

Demands for this huried publication far exceeded expectations. The first revision of this study guide is underway and some additional pages have been sent to those who received the original copies. There was no charge for this first study guide.

Examinations for a provisional license were held in 1972. The multiple choice questions selected for these examinations were based on material in the study guide. This pilot plant start provided many answers to questions of procedure. So successful was the outcome that decisions to proceed with study guides for each of the categories listed in the law was quickly agreed upon.

Leadership in providing training and refresher materials was considered the most obvious role for the University. However, it was recognized that courses covering study materials could best be established in the State Universities and Community College systems. Their location in all areas of the State provided easy access for prospective licensees.

Unit coordinators in the Agricultural Extension group, who were specialists in each of the seven categories were asked to act as editors, collectors and organizers within their own specialties. Repeatedly, target dates were set and re-set under time pressures of the usual "deadline yesterday". The specialists and their colleagues did a magnificent job of writing, compiling and preparing manuscripts under such conditions. The various study guides, including a separate one on the Safe application of Agricultural Chemicals—Equipment and Calibration, have now all been published and many have been distributed under the guidance of our Agricultural Publication group. They range in price from $1.25 to $3.50 each.

The examinations, which now cover all seven areas, are based, at least 80 percent on the material in the study guides. The questions used in examinations are reviewed by panels of specialists and workers to provide practical, unambiguous, reasonable subjects.

From partial results of examinations some facts appear noteworthy. Most people who take one or two examinations in a day pass at the required 70 percent. The average overall mean raw score on Weed Control, Nematode Defoliation and Plant Growth regulators was 61.47 with 92.60 percent passing and 7.40 percent failing their first examination.

It was early apparent that teaching aids other than the study guides would be needed. After exploring available techniques the committee decided upon audio-slide combinations as the best way of presenting needed materials. A series of new self-contained, cassette-slide sets covering all seven categories is almost ready. University Extension with authors of the study guides as Key people in each discipline have been working to produce these training aids. Forty-seven staff specialists from the University's Division of Agricultural Scientists, working with University Extension have produced 50 hours of slides and lectures covering all seven categories. It is estimated that the cost for a complete set of these teaching aids will fall somewhere between $1350 to $1400. They will be available to anyone who wants them and will include about 2000 slides.

Another effective training method in the Crash Program was a series of three briefing meetings sponsored by the Western Agricultural Chemicals Association. The first two meetings, one in the southern part of the State at Anaheim and one in the north at Sacramento covered weed control, application and equipment, nematodes, growth regulators and defoliants. The third meeting was held in the central part of the state and covered insects and invertebrates, vertebrate pests and plant pathogens.

At these meetings authors of the study guides presented thumbnail sketches of the categories represented and tried to point out principles as opposed to details or illustrations. Members of the State Department of Agriculture presented the orgins, current thinking and mechanics of examinations and licensing.

Perhaps one measure of the success of these meetings was the attendance. There were between 500 and 600 people who attended each meeting. They were attentive and stayed for at least an hour after the meetings were over. There were many questions written and submitted on 3x5 cards. Some were facetious and not pertinent but these were so few that they represented only one in a hundred serious questions.

The real intent of the meeting was to allay widespread apprehension, to spike unfounded rumors and to provide a two way exchange between authors of study guides and candidates for examinations. The meetings apparently accomplished these objectives.

There is a real interest on the part of the five state colleges, now parts of the State University System. An equal interest exists among some 27 Community Colleges. Considerable effort has been expended to help any of the interested groups to establish adequate courses.

Thus the Crash Program has been completed. We are still working on the Shakedown Program which will probably be continued until January 1, 1974 when all Agricultural Pest Control Advisors will be required to be licensed in at least one of the seven specific categories. There will undoubtedly be many changes which could qualify as test runs but the Ongoing Program is beginning to emerge.

Under the existing law employees of State, Federal or other public agencies are exempt from the license requirement. They must, however, write and sign any recommendations which they make for agricultural use of pesticide chemicals. No small amount of criticism has been directed at members of the Agricultural Extension Service because of this exemption.

In the past it has been assumed that the training necessary to be hired as a farm advisor would provide adequate proof of competency. There have been many Farm Advisors or County Agents whose training would qualify them to make recommendations in a given discipline. It is equally apparent that few, if any, specialists or farm advisors are qualified to operate in all seven areas named in the law. Nor will funds permit staff additions to county groups whose competencies are obvious in the categories for which men are being examined.

Most county extension staffs are organized on a crop basis. Their responsibilities are to cover fruits or field crops or some other crop in all of the needed technology. It is apparent that some changes must be made to meet new legal requirements.

In an attempt to cope with the current situation the Agricultural Extension Service of the University of California now has a group who is studying the matter of special training procedures, examinations and accreditation for extension persoonnel.

The outcome of this study may well mark an important facet of the Ongoing Program. Questions as to what is required for a county farm advisor to qualify as a person to recommend pesticide, or other agricultural chemicals will undoubtedly involve some reorganization of responsibilities–particularly in county staffs.

A particularly interesting part of the Ongoing Program will be provisions for up-dating information. The question of revising study guides has been discussed. Every three years has been set as a temporary goal. The need for refresher courses for teachers as well as candidates is apparent. For the time being it has been decided not to re-examine licensees. There is, however, an obvious need for some kind of informational procedure. The whole area of chemical usage in agriculture is one of rapid change both legally, chemically, and environmentally.

It is too early to assess the impact of changes. We are just barely underway in California but we feel there are already some signs of interest. The chemical industry is in full support of this attempt to professionalize the industry. The value of providing proper, safe and efficient use of chemicals for food and fiber production, for the protection of public health and safety, protecting the environment, assuring workers in agriculture of safe working conditions and insuring pest control by competent people seems certain. We are building a body of professionals.

One final point seems noteworthy. We have trained highly competent research scientists in the several disciplines needed in agricultural food and fiber production, in forest and recreational area management. There will be a continuing need for such people–discipline-oriented as entomologists, botanists, pathologists, nematologists and all the rest. But there now emerges a need for the generalist. He could be compared to the general practitioner in medicine. He need not be a specialist in any one discipline but he should be a good diagnostician, aware of specialist expertise and alert to a multiplicity of laws and regulations. The challenge to all educational groups is to prepare such supermen for future activities in a fast-moving society. It is also a field for tomorrow's pest control advisor to consider.

[1]University of California, Berkeley 94720.

ModownTM – A New Broadleaf Herbicide

W. T. Smith[1]

MODOWNTM is the tradename for products containing the experimental herbicide MC-4379. MODOWNTM has been extensively evaluated in the United States and abroad as both a pre-emergence and directed post-emergence treatment for control of important broadleaved weeds in soybeans, corn, sorghum, rice and small grains.

MODOWNTM containing the active ingredient Methyl-5-(2[1],4[1]-dichlorophenoxy)-2-nitrobenzoate will give excellent control of the following broadleaved weeds: velvet leaf, smartweed, pigweed, lambsquarters, jimsonweed, purslane, nightshade, mallow, bindweed and mustards. Good control can be expected on ragweed, morning glory, cocklebur, and Russian thistle. Although MODOWNTM is primarily a broadleaf killer, it will provide satisfactory control of certain grasses such as: barnyard grass, fall panicum, cup grass, green and yellow foxtail and seedling johnsongrass. Combination treatments with leading commercial grass killers are very promising, giving generally excellent overall weed and grass control.

Pre-emergence applications of 1.5 to 2.0 pounds a.i./acre are recommended to provide effective weed control over a wide range of soil types, organic matter content and under a variety of climatic conditions. Post-emergence applications as directed sprays have shown good activity at rates of 1.0 to 1.5 pounds a.i./acre. Residual control usually persists for 5 to 10 weeks depending upon rainfall, soil type and plant spectrum. Tests indicate that the broadleaf weed control by MODOWN™ is not as adversely affected by rainfall extremes as most other surface applied materials.

Research has shown that there is no need for incorporation and no carry over or residue problems.

[1]Mobil Chemical Company, Millard, Nebraska 68137.

Differential Sensitivity of Two Common Groundsel Biotypes *(Senecio vulgaris L.)* to Several *s*-Triazine Herbicides

Steven R. Radosevich[1]

Studies were initiated to determine the response of two common groundsel biotypes (*Senecio vulgaris* L.) to several *s*-triazine herbicides. Herbicides tested were: 2-chloro-4,6-bis(ethylamino)-*s*-triazine (simazine), 2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine (atrazine), 2- 2-(*sec*-butylamino)-4-(ethylamino)-6-methoxy-*s*-triazine (GS-14254), 2,4-bis(isopropylamino)-6-methoxy-*s*-triazine (prometone), 2-(*tert*-butylamino)-4-(ethylamino)-6-methylthio-*s*-triazine (terbutryn), and 2,4-bis(isopropylamino)-6-methylthio-*s*-triazine (prometryne). One biotype was much more susceptible than the other. Sensitive plants were effectively controlled by 0.5 ppm of atrazine and simazine, 1 ppm of GS-14254 and prometone, and 4 ppm of prometryne. The resistant biotype failed to show any symptoms of photosynthesis inhibition at the highest rates tested, i.e. 4 ppm of simazine and 30 ppm for atrazine, GS-14254, prometone, and prometryne. Both biotypes were resistant to terbutryn at 30 ppm.

When a triazine herbicide was applied, the susceptible plants became chlorotic and died; resistant plants never exhibited these symptoms. Photosynthesis was completely inhibited by simazine in susceptible (S) plants but resistant (R) plants were unaffected. Photosynthesis in the susceptible biotype resume when the herbicide was removed after 24 hours.

Absorption and metabolism of simazine were explored as possible explanations for the herbicide tolerance exhibited by the R biotype. Both biotypes absorbed the herbicide equally well, and no differences in simazine metabolism were found which could explain the mechanism of resistance. Plants of both biotypes were subjected to ^{14}C-simazine for up to 96 hours. The greatest concentration of ^{14}C activity (80 to 90%) was located in the chloroform-soluble fraction of the foliage tissue of each biotype. The ^{14}C in this fraction of the plant extracts was determined by thin-layer chromatography to be similar to ^{14}C-simazine. Small amounts of ^{14}C activity (10-15%) were isolated in the water-soluble fraction of the plant extracts, but time-course studies revealed no differential increase in water-soluble simazine metabolites by either biotype. A similar metabolism study using corn was conducted, which substantiated the findings of numerous workers. Several alternative explanations for the difference in triazine sensitivity between the two common groundsel biotypes are suggested.

[1]Agricultural Extension Service, University of California, Davis 95616.

An Evaluation of the Potential Use and Performance of Glyphosate in the Northwest

R. J. Burr[1]

Glyphosate has shown good initial control of several perennial weeds such as quackgrass *(Agropyron repens)*, Canada thistle *(Cirsium arvense)*, German velvetgrass *(Holcus mollis)*, bermudagrass *(Cynodon dactylon)*, johnsongrass *(Sorghum halepense)*, saltgrass *(Distichlis stricta)*, dalmatian toadflax *(Linaria dalmatica)*, leafy spurge *(Euphorbia esula)*, and hoary cress *(Cardaria draba)*. For complete control of these weeds, retreatment would be necessary. In most cases, 2 to 4 lb a.i. per acre are giving acceptable control.

Tillage has been found to aid control of bentgrass *(Agrostis tenuis)* following glyphosate application. Glyphosate combined with subsequent tillage gave nearly complete elimination of the bentgrass.

Potential uses seen for glyphosate in the Pacific Northwest include uses in the stale seedbed technique and chemical fallow for both annual and perennial weed control, spot-treatment of many noxious weeds in crop and noncrop areas, directed spraying in orchards for perennial weed problems, weed control on ditchbanks, range reseeding, and lawn and landscaped area renovation.

[11]Extension Agronomist, Oregon State University, Corvallis, Oregon 97331.

R-25788 as an Antidote for Several Thiocarbamate Herbicides in Corn

Heikes, P. Eugene and Jerri F. Swink[1]

The experimental compound, R-25788 (N,N-diallyl-2,2-dichloroacetamide) from Stauffer Chemical Company, was tested in field trials for antidote properties against EPTC, butylate, vernolate and DS-5328 (2,5-dimethyl-1-pyrrolidinecarboxanilide). EPTC and butylate were premixed with R-25788; vernolate was tank mixed at ½ lb a.i. of R-25788. EPTC and butylate were applied ppi at 4, 6, and 8 lbs a.i. per acre and vernolate at 2, 4 and 6 lbs a.i., with and without R-25788.

DS-5328 is a carbamate type herbicide developed by

CORN YIELD
Thiocarbamate/Antidote Study, Arkansas Valley Branch Station Rocky Ford, Colorado[1]

Herbicide and Rate per Acre		With R-25788 – Avg/2 Reps lbs/A	bu/A	% of Weedy Check	W/O R-25788 – Avg of 2 Reps lbs/A	bu/A	% of Weedy Check
Eptam	4 lbs	9,985	178	107	6,569	117	72
EPTC	6 lbs	9,604	171	102	4,453	79	49
	8 lbs	9,440	168	100	3,413	61	37
	Check	9,362	167	100	9,072	162	100
Sutan	4 lbs	10,335	184	98	10,285	183	101
butylate	6 lbs	10,529	191	101	9,352	167	92
	8 lbs	10,797	193	102	9,835	175	96
	Check	10,571	188	100	10,119	181	100
Vernam	2 lbs	10,345	184	95	10,517	188	103
vernolate	4 lbs	10,493	187	97	8,243	147	81
	6 lbs	10,884	194	100	7,133	127	70
	Check	10,827	193	100	10,226	182	100
Rowtate	3 lbs	10,839	193	99	10,652	190	96
(DS-5328)	6 lbs	9,449	168	86	10,043	179	91
	9 lbs	9,209	164	84	9,190	164	83
	Check	10,944	195	100	11,029	197	100
EPTC Eptam	4 lbs	9,846	175	106			
with	6 lbs	8,876	158	96			
"Protect"	8 lbs	6,265	111	67			
seed treatment	Check	9,230	165	100			

[1]Corn variety Pioneer 3369A, planted 5/5/72, harvested 10/27/72 – 2 rows x 20'.

Diamond Shamrock Corporation. It was applied ppi at 3, 6 and 9 lbs a.i. per acre, with and without R-25788.

"Protect" (1,8-naphthalic anhydride) seed treatment was dusted on corn seed at 2 oz. per half bushel of corn seed prior to planting. EPTC was applied ppi at 4, 6 and 8 lbs a.i. per acre; corn treated with "Protect" was seeded in the treated area immediately following application of the EPTC.

This field was furrow irrigated; the soil was clay loam; the corn variety was Pioneer 3369A, planted 5/5/72 and harvested 10/27/72. Plots were 20 x 25 ft – 500 sq. ft. with 2 replications; herbicides were applied with a plot sprayer in 40 gallons of water per acre. The major weeds were flower-of-an-hour *(Hibiscus trionum)*, kochia, redroot pigweed, Russian thistle, purslane and puncturevine; there was not enough grass to evaluate.

There was no visible crop injury in any of the EPTC plots where R-25788 antidote was combined with the herbicide; the crop showed good vigor and near 100 percent weed control in the 6 and 8 lb rates. There was some flower-of-an-hour in the 4 lb plots but control was more than 95 percent.

None of the butylate plots were weed-free but weed control was good with all rates. There was some kochia and puncturevine left; butylate appeared to be reasonably effective on flower-of-an-hour. It controlled redroot pigweed and purslane.

All rates of vernolate were weed-free including the 2 lb rate. At 2 lbs there were fewer weeds than with 4 lbs of EPTC and it appeared to be more effective on flower-of-an-hour than EPTC. Vernolate appeared to also be more effective on puncturevine than EPTC; it is usually weak on puncturevine. There was no phytotoxic effect on the crop at any of the rates. There was no crop injury in any of the series where R-25788 was mixed with the herbicides.

R-25788 did not reduce the phytotoxicity of DS-5328, to the extent it did EPTC, vernolate or butylate. There was distinct evidence of stunting in the 3 lb rate, with or without the antidote. At 6 lbs, there was 25 percent stand reduction and 50 percent stunting, with or without the antidote. There was little difference in crop injury between the 6 and 9 lb rates. Weed control was relatively poor at the 3 lb rate; it was good at 6 and 8 lbs. This herbicide did not perform well in this series, both from the standpoint of weed control and crop tolerance. It controlled flower-of-an-hour but was weak on redroot pigweed. It controlled purslane and Russian thistle. R-25788 did not appear to reduce the phytotoxicity of DS-5328.

Where no antidote was used, there was stand reduction at all rates of EPTC ranging from 70 percent in the 4 lb rate to near 100 percent in the 8 lb. All plots were weed-free. In the 4 lb rate, there was unhealthy corn and many plants showed severe carbamate symptoms. In the 6 lb rate there was 95 percent stand reduction. Many of the plants emerged but were severely stunted; many did not survive past the 2-leaf stage. Flower-of-an-hour was controlled at all rates.

There was no stunting or stand reduction in the 4 lb rate of butylate; weed control was acceptable but flower-of-an-hour was left and considerable kochia. There was minor crop injury in the 6 lb rate; this did not control flower-of-an-hour or kochia; it was very little better than the 2 lb rate. Five percent of the corn plants showed carbamate symptoms in the 8 lb rate. There was minor stunting, but this did not cause severe yield loss. This did not control flower-of-an-hour or kochia; it was no better than the 4 and 6 lb rates.

There was less phytotoxicity in the vernolate plots than the EPTC plots; it showed better crop tolerance than EPTC. There was minor crop injury at the 2 lb rate; about 5 percent of the plants showed carbamate symptoms and 5 and 8 percent stand reduction in the 2 replications. There was some kochia left in the 2 lb plots but weed control at 2 lbs was good. Vernolate might have enough corn selectivity in medium to heavy textured soils to use without the antidote. It appeared to have better corn selectivity than EPTC and provided better weed control at lower rates than EPTC or Sutan. Without antidote, vernolate looked the most promising, EPTC second and butylate third. EPTC was the most phytotoxic of the three herbicides.

"Protect" seed treatment did not protect the corn against EPTC phytotoxicity as well as R-25788. At 4 lbs of EPTC per acre, there was minor phytotoxicity. It was in the form of carbamate symptoms. Three and five percent of plants in the 2 replications showed rolled, onion-like leaves. There was stunting and stand reduction in the 6 lb rate and more in the 8 lb rate. "Protect" did not protect the corn beyond 4 lbs per acre. Based on this test, it appears that "Protect" does not reduce phytotoxicity of thiocarbamate herbicides as effectively as R-25788.

From this series of field evaluations, it appears that R-25788 provides adequate protection for EPTC, vernolate or butylate at the rates tested. Weed control was excellent at all rates of these herbicides.

---

[1]Colorado Extension Service, Colorado State University, Fort Collins, and Agricultural Experiment Station, Rocky Ford, Colorado.

Effect of Glyphosate on Chloroplast Ultrastructure of Agropyron repens L.

W. F. Campbell, J. O. Evans and S. C. Reed[1]

Abstract: Phytoxicity of glyphosate, N–(phosphonomethyl) glycine, applied at 0, 0.5, 1.0, 1.5, 2.0 and 4.0 lbs ai/A to uniform naturally growing quackgrass, *Agropyron repens* L., plants, was studied with the electron microscope. Visible damage (yellowing of the leaves) to the plants was observed at the higher dosage rates within 72 hours while similar damage at the lower rates became evident after 120 hours. Leaf discs (1 mm in diameter) were harvested at 24, 48, 96 and 192 hours and prepared for electron microscopy by standard techniques. Cellular damage could be detected at the lowest dosage rate as early as 24 hours. The type of damage observed was partial to complete disruption of the chloroplast envelope, swelling of the RER with the subsequent formation of vesicles. With loss of integrity of the envelope, the chloroplast became completely disrupted with increased time and dosage rate. Other organelles within the cell were also destroyed.

---

[1]Plant Science Department, Utah State University, Logan 84322.

Aerial versus Ground Application of Phenmedipham on Sugar Beets

H. M. Kempen[1]

Evaluation of aerial applications of phenmedipham showed that this technique offers distinct advantages in management of January beet plantings. It permits control of weeds when inclement weather prevents entry into fields during rainy weather. Optimum timing of applications reduces the rate needed.

Because temperatures are cool (below 70 F) when applications are made, beet tolerance to phenmedipham is sufficient to permit selective control when true leaves are just beginning to develop. Since weeds are in the seedling stage, rates as low as ½ lb/A are effective.

Evaluations showed that increased control results when gallonage is increased from 5 to 20 gpa. Combinations with dalapon increased effectiveness but also caused excess beet injury. Interaction with preplant cycloate application was evident.

---

[1]University of California, Bakersfield 93303.

Effects of Winter Weed Control on Season-long Yield and Quality in Alfalfa

Robert F. Norris[1]

Abstract. Diuron or weed oil plus dinoseb have been available for winter weed control in California alfalfa for several years. Flaming can be used, but has never been judged economically feasible. Recently the triazine

GS-14254 has shown considerable promise for controlling most winter weeds. Many growers have attempted winter weed control in established alfalfa by mechanical 'renovation', usually with a spring-tooth harrow. The relative short-term effectiveness of these treatments has been well documented with respect to weeds controlled, but even first cutting yield data have usually not been obtained, and seasonal effects on yield and quality have generally not even been considered.

In January 1971 diuron (2.4 lb/A), GS-14254 (2.0 lb/A), oil plus dinoseb (40 gal/A plus 1.25 lb/A in 100 gal/A total mix), or flaming (30 to 35 gal/A of propane) treatments were applied to 1.25 A plots in a 4 times replicated randomized block design experiment. Untreated checks were also included. Yield and quality, as % of protein, data were obtained throughout the season. First cutting yields were reduced following effective weed control. Yield increases were, however, recorded for the second through fifth cuttings! The protein content was increased by all treatments for the first four cuttings. The plots were retreated in January 1972, and seasonal yields again obtained. First cutting yields of plots with effective winter weed control were again lower than that of the untreated check. Yield was increased at the second through fifth cutting; the magnitude of these increases was greater than in 1971, and was over 0.2 ton/A for the third and fourth cutting. Protein content was elevated at all except the fourth cutting. The seasonal increase in yield was between 0.4 and 0.5 ton/A, coupled with an average 2% increase in protein. The same treatments were also applied to 0.5 A plots at a different location in 1972. Increases in yield were again recorded at the second and third cutting following effective winter weed control. Protein content was increased at the first and second cutting.

The data will be discussed in light of the fact that winter weed control in California alfalfa can increase yield and quality over the entire growing season. This is contrary to the opinion currently held by many farmers and researchers working with alfalfa.

[1]Botany Dept., University of Calif., Davis 95616.

Will 100 Percent Control of Weeds in Crops Pay Off?

C. I. Seely[1]

Studies conducted over a two year period of the effect of various densities of wild oats on the yield of dry peas indicates that under favorable growing conditions the maximum net return from the control of wild oats is with a kill of approximately 98 percent. This results primarily because the wild oat stand is reduced approximately as the log of the herbicide rate while the cost of the treatment rises directly with the rate. Any injury to the crop from the herbicide would reduce the optimum level below 98 percent. Any increase in wild oat stand density above normal or a crop price above average would increase the optimum kill above 98 percent but would probably never reach 100 percent.

Stand densities of as low as 1 plant per square yard reduced yield 5 percent which in these studies appeared to be the threshold below which treatment would not be justified. Stand densities of 85 wild oat plants per square yard reduced pea yields by 69 percent and at this level a 98 percent kill from an herbicide would give a benefit cost ratio of 12:1 which does not include the benefits from reduced harvesting costs or improved quality.

The desirability of similar studies of other major weed problems so that minimal rates of herbicides can be used for maximum economic benefit with a minimum effect on the environment is emphasized.

[1]Department of Plant Science, University of Idaho, Moscow 83843.

Evaluation of (MON-2139) Herbicide for Control of Several Perennial Noxious Weeds

P. Eugene Heikes[1]

This herbicide was evaluated at 7 locations in Colorado; a uniform plot plan was used at each of the sites. MON-2139 (*N*-phosphonomethyl) glycine, was applied first early in the summer at a vegetative stage of growth prior to the bud or blossom stage; a second application was made near mid-summer when weeds were in bloom and a third application in late summer when the weeds were nearing maturity but were still green. A final broadcast spray was made over half of the plots in late September, prior to frost. All plots were 20 x 50 ft; replicated twice at each location. Herbicides were applied with a plot sprayer in 40 gallons of water per acre.

MON-2139 was applied at 1, 2 and 4 lbs a.i. per acre each of the three times. Dicamba and picloram were applied at two of the sites at each of the three times for comparison, at 4 and 2 lbs a.i. per acre respectively. Visual estimates were made of ground cover at each of the locations prior to herbicide application.

APPLE ORCHARD: A dense stand of field bindweed and quackgrass was treated with MON-2139 in an apple orchard near Delta, Colorado. There was also alfalfa, dandelions and some asparagus growing in the orchard, later there was a considerable amount of showy milkweed *(Asclepias speciosa)*. The first application was made May 17, the second June 20, the third July 26, and the overspray September 21.

None of the apple trees showed injury at any of the rates or at any of the four times of application. The 4 lb rate was applied around a newly planted apple tree in May and observed throughout the season. There was no evidence of phytotoxicity to the small tree and there was 100 percent weed control throughout the season.

MON-2139 appears to show more herbicidal activity to quackgrass than field bindweed. It appears that more than one application will be necessary for eradication of either quackgrass or bindweed. One pound per acre controlled quackgrass through most of the season, but there was some regrowth in the fall at all rates and a second application prior to frost appeared necessary. Field bindweed was more tolerant than quackgrass and it appears that three to four pounds per acre will be necessary for control of bindweed. It appeared that applications at late bud or early bloom stage were more effective than the late summer application and that at least one repeat application and probably several will be necessary for eradication.

CANADA THISTLE: This test was made on a dense stand of Canada thistle east of Brighton, Colorado. The uniform plot plan was used including dicamba and picloram. In addition to Canada thistle, there was prickly lettuce, tansy mustard and cheatgrass in the treated area. MON-2139 appears to have good herbicidal activity on Canada thistle and looks promising for control of this weed. 2 lbs a.i. per acre was minimum for good control. Based on this experiment, it appears that MON-2139 should be applied when thistles are in a lush growing condition – pre-bud or early blossom stage. 2 lbs per acre was effective at this stage of growth, but 3 or 4 lbs per acre is probably necessary if treatment is made later in the summer, after bloom stage. One or several repeat applications may be necessary for eradication of Canada thistle; these should be made whenever a green growth appears.

FIELD BINDWEED: A dense stand of field bindweed was treated on the Experiment Station at Austin, Colorado. The uniform plot plan was used, except that dicamba and picloram were omitted. There were no plants except field bindweed in the treated area. At time of the first application, it was estimated there was 80% ground cover of bindweed.

Field bindweed appears to be less susceptible to MON-2139 than Canada thistle or quackgrass. Based on this experiment, it appears that 3 lbs a.i. per acre is minimum for good control of bindweed and that this should be applied in late bud or early blossom stage. One or two repeat applications should be made later in the season whenever regrowth appears. MON-2139 apparently affects bindweed differently than it does Canada thistle; at lb a.i. per acre, it shortened the internodes and caused a deformed plant.

JOHNSONGRASS: This field was in the Arkansas Valley, close to the river. The soil was a sandy loam with less than 1 percent organic matter. The first application was made May 24 when the Johnsongrass was 8 to 12 inches high. The second application was made June 26 when the Johnsongrass was 2 to 2½ ft. high and the late application was made on July 9 when the grass was 4 ft. high and fully headed out. There were a few kochia and nightshade plants in the plots. The over-spray was made September 22 when the grass was mature, had made seed, and the foliage was dry. There was good soil moisture and the base of the plants were green.

It appears that more than one application of MON-2139 will be necessary for the eradication of Johnsongrass. In this series, there was good desiccation with the mid and late applications but by fall there was some regrowth in all mid-season plots. It appears that less than 1 lb per acre is enough to desiccate Johnsongrass but that repeat applications will be necessary for eradication and root kill. The stage of growth does not appear to be extremely critical but it is important that all Johnsongrass be emerged when the herbicide is applied and there be adequate moisture and the grass must be in an active growing condition.

LEAFY SPURGE AND RUSSIAN KNAPWEED: MON-2139 was applied in late June on dense stands of leafy spurge and Russian knapweed at 1, 2 and 4 lbs per acre. A second application was made in late July. There was little effect on either of these weeds with 4 lbs per acre. Unfavorable growing conditions may account for some of the poor results. Neither of these sites were oversprayed in September.

[1]Extension Service, Colorado State University, Fort Collins 80521.

Resistant Weeds in Cotton

J. Wayne Whitworth[1]

Populations of weeds resistant to commonly used herbicides have become a problem where growers have repeatedly used a single herbicide for weed control in cotton. This paper is a brief report of this problem and the use of various combinations of herbicides designed not only to eliminate the build-up of resistant weeds but also to minimize the herbicide residual in the soil which would limit crop rotations.

Trifluralin type materials ranged in effectiveness from as high as 100% control of annual grasses such as Southwestern cupgrass *(Eriochloa gracilis)* (Fourn.) Hitchc. to 28% on morning glory *(Ipomoea* spp.) and to 0% on *Flaveria trinervia* (Spreng.) C. Mohr. Two other species which were poorly controlled were Wright groundcherry *(Physalis wrightii)* Gray, 44%, and spurred anoda *(Anoda cristata)* (L.) Schletch., 12%. The triazines such as prometryne at 2 lb/A were more effective on these hard-to-kill weeds giving an average of 80% control. However, they did not give full season control of grasses with a single treatment and a double or repeat treatment left too much herbicide residue in the soil. When these two types of herbicides were combined, a single application of some of the combinations gave full season weed control with yields of cotton equal to or slightly higher than the handweeded check. Some of the data are shown in the following table.

[1]New Mexico State Univ., Agr. Exp. Sta., Las Cruces, N.M. 88001.

Repeated Herbicidal Treatments for the Control of Creosotebush

Walter L. Gould and C. H. Herbel[1]

Creosotebushsh (*Larrea divaricata* Cav) is one of the most prominent brush species on rangeland in the Southwest. It has invaded extensive areas of grassland and appears in almost pure stands in some localities. Where remnants of perennial grasses remain, revegetation will occur if the competition from creosotebush is reduced. Single applications of various herbicides at low rates have given little control of creosotebush in New Mexico. Repeated applications of herbicides were tested to determine their effectiveness in controlling this species.

Repeated applications of dicamba, either alone or in combination with 2,4-D or 2,4,5-T, increased the degree of control over that obtained from a single treatment. The effects of repeated applications were generally additive or greater. The response was evident from treatments 1, 2 or 3 years apart. Combination treatments of dicamba with 2,4-D or 2,4,5-T were more effective than dicamba alone at the same rate. The combination appeared to have greater effect as a final treatment than as an initial treatment.

Repeated applications of 2,3,6-TBA in successive years gave greater than additive effects as compared to single applications in the respective years. Retreatment at intervals longer than one year were relatively less effective. Repeated applications of picloram, 2,4-D or 2,4,5-T in successive years were no more effective in controlling creosotebush than a single application. However, repeated combination treatments of picloram and 2,4,5-T gave greater than additive effects as compared to single applications. The picloram-2,4,5-T combination as a repeat-treatment was not as effective as a dicamba-2,4,5-T treatment at identical rates of application.

[1]Weed Physiologist, N.M. Agricultural Experiment Station and Range Scientist, Crops Research Division, Agricultural Research Service, Las Cruces, New Mexico.

Effect of Soil Moisture on Preemergence Weed Control with Ultrahigh Frequency (UHF) Electromagnetic Energy in Cantaloupe

R. M. Menges and J. R. Wayland[1]

UHF energies (46 to 732 joules/cm^2, at 2,450$\pm$ – 20 megahertz) were applied to wet and to dry soils in the field 1 day before planting of cantaloupes to study the influence of UHF on the growth of weeds and cantaloupes as affected by soil moisture. Applications of 183 j/cm^2 of UHF controlled London rockket (*Sisymbrium irio* L.), Japanese millet (*Echinochloa frumentacea* (Roxb.) Link), ridgeseed spurge (*Euphorbia glyptosperma Engelm.*), redroot pigweed (*Amaranthus retroflexus* L.) and common sunflower (*Helianthus annuus* L.), but failed to give adequate control of common purslane (*Portuluaca oleracea* L.), regardless of soil moisture. Applications of 366 j/cm^2 of UHF controlled purslane on dry soil, however.

Although UHF energy increased the size of cantaloupe plants, harvests were precluded by excessive flooding in wet soils. In dry soils, UHF decreased the populations of reniform nematode (*Rotylenchulus reniformis*) and increased the yield of cantaloupe.

[1]So. Region, Agr. Res. Serv., U.S. Dept. of Agr., Weslaco, Tex. 78596.

Influence of Time of Application and Tillage on the Herbicide Performance of Glyphosate[1]

by Gary A. Lee[2]

A brief review of the properties of glyphosate may clarify several points of my assigned topic. This compound is translocated from above-ground portions of the plant to the root system. No soil activity has been demonstrated which indicated rapid adsorption to soil particles. Since glyphosate is nonselective, broadleaved and grassy species of annual and perennial weeds have been effectively controlled.

Glyphosate does not readily translocate to the root system compared to dicamba or picloram. The material, however, does appear to translocate most efficiently in perennial broadleaved weeds when the "sink" site shifts to the root system shortly after flowering. In musk thistle (*Cardulus nutans* L.) and quackgrass (*Agropyron repens* (L.) Beauv.), the translocation is less dependent upon stage of growth.

Stage of Growth

Studies were conducted in Wyoming to determine the most susceptible stage of growth of Canada thistle (*Cirsium arvense* (L.) Scop.) to glyphosate. Relatively low rate of applications were utilized so that a differentiation of response could be detected. Glyphosate at .5, 1.0 and 1.5 lb/A were applied when the plants were in (1) the 10 to 12 inch stage of growth (June 1, 1972), (2) full flowering stage of growth (July 26, 1972), and (3) mature seed stage of growth (August 25, 1972). Treatments were made in 40 gpa of water diluent with a knapsack sprayer. Visual evaluations and photos were taken September 9, 1972. Glyphosate applied when the Canada thistle plants were in the vegetative state (10 to 12 inches tall) resulted in severe stunting and flower inhibition (Table 1). At the time of evaluation, no infestation reduction was apparent. Treatments made when the Canada thistle was in full flower were the most effective. Glyphosate at 1.0 and 1.5 lb/A resulted in 90% or better initial control of the above-ground portions of the plant. Subsequent evaluations will be necessary to determine the actual elimination of plants from the population. Glyphosate at all rates applied when plants were fully matured in late August appeared to have little or no phytotoxic effect on the plant foliage.

Table 1.

Effect of treatment date on initial control of Canada thistle with glyphosate.

Treatment	Rate lb/A	Percent control[1] 6/1/72	7/26/72	8/25/72
glyphosate	.5	0 (stunt.)	70	0
glyphosate	1.0	0 (stunt.)	90	0
glyphosate	1.5	0 (stunt.)	90+	0

[1]Visual evaluation 7/9/72.

Russian knapweed (*Centaurea repens* L.) was not controlled by glyphosate at .5, 1.0 and 1.5 lb/A applied when the plants were in the early bud stage of growth. Mild stunting and chlorosis on some plants were the only phytotoxic symptoms visible.

Studies conducted in North Dakota indicate that leafy spurge (*Euphorbia esula* L.) is most susceptible to glyphosate after full maturity and seed drop (3). Applications of glyphosate at 2.0 lb/A in June resulted in defoliation of the plants but flower production continued from axillary buds. Glyphosate at 2.0 lb/A applied in mid-September gave nearly complete elimination of leafy spurge the next spring.

Glyphosate at 2.0 lb/A resulted in 90% control of common milkweed (*Asclepias syriaca* L.) that was in the flower stage of growth (2). The reinfestation of the treated area was a result of new shoots emerging from buds 12 inches below the soil surface.

Musk thistle was effectively controlled with glyphosate at 1.0 and 1.5 lb/A when the plants were 12 to 24 inches tall. Since glyphosate is nonresidual in the soil, a severe infestation of seedlings were present in all treatment areas at the time of evaluation. Additional applications would have been necessary to eliminate the species.

Effect of Tillage

In Minnesota, quackgrass 12 to 14 inches tall was treated with glyphosate at 1.0, 2.0, and 3.0 lb/A (1). The area was deep plowed within one and 10 days after treatment. The 2.0 and 3.0 lb/A rates of glyphosate gave 99 and 100% control, respectively, when tillage was delayed 10 days. Inadequate control of quackgrass was obtained with glyphosate at all rates of application in areas tilled one day after treatment. This indicates that insufficient time had elapsed for translocation of toxic quantities of the herbicide.

Summary and Conclusions

1. Preliminary data indicate that Canada thistle in the flower stage of growth is most susceptible to lower rates of glyphosate.
2. Russian knapweed in the bud stage of growth is quite resistant to lower rates of glyphosate.
3. Leafy spurge is effectively controlled with fall applications of glyphosate.
4. Musk thistle in the vegetative growth stage is effectively controlled with glyphosate at 1.0 and 1.5 lb/A.
5. Glyphosate at 2.0 lb/A killed common milkweed roots 12 inches below the soil surface but regrowth from established plants did occur.
6. Tillage of quackgrass one day after treatment with glyphosate does not allow adequate translocation. Plowing 10 days after treatment did not influence subsequent quackgrass control.

References

1. Behrens, Richard. 1972 Quackgrass control with glyphosate. Monsanto Seminar. Brainerd, Minn.
2. Martin, A. R. 1972. Common milkweed control with glyphosate. Monsanto Seminar. Brainerd, Minn.
3. Messersmith, C. G. 1972 Leafy spurge control with glyphosate. Monsanto Seminar. Brainerd, Minn.

[1]Presented with approval of the Director, Wyoming Agricultural Experiment Station as Scientific Report 465.

[2]Assistant Professor, Weed Science, Plant Science Division, University of Wyoming.

Comparison of Thiocarbamate Antidote Seed Treatments in Corn[1]

D. A. Schmer, G. A. Lee and H. P. Alley[2]

A study was conducted at the Torrington Experiment Station to compare Protect (1,8-naphthalic anhydride) and R-25788 (N,N-diallyl dichloroacetamide) for their potential effectiveness in decreasing thiocarbamate damage to corn. EPTC and vernolate, alone and in combination with cyprazine and cyanazine and Knoxweed 42 were applied preplant and incorporated 1.5 inches deep. EPTC (A.D.) (Aqueous Dispension) was applied preplant, but not incorporated. Corn seed was treated prior to planting with Protect and R-25788 at 0.5 percent (weight basis) and compared to nontreated seed.

Percent weed control and corn stand were determined by quadrant counts and compared to the nontreated check. Corn vigor was determined by visual observations when the plants were 16 to 18 inches tall. Silage yields were taken when the corn was in the early dent stage.

All herbicide treatments resulted in effective broadleaf weed control (96-99+%) except EPTC and EPTC (A.D.) at 3.0 lb/A (Table 1), which gave only 81% and 82% control, respectively. Effective control (97-100%) of green foxtail (*Setaria viridis* (L.) Beauv.) was obtained with all herbicide treatmeents.

Table 1.

Broadleaf and grass weed control as a result of thiocarbamate herbicide treatments, alone or in combination with other herbicides.

Treatment	Rate (lb/A)	Percent control Broadleaf	Grass
EPTC + 2,4-D	3.0 + 1.5	99+[1]	100[2]
Vernolate			
EPTC + Cyprazine	2.0 + 0.5	99	100
EPTC	6.0	98	100
Vernolate	3.0	98	100
Vernolate + Cyanazine	3.0 + 1.0	98	100
EPTC + Cyanazine	3.0 + 1.0	98	100
EPTC + Cyprazine	2.0 + 0.75	96	100
EPTC (A.D.)	3.0	82	100
EPTC	3.0	81	97

[1]Average control of all broadleaf species present. Species are nightshade (*Solanum* sp.), lambsquarter (*Chenopodium album* L.), pigweed (*Amaranthus* sp.), kochia (*Kochia scoparia* (L.) Roth), and others.

[2]Average grass control. Species is green foxtail (*Setaria viridis* (L.) beauv.)

Both antidote treatments resulted in lower corn stands than the unprotected corn; however, corn vigor was substantially increased with either antidote (Table 2). Yield of corn treated with either antidote was higher than unprotected corn for all herbicide treatments, except EPTC plus 2,4-D (Knoxweed 42) at 3.0 and 1.5 lb/A, respectively. The greatest damage to corn vigor and yield was observed in plots treated with vernolate at 6.0 lb/A and EPTC at 6.0 lb/A. Treatment with R-25788 resulted in greater protection and higher corn yields for applications of vernolate and EPTC at 6.0 lb/A than did treatment with Protect. Generally, treatment with R-25788 resulted in better protection from all herbicide treatments compared to treatment with Protect.

[1]Published with the approval of the Director, Wyoming Agricultural Experiment Station as Scientific Report No. 466.

[2]Plant Science Division, University of Wyoming, Laramie 82070.

Table 2.

Comparison of Protect and R-25788 for decreasing damage to corn as a result of thiocarbamate herbicide treatments, alone or in combination with other herbicides.

		Antidote Seed Treatment								
		None			Protect			R-25788		
Treatment	Rate (lb/A)	S[1]	V[2]	Y[3]	S	V	Y	S	V	Y
EPTC (A.D.)	3.0	100	7	19	91	8	25	100	9	24
EPTC	3.0	96	5	20	84	9	24	58	9	24
EPTC	95	3	12	77	8	22	70	8	26	
Vernolate	3.0	100	6	20	63	8	25	89	9	27
Vernolate	6.0	96	2	13	77	7	17	58	9	31
EPTC + Cyprazine	2.0 + 0.5	93	7	23	77	9	30	86	9	35
EPTC + Cyprazine	2.0 + 0.75	100	6	23	84	7	24	70	9	28
Vernolate + Cyanazine	3.0 + 1.0	100	5	22	79	8	26	44	9	31
EPTC + Cyanazine	3.0 + 1.0	96	7	24	72	9	30	82	9	27
EPTC + 2,4-D	3.0 + 1.5	91	5	27	70	7	24	82	10	24
Nontreated check		100	10	10	79	10	13	100	10	13

[1]Percent corn stand. [2]Vigor observations: 1 = dead, 10 = healthy and normal. [3]Yield in tons of silage per acre.

Control of Russian Knapweed and Field Bindweed with Dicamba, 2,4-D and Their Combinations, with and without DMSO

Ivan Blaine Jones and J. O. Evans[1]

Russian knapweed and field bindweed are serious weeds in cropland on the Colorado Plateau in Southwestern Colorado and Southeastern Utah as well as in other parts of the country.

In the fall of 1970, a study was initiated in Southeastern Utah to study and compare the effectiveness of dicamba and 2,4-D alone and in combination for the control of Russian knapweed and field bindweed at rates that would permit simultaneous use of the land for the production of winter wheat. The two herbicides were used with and without dimethylsulfoxide (DMSO) to see if the DMSO would be an aid to absorption and translocation of the herbicides.

At two locations, one with Russian knapweed and one with field bindweed, experiments were established in the spring, summer and fall of 1971 and in June 1972. Each experiment was on new plots in the same field. A third experiment was established at a separate location but in the same general area as the above two experiments. Crop production at all three locations had been abandoned and the weeds were in solid stands.

The plots were 10 feet by 25 feet and each treatment was replicated four times. The plants were counted in a 27 square foot area in each plot. Three foot square quadrants were used and three quadrants were counted per plot in each evaluation. The plots were evaluated in August and September of 1971 and again in August of 1972.

Table 1 shows the rates of herbicide used and the Russian knapweed response to the three times of application. With the exception of the 4 lb/A rate of dicamba, the herbicides applied in the spring failed to give acceptable control during the first growing season. Percent control for the spring applications at all rates increased considerably however, when evaluated the second growing season after treatment (Figure 1). Both summer and fall applications gave excellent control with fall applications being slightly better. Two lb/A or more of dicamba gave essentially complete control when applied in the fall. One discrepancy in the 4 lb/A dosage of dicamba plus DMSO should be noted; three of the replications in the summer experiment produced better than 98% Russian knapweed control but the fourth replication showed 38% control. The average control for the 4 replications was 81.5%.

A preliminary experiment established the fall of 1970 showed that all treatments containing 2 lb/A or more dicamba gave 100% control after 10 months and from 86 to 98% control 22 months after treatment (Figure 2).

Table 2 shows the rates of herbicides used and the field bindweed response to the three times of application. Lighter rates of the herbicides were used because the farmer had expressed a desire to plant wheat in the field. The field was not planted however, so there was no competition from a crop. The 1.5 lb/A rate of dicamba alone or in combination are the only ones that consistantly approached an acceptable level of control. The 0.5 lb/A rate of dicamba alone gave little or no control of the bindweed. Dicamba combined with 2,4-D gave better control than either herbicide alone. The reduced level of control shown in Table 2 with 1.5 lb/A dicamba + 1.0 lb/A 2,4-D applied in the summer was not significant. Improved control by combining the 2 herbicides was most noticeable when 1 lb/A 2,4-D alone or 1 lb/A 2,4-D plus DMSO was combined with 0.5 lb/A dicamba for the spring treatment and evaluated four months after treatment. This combination applied in the spring gave fair control for one growing season and the combination with DMSO maintained the control level through the second growing season.

A preliminary experiment was also established at this location in the fall of 1970 and evaluated for two seasons.

Table 1.

Response of Russian knapweed to dicamba alone and in combination with 2,4-D and/or DMSO applied at three different times during the 1971 season

Russian knapweed response (% control)

Treatment	Rate lb/A	Time of Treatment: Spring After 3 Months (Aug. 1971)	After 15 Months (Aug. 1972)	Summer After 12 Months (Aug. 1972)	Fall After 10 Months (Aug. 1972)
Dicamba	1.0	9.5	37.5	86.9	90.5
Dicamba	2.0	49.5	66.0	94.3	99.4
Dicamba	4.0	89.5	96.3	99.8	99.5
Dicamba + DMSO	2.0 + 5%	65.5	77.9	96.2	98.6
Dicamba + DMSO	4.0 + 5%	73.6	90.9	81.5	99.5
Check	–				–
Dicamba + 2,4-D	1.0 + 1.0	10.2	25.2	72.0	96.3
Dicamba + 2,4-D	2.0 + 2.0	45.0	77.5	97.4	98.9
Dicamba + 2,4-D DMSO	2.0 + 2.0 + 5%	47.1	81.1	96.2	98.9
DMSO	5%			–	–

Table 2.

Response of field bindweed to dicamba, 2,4-D and their combinations with and without DMSO applied at three different times during the 1971 season

		Field bindweed response (% control)			
		Time of Treatment			
Treatment	Rate lb/A	Spring After 4 Months (Aug. 1971)	After 15 Months (Aug. 1972)	Summer After 12 Months (Aug. 1972)	Fall After 10 Months (Aug. 1972)
Dicamba	0.5	0.0	0.0	0.0	16.0
Dicamba	1.5	77.4	57.6	64.1	55.3
Dicamba + DMSO	0.5 + 2.5%	16.7	17.2	12.2	7.3
Dicamba + DMSO	1.5 + 2.5%	71.4	34.4	57.6	93.1
DMSO	2.5%	–	–	–	–
Check		–	–	–	–
Dicamba + 2,4-D	0.5 + 1.0	66.1	25.6	38.3	23.3
Dicamba + 2,4-D	1.5 + 1.0	82.3	60.6	57.9	84.4
Dicamba + 2,4-D DMSO	0.5 + 1.0 + 2.5%	61.9	57.6	35.1	16.0
2,4-D + DMSO	1.0 + 2.5%	22.0	26.9	28.0	29.8
2,4-D	1.0	54.0	62.9	13.3	5.1

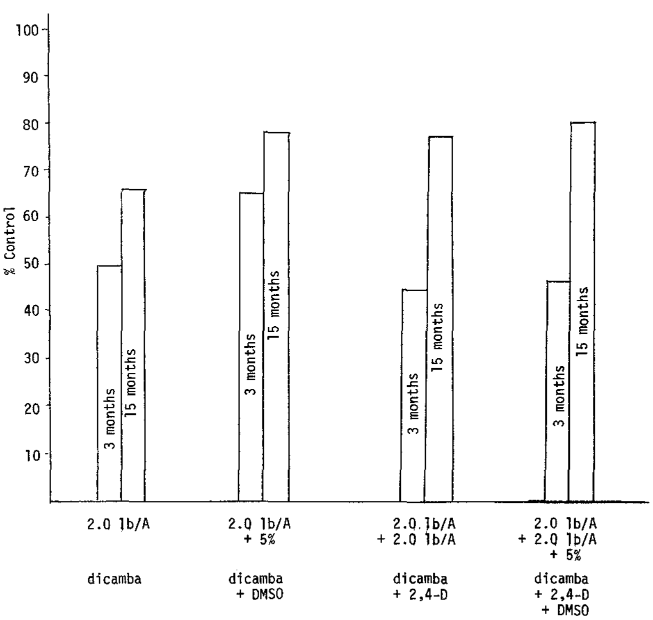

Figure 1.

Percent control of Russian knapweed with spring applications of 2.0 lb/A dicamba alone or in combination with 2.0 lb/A 2,4-D and/or DMSO (5%) at 3 and 15 months after treatment.

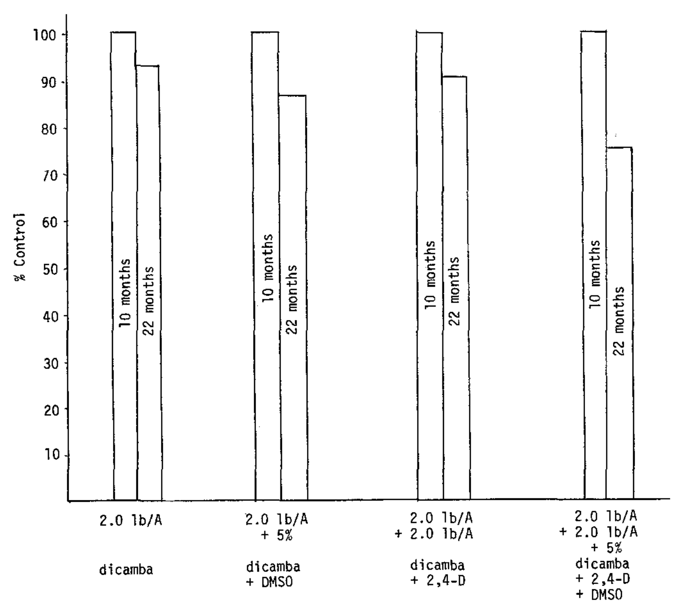

Figure 2.

Percent control of Russian knapweed with fall applications of 2.0 lb/A dicamba alone or in combination with 2.0 lb/A 2,4-D and/or DMSO (5%) at 10 and 22 months after treatment.

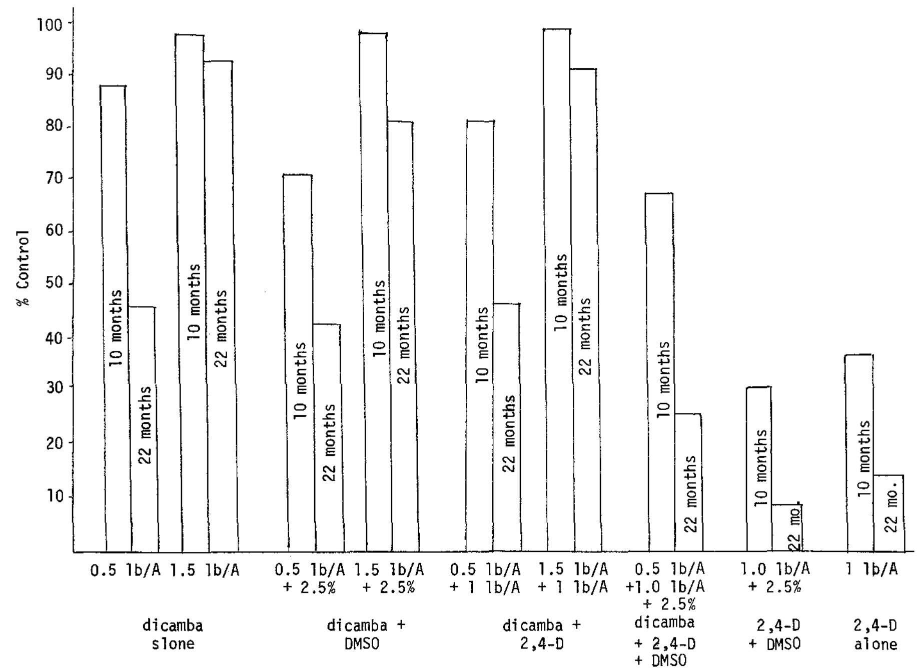

Figure 3.

Percent control of field bindweed with fall applications of dicamba (at two different rates) and 2,4-D alone and in combination, with and without DMSO, at 10 and 22 months after treatment

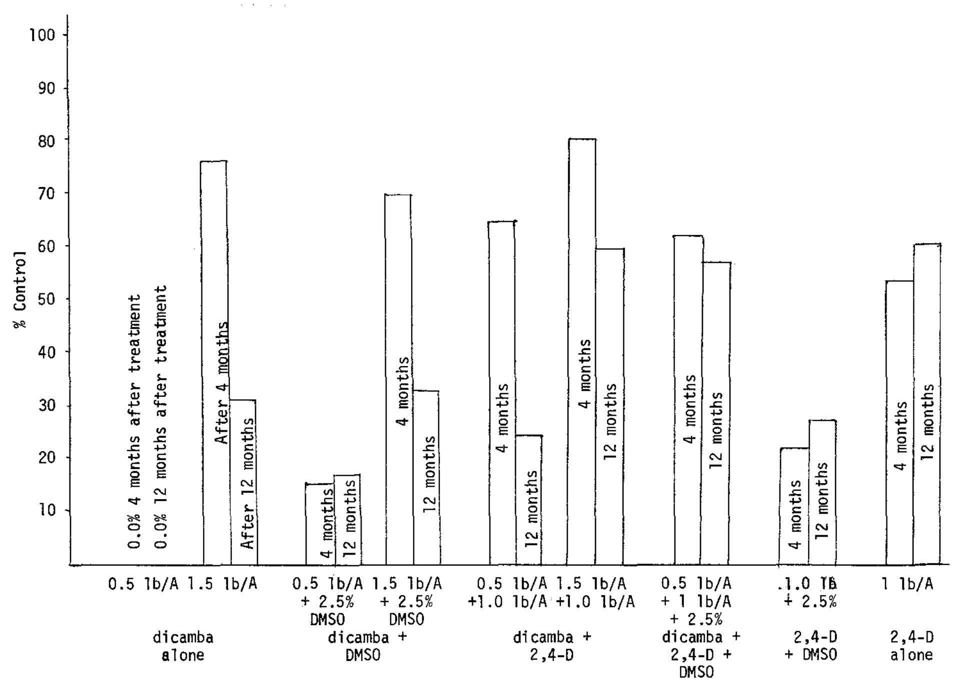

Figure 4.

Percent control of field bindweed with spring applications of dicamba (at two different rates) and 2,4-D alone and in combination, with and without DMSO, at 4 and 15 months after treatment

Figure 3 shows the results 10 and 22 months after treatment.

The treatments applied the spring of 1971 for field bindweed control were evaluated for two seasons. Figure 4 graphically represents the results obtained 4 and 15 months after treatment.

Summary

The results of this study indicate that fall applications of dicamba at 2 lb/A are sufficient to give essentially 100% control of Russian knapweed for 1 growing season and approximately 90% control for the second growing season. The 4 lb/A rate of dicamba or the addition of 2,4-D does not seem justified. Summer applications are about as good as fall applications. Spring applications are less effective. On field bindweed only the 1.5 lb/A rate of dicamba consistantly approached an acceptable level of control. Dicamba at 0.5 lb/A plus 1 lb/A 2,4-D applied in the spring gave fair control for 1 season. DMSO generally did not significantly increase the phytotoxicity of the herbicides. This, however, merits further study.

[1]Plant Science Department, Utah State University, Logan 84322.

Minutes of the Business Meeting
March 15, 1973

President Bayer called the meeting to order at 9:50 a.m. with 81 members in attendance. Minutes of the 1972 WSWS Business Meeting were accepted as printed in the Proceedings of WSWS, Vol. 25 by unanimous vote.

Report of WSWS Representative to WSSA, 1973

Representative K. C. Hamilton reported that the 1973 meeting of the Weed Science Society of America (WSSA) was February 6-8 at the Regency Hyatt Hotel in Atlanta, Georgia. Seven hundred people registered and many were accompanied by their wives to enjoy the fine hotel and hospitality.

President R. P. Upchurch met with the Executive Group of WSSA on September 7, 1972, in St. Louis and with the Executive Committee on February 5, 1973, in Atlanta. The business meeting of WSSA was February 6. The Executive Committee met with our new President E. G. Rodgers on February 9.

Other new officers of WSSA are:

President Elect . . . . E. L. Knake
Vice-President . . . . C. R. Swanson
Secretary . . . . R. D. Ilnicki

New members of the Executive Committee are:

P. A. Frank . . . . Member-at-large
J. D. NalewajaNorthcentral Weed Cont. Conf. Representative

Membership in WSSA increased 260 during the past year. WSSA income exceeded expenses and $20,000 was returned to the reserve fund. Fred Slife, Treasurer-Business Manager of WSSA, will resign at the end of this business year and will be replaced by a professional manager of scientific societies. The new Executive Secretary will handle most of the duties of the Treasurer-Business Manager.

WSSA regrets that some of its mailings were late in reaching members during the past year. In the future mailings will be earlier and some will be by first-class and air mail.

Associate membership is now available in WSSA for $10 per year. Associate members receive Weeds Today, the Newsletter, and mailings of WSSA, and can serve on WSSA committees. They do not receive Weed Science and can not vote or hold office in WSSA. Over 100 people and organizations have joined WSSA as associate members.

The Weed Science journal has done well with T. J. Sheets as Editor. New Associate Editors of Weed Science are C. R. Swanson, and K. C. Hamilton. The popular publication, Weeds Today, has continued publication with G. A. Buchanan as Editor. It is possible that WSSA will have to pay income tax on advertising in Weeds Today. A Newsletter for WSSA has been started with P. W. Santelmann as Editor. A monograph on "Surfactants and Herbicides" is being prepared.

Awards for outstanding work in extension, research, and teaching were presented to E. P. Sylwester, D. E. Moreland, and F. W. Slife, respectively.

The next meeting of WSSA will be at Caesar's Palace Hotel in Las Vegas, Nevada, on February 12-14, 1974. Following meetings will be in Washington, D.C. in 1975; Denver, Colorado in 1976; St. Louis, Missouri in 1977; Dallas, Texas in 1978; and San Francisco, California in 1979. WSSA rejected summer meetings in the near future.

Local Arrangements Committee Report

Keith E. Wallace expressed his thanks to members of the committee for their assistance prior to and during the meeting. The membership acknowledged the fine efforts of Mr. Wallace and his committee.

Local Arrangement Committee, 1974 Site

Don L. Burgoyne reported that he and Larry C. Burrill had considered several locations in the state of Hawaii. The site for the 1974 WSWS meetings will be the Royal Lahaina Hotel on the Island of Maui on March 12, 13 and 14, 1974. Travel information will be forwarded to the membership in the near future. Early reservation arrangements are encouraged to assure best possible accommodations.

Site Selection Committee Report

Jesse M. Hodgson reported that sites for WSWS meetings for the next 3 years will be Maui, Hawaii in 1974; Phoenix, Arizona in 1975; and Portland, Oregon in 1976. H. F. Arle and W. L. Anliker will serve as local arrangement chairman for the Phoenix and Portland meetings, respectivvely.

Nominations Committee Report

H. P. Alley reported that 142 members cast ballots. Results were:

President-Elect	Gary A. Lee
Secretary	William L. Anliker
Chairman Elect Research Section	Richard D. Comes
Chairman Elect Education/Regulatory	Clyde Elmore
Representative to WSSA	Arnold P. Appleby

Constitutional changes:

a. Article IV, Section 5: The Society Representative to WSSA shall serve 2 years . . . . Passed

b. Title of Research Section Project to be changed from "Herbaceous Range Weeds" to "Herbaceous Weeds of Range and Forest" . . . . Passed

Treasurer-Business Manager Report

J. LaMar Anderson presented the financial statement of WSWS from March 1, 1972 to March 10, 1973.

Income

On hand March 1, 1972	$3,704.88
Registration, Salt Lake Meeting (248)	735.00
Dues, members not attending Salt Lake meeting	79.00
Salt Lake luncheon tickets	518.50
1972 Research Progress Reports	1,345.30
1972 Proceedings	1,434,10
Sale of old publications	211.00
Payment of outstanding accounts	.91.50
Interest on savings	252.21
Advance order payments	.21.00
	$8,392.49

Expenditures

Annual meeting incidental expenses	$ 365.79
Salt Lake luncheon	514.45
1973 Research Progress Report	.15.95
1972 Research Progress Report	945.72
1972 Proceedings	1,279.00
Office supplies	144.20
Business Manager Honorarium	250.00
Postage	229.00
Plaques for honorary members	.37.30
Refunds	.44.00
	$3,825.41

Liquid Assets

Savings	$2,600.00
Checking	1,947.08
Cash on hand	.20.00
	$4,567.08
Accounts Receivable	100.10
Potential Net Worth	$4,667.18
Old publications on hand (685)	

Jean H. Dawson, substituting for the Finance Committee chairman, W. L. Gould, presented auditing committee report on Treasurer-Business Manager financial statement. The books were in good order with all expenditures being well documented. A new Internal Revenue Service regulation requires that provisions must be made in the constitution of a non-profit organization (WSWS) for the disposal of its assets upon the dissolution of the organization. In order to comply with IRS regulations, an amendment to the constitution of WSWS will be offered to the membership before the next meeting.

The financial statement and auditing committee report was passed unanimously by members present.

Report on Weeds Today

Jean H. Dawson, Regional Editor for Weeds Today, reported the status of the publication. He encouraged greater participation by Western Region weed scientists. News worthy items should be forwarded to him for inclusion in the publication.

Resolution Committee Report

Chairman W. L. Anliker reported that three resolutions were submitted for consideration by the WSWS membership.

Resolution No. 1

WHEREAS: Expo '74 is the first international exposition to be themed to the environment and outdoor living, and the attendance is anticipated to be from 4.5 to 5 million people and

WHEREAS: the need to inform the public of the true story regarding the use of agricultural chemicals is considered to be of utmost importance,

THEREFORE: be it resolved that the WSWS support the concept that Expo '74 presents an important and unique opportunity for the Agricultural Chemical Industry to inform the public of the facts concerning our industry and its impact on the environment. Be it further resolved that we urge other organizations within our industry to consider the possibility of developing a meaningful exhibit for Expo '74.

The resolution was adopted unanimously by the WSWS membership present.

Resolution No. 2

WHEREAS: most states within this region are presently considering, developing, or have enacted programs for the licensing of Pesticide Advisors or Consultants, and

WHEREAS: many of those concerned with the development, marketing or recommendation of pesticides are responsible for geographical areas comprising more than one state,

THEREFORE, be it resolved that the Western Society of Weed Science urges that state regulatory agencies standardize examination procedures so that Pesticide Advisors or Consultants who complete the requirements for licensing in one state will be permitted to obtain a license in the neighboring state without repeating the examination procedure.

The resolution was adopted with majority vote of WSWS members in attendance.

Resolution No. 3

WHEREAS: weed science and weed control programs need to be strengthened, and

WHEREAS: the Federal Extension Service has recently appointed a half-time Weed Extension Specialist at the Federal level to coordinate Federal-State programs, serve as liaison between EPA and state specialists as well as many other functions to strengthen weed science programs.

THEREFORE: be it resolved that the Western Society of Weed Science commend the Secretary of Agriculture for his prompt action on the request for the appointment of a Federal Extension Specialist and be it further resolved that the WSWS support the effort of the WSSA to get this appointment upgraded to a full-time appointment.

The resolution was adopted unanimously by the WSWS membership present.

WSWS Education Committee

G. A. Lee reported that A. P. Appleby, chairman of Education Committee, solicited comments from WSWS members engaged in teaching weed science courses regarding techniques and ideas for presenting materials to students. Of those contacted, 20 questionnaires were returned and compiled as a bound report. The report was forwarded to the WSSA Education Committee as an input from WSWS.

Placement Service Committee Report

Chairman Robert F. Norris reported that the Placement Service was operated for approximately 8 hours on March 13 and 14, 1973. The WSSA placement lists of "Positions Available" and "Positions Desired" were available for interested persons to read. An estimated 20 to 30 persons, mainly from the chemical industry, utilized the facilities. Eight persons seeking employment filed application forms. No estimate could be made of the number of "contacts" established. The committee recommends that future operation of the Placement Service should provide more information to all concerned by prior advertising of the service.

Education and Regulatory Section Report

Chairman Stanley Heathman reported briefly on the activities of the Education and Regulatory Section. Discussions were orientated toward implementation and interpretation of new pesticide laws at State and Federal levels. Arthur H. Lange will be Chairman in 1974 and Clyde Elmore is Chairman-Elect.

Research Section Report

Chairman Jack O. Evans summarized the activities of the seven project meetings and called on each of the project chairmen for reports.

Dean Schachterle, chairman of the Aquatic and Ditchbank Weeds, reported that the members of Project 6 proposed changing the name to "Aquatic and Marginal Weeds". The proposed change has been requested to appear on the 1974 ballot for WSSA membership approval.

Mr. Tagert, Representative of the Ridpath Hotel, presented Plaques of Appreciation to President Dave Bayer, President-Elect Don Burgoyne, and Local Arrangements Committee Chairman, Keith Wallace.

Outgoing WSWS President Bayer expressed his thanks to members of standing committees for their efforts during the past year prior to turning over his duties to incoming President Don Burgoyne. A motion from the floor for adjournment was seconded and passed. The 1973 Western Society of Weed Science business meeting adjourned at 11:35 a.m., March 15, 1973.

Respectfully submitted,

Gary A. Lee
Secretary, WSWS

Project 1. Perennial Herbaceous Weeds
Summary

The project met for 2 hours Wednesday morning March 13, 1973. Over 75 people were in attendance during the informal discussions which were led by chairman, D. E. Baldridge.

A major topic of discussion concerned the rather new techniques of layering and injection of herbicides for controlling troublesome perennial weeds. Robert Higgins (University of Idaho) led a discussion of the use of fumigants to control field bindweed and the degree of control one could expect using this procedure. A lively discussion followed this presentation leading to a more thorough search for application rates and depths of treatment to obtain maximum effectiveness on bindweed. The role of climatic and soil factors affecting performance was stressed. Cost of controlling bindweed using this method was also investigated.

A discussion of the use of glyphosate to control perennial grassy and broadleaved species was led by Earl Spurrier (Monsanto Company). The relationship of growth stage, temperature, moisture and light were discussed as they relate to the performance of glyphosate on plants.

Perennial weed control in irrigated crops was led by Ed Schweizer with an initial discussion of his work with dicamba on land rotated to sugar beets. A discussion of other herbicides, weeds and crops then followed.

The impact of the 1972 weed law as it relates to perennial weed control was discussed.

Chairman 1974, Warren G. (Skip) Purdy; chairman-elect, Alvin F. Gale.

Project 2. Herbaceous Weeds on Range and Forest
Summary

About 34 persons attended the Section. Dr. Roland Schirman, USDA, Washington State University, Pullman, was chosen to be Chairman-elect to succeed Dr. Dale Christenson, Chairman for 1974.

A stimulating discussion concerned developing and relating treatments to range management objectives and procedures. Selecting primary, secondary and lower priority objectives should be part of the multiple use concept, but the idea of recognizing and managing for the primary or dominant use has not been emphasized for various parts of range units. Recognizing the opportunity and desirability of placing proper priority on the wildlife aspects was considered. Wildlife specialists should be involved.

The characteristics of yellow star thistle, its areas of adaptation and some data on its control were presented by Dr. Ben Roche (Extension Range Specialist, WSU, Pullman). It has been found to be toxic to horses. The aggressive and repulsive nature of this weed enables it to advance into many grass ranges with rainfall of over about 12" per year. Chemical control is needed to prevent this advance and recover the range from infested areas. Geographical distribution is quite general.

Diffuse and spotted knapweeds are of a similar nature and are advancing from the northern and eastern borders of Washington. Spotted knapweed was reported to have spread 200 miles east of the Divide. These are adapted to drier conditions than is yellow star thistle. All of these weeds are susceptible to 2,4-D, but residual control for a season is needed; this is provided by picloram at 2-4 oz. per acre in the spring or fall.

Charles Robocker (WSU, Pullman) reviewed the problem and distribution of bracken fern. Pre-emergence or early post-emergence treatments of dicamba or picloram will reduce stands well, but repeat applications do little more. Asulam and glyphosate showed promise last fall. In forest sites, the bracken problem of 8' ferns falling on young trees may be solved by planting 30" high trees. They will stand the covering by dead fern and will overgrow the fern in a few years.

The status of 2,4,5-T registration and possibility of withdrawing it from range use was discussed. The need to contact legislators to help impress this problem on EPA was emphasized. It was noted that EPA should show equal concern for the natural toxins in our food and regulate their use as they do for pesticide residues; if they did we would probably starve!

Mike Newton (Forestry, OSU, Corvallis) lead a discussion on herbaceous weed control in conifers using atrazine + dalapon as pre-bud break topical applications. Addition of 2,4-D may help further on weed control. Dalapon alone hurts the trees but atrazine safens it so over 8 lbs. dalapon can be used with 3-4 lbs. of atrazine. Tree stimulation has resulted.

Chairman 1974, Dale Christenson; chairman-elect, Roland Schirman.

Project 3. Undesirable Woody Plants
Summary

Thirty-four were in attendance at this years session of Undesirable Woody Plants. Discussions were oriented to environmental impacts various treatments of undesirable woody plants may have. A presentation was made on the effects of chemical treatment of mesquite had on abatement of soil movement. 50% reduction was obtained 100 ft. from boundary of treated area and results showed only 5% as much soil was collected 600 ft. from the boundary compared to amount collected at the boundary. Various treatment techniques for the use of picloram in the control of Western Juniper in Idaho were discussed. Effective control is being achieved on young trees spreading downslope from the climax stand. A very interesting study is being conducted in Utah on determining the movement of various herbicides in the surface water from areas of brush treated with these herbicides. Picloram was found in significant amounts in surface water 300 ft. from the treated area. Minute amounts of picloram were found 1000 ft. from the treated area. The need for caution was expressed for the use of picloram where surface water movement may carry toxic amounts to sensitive crops further down the watershed.

The environmental impact statements now being written on herbicide use indicate guidelines would be helpful in writing these statements. A suggestion was made that the WSWS prepare guidelines that would be useful in writing these statements and that the Undesirable Woody Plant project takes the lead in developing these guidelines.

Ron Oliver, Niagra Chemical, is 1974 chairman and Dr. Steve Radosevich was chairman-elect, Extension Weed Specialist, Davis, Calif. for 1975.

Project 4. Weeds in Hort Crops
Summary

Fifty-two people attended the Project 4 meeting. A series of short informal presentations were used to introduce the two main topics, with a free flow of questions and comments during and after the presentations.

The informal presentations were as follows:
Subject 1: Layering of herbicides for perennial weed control in horticultural crops. Three informal presentations were made:

(a) Dr. Lloyd Warner–discussed the development of trifluralin layering equipment and showed slides of the equipment that has and is being used to apply this herbicide as a subsurface layer.

(b)Mr. Frank Phipps—discussed the equipment and use of dichlobenil as a layered herbicide. Frank also showed slides of the results achieved in Washington and California.

(c)Harold Kempen—discussed the results of a number of experiments conducted with layering of herbicides in California. His discussion covered numerous herbicides and various pieces of equipment.

Many questions and comments were made concerning this subject and it appears that this technique will be a valuable tool for perennial weed control in hort crops. Bindweed, Canada thistle, and nutgrass were some of the weeds mentioned.

Subject 2: Glyphosate in Horticultural crops. Two informal presentations:

(a)Mr. Dean Brown—introduced the subject by discussing and showing slides of the work he has done with glyphosate in horticultural crops. Results on tough perennial weeds in horticultural crops were very encouraging.

(b)Mr. Jim Mchenry—discussed the work of various California workers and showed results of their experiments. Slides were used to visually show weed control and crop injury symptoms in certain crops.

Glyphosate appears to be a highly effective herbicide for weed control in horticultural crops, with many of the crops exhibiting considerable tolerance, particularly the woody species. Much of the work discussed concerned tree fruits and vines. Perennial weeds have been steadily increasing and this herbicide appears to be promising for control of these weeds.

Chairman 1974, Kenneth Dunster; chairman-elect, Harold Kempen.

Project 5. Weeds in Agronomic Crops

Chairman 1974, Larry Burrill; chairman-elect, Dean Brown.

Project 6. Aquatic and Ditchbank Weeds Summary

Project 6 met on Wednesday afternoon and had 26 participants who are vitally interested in control of aquatic and ditchbank weeds. The chairman for the 1974 meeting, Mr. Gene Otto, Bureau of Reclamation, Denver, Colorado was introduced. An election for a chairman-elect was then held and Mr. Floyd Oliver, Bureau of Reclamation, Boise, Idaho was unanimously elected.

A discussion was held concerning the scope and name of Project VI. It was the concensus of all present that ditchbank weeds should not be dropped from the scope of the Project but that the name could be changed so that this Project would cover other aquatic areas in addition to irrigation systems as the name now implies. It was finally decided by a majority vote to recommend to the Executive Committee that the name of Project VI be changed to "Aquatic and Marginal Weeds". This Project name coincides with a similar Project in the WSSA, Weed Society of America.

Several interesting papers were presented giving insight into some of the new developments which lie ahead in the control of aquatic and marginal weeds and the overall management of aquatic sites.

One of the big problems confronting people, agencies and industries in the control of aquatic and marginal weeds is the uncertainty of registration and labeling of the limited number of herbicides now being used for this purpose. Also the details concerning the enforcement of the Environmental Pesticide Control Act of 1972 looms over the heads of irrigation managers and others who are forced to control weeds in aquatic sites in order to deliver water to their customers.

All is not gloom, some breakthrough was made this past year in the registration of aquatic herbicides and more are expected in the coming year.

Project 7. Chemical and Physiological Studies Summary

Between 50 and 60 attended the Tuesday afternoon section meeting, with good attendance well past 5:00 p.m.

Chairman Norris opened the meeting with a discussion of the purposes of the project meeting. The general concensus was that informal discussion, with topic introduction by previously selected individuals, was the most desirable format for the meeting.

The theme for the meeting was uptake, movement, and action. Dr. Bayer presented information on the use of the scanning electron microscope, and cathodoilluminescence, as a tool for studying spray deposits on the cuticle surface. A lively discussion ensued on the interaction of cuticle structure and surfactants in relation to spray deposition and herbicide penetration.

Dr. Zimdahl posed a question concerning interpretation of experiments on uptake of triallate by barley and wild oat seedlings. The data indicated that uptake was probabbly not related to selectivity. Discussions centered around influence of plant size, numbers of stomata present, extractibility of triallate or a metabolic product on the interpretation of the data presented. Several avenues of investigation were suggested but the ultimate relationship between uptake and selectivity could not be resolved.

Dodder can be killed by vapor movement in the air from granules to the seedlings. Dr. Dawson presented data to show this, and also discussed the action of the carbamate inhibitor of chlorpropham breakdown. It was pointed out that the mechanism of inhibition acted through blocking the action of an extracellular enzyme and not through reducing microbial population or activity. An unresolved philosophical discussion developed about how a mitotic inhibitor could kill existing dodder plants after they have become attached to the host.

Translocation, and its relation to diffusion and 'contact, non-mobile' herbicides was briefly discussed.

Chairman Norris introduced the topic of twisting (corkscrew effect) of sugar beets growing in soil containing small amounts of trifluralin. Several researchers verified that this was a real phenomenon but nobody could really say what was happening. Considerable amusement was generated within the group in considering the possibility of sugar beets 'revolving' in the soil to cause the twisting. Other alternatives considered were severe 'telescoping' of the tissues, or development of a twisted root during growth.

The session ended in a short business meeting. Robert Zimdahl was introduced as the chairman for the 1974 meeting, and Alex Ogg was elected as chairman-elect, to preside at the 1975 meeting. Meeting adjourned at 5:15 p.m.

Honorary Members of WSWS

The constitution of the Western Society of Weed Science adopted in 1967 provides for the selection of honorary members of WSWS. Individuals receiving the highest honor given by the Western Society of Weed Science are:

Robert B. Balcom – 1968
Walter S. Ball – 1968
A. A. Crafts – 1968
F. L. Timmons – 1968
D. C. Tingey – 1968
Lambert C. Erickson – 1969
Jesse M. Hodgson – 1969
Lee Burge – 1970
Bruce Thornton – 1970
Virgil H. Freed – 1971
W. A. Harvey – 1971
H. Fred Arle – 1972
Boysie E. Day – 1972
Harold P. Alley – 1973
K. C. Hamilton – 1973

Harold P. Alley

Harold P. Alley was born on March 26, 1924 in Cokeville, Wyoming. He served in the 13th Airborne Division during WW II. As an undergraduate at the University of Wyoming, he majored in vocational agriculture and received his bachelor of science degree in 1949. Harold taught vocational agriculture for 5 years prior to returning to the University of Wyoming to earn a master of science degree in agronomy in 1955. He joined the University of Wyoming faculty in 1955 to teach and conduct research in weed control. He was awarded a Ph.D. degree in botany at Colorado State University in 1965. Dr. Alley is presently Professor of Weed Science and Extension Weed Specialist at the University of Wyoming. He has directed 30 M.S. and Ph.D. graduate students in weed science during his tenure at the University.

Harold Alley is a leading authority in perennial weed and rangeland weed control. He recently received the American Forage and Grassland Council's Merit Award for his contributions to range improvement with herbicides. Harold was the 1972 recipient of the Alvie Ellege Award for outstanding contribution to the weed and pest control program in Wyoming.

He has served the Western Society of Weed Science as Research Section Chairman, Secretary, Program Chairman, and President. Ambitious weed control programs have been developed in Wyoming as a result of his dedicated efforts to define problems and find solutions through research and extension projects. Dr. Alley has authored and co-authored more than 300 publications dealing with weed science.

K. C. Hamilton

Dr. Keith C. Hamilton was born June 22, 1928, at Fox Lake, Wisconsin. He attended the University of Wisconsin receiving his B.S., M.S. and Ph.D. degrees before joining the staff at the University of Arizona in 1954. He was promoted to the ranks of Professor and Agronomist at the University of Arizona in 1962.

Dr. Hamilton has conducted research on weed control at the University of Arizona since 1954 in conjunction with H. F. Arle, USDA, Phoenix, Arizona. These men have done pioneering research in layby application of herbicides in irrigated cotton and on herbicide residues in desert soils. In addition, they have conducted the normal type of weed control studies in all Agronomic and Horticultural crops. Dr. Hamilton has taught the weed control courses at the University of Arizona and advised both graduate and undergraduate students. He is actively sought as an advisor and counselor to students.

K. C. has been active in the Western Society of Weed Science, contributing to the Proceedings and Research Progress Reports, serving as President during 1969-1970 and as representative of W.S.W.S. to the Weed Science Society of America since 1970.

Dr. Hamilton is a recognized authority in the field of weed science. He has been on the Editorial Board of the Weed Science Society of America for the past eight years and has recently been appointed as Associate Editor for *Weed Sciencece.*

Membership List

A

Jawad T. Agha
University of Mosul
Bab El-Baid
Mosul, IRAQ

W.E. Albeke
PPG Industries
1500 N.E. Irving
Portland, OR 97232

Jack Aldridge
Nor-Am Agricultural Prod.
1033 Crellino Road
Pleasanton, CA 94566

Harold Alley
Plant Science Div.
University of Wyoming
Laramie, WY 82070

Clark R. Amen
American Cyanamid Co.
1445 N.W. 14th Place
Corvallis, OR 97330

David A. Anderson
Velsicol Chemical Corp.
5475 S.W. 182
Beaverton, OR 97005

David J. Anderson
O.S.U. Extension Service
450 N. Buena Vista
Burns, OR 97720

J. LaMar Anderson
Plant Science Dept.
Utah State Univ.
Logan, UT 84322

W. L. Anliker
811 S.E. 97th Ave.
Vancouver, WA 98664

H. Fred Arle
ARS – USDA
4207 E. Broadway
Phoenix, AZ 85040

Wendell Arnold
Eli Lilly & Co.
1100 Pitkin Street
Fort Collins, CO 80521

Floyd M. Ashton
Botany Dept.
University of California
Davis, CA 95616

David G. Austin
U.S. Borax
332 Bedford Place
Thousand Oaks, CA 91360

B

Alvin A. Baber
DuPont Company
2180 Sand Hill Road
Menlo Park, CA 94025

Richard W. Bagley
HLR Sciences, Inc.
340 Kingsland St.
Nutley, NJ 07110

Richard B. Bahme
Agridevelopment Company
3 Fleetwood Court
Orinda, CA 94563

Richard M. Bailey
Amchem Products, Inc.
3959 Dakota Road SE
Salem, OR 97302

Thomas R. Bartley
U.S. Bureau of Reclamation
Bldg. 56, Denver Federal Cent.
Denver, CO 80225

Robert B. Balcom
U.S. Bureau of Reclamation
Interior Bldg., Room 7418
Washington, D.C.

Don Baldridge
So. Agric. Res. Center
Huntley, MT 59037

Walter S. Ball
1440 Wintworth Ave.
Sacramento, CA 95680

David E. Bayer
Botany Dept.
University of California
Davis, CA 95616

Jerry Benson
Washington Dept. of Game
1031 Lakeside Drive
Moses Lake, WA 98837

E. Ray Bigler
Chemonics Ind.
P.O. Box 21568
Phoenix, AZ 85036

Jarrad D. Blank
Sandoz Wander
P.O. 1489
Homestead, FL 33030

Bert L. Bohmont
Extension Service
Colorado State University
Fort Collins, CO 80521

E. J. Bowles
Pennwalt Corp.
3239 Mayfair Blvd.
Fresno, CA 93703

R. Charles Bowers
The Upjohn Co.
4116 Vista Way
Davis, CA 95616

Curtis Bowser
Bureau of Reclamation
P.O. Box 22
Boulder City, NV 89005

Clarke Brown
Washington State Dept. Agr.
P.O. Box 617
Yakima, WA 98907

Dean A. Brown
Monsanto Company
5486 E. Washington
Fresno, CA 93727

V. F. Bruns
Irr. Agr. Res. & Ext. Center
Prosser, WA 99350

Carl Buchholz
CIBA-GEIGY
Route 4, Box 4008-D
Wapato, WA 98951

Lee Burge
Nevada Dept. of Agr.
1625 California Ave.
Reno, NV 89507

Van Burgess
Utah State Dept. of Agr.
71 South 1st East
Provo, UT 84601

Donald L. Burgoyne
DuPont Company
2180 Sand Hill Road
Menlo Park, CA 94025

John Burr
CIBA-GEIGY
5310 Moody Lane
Carmichael, CA 95608

Ronald J. Burr
Crop Science Dept.
Oregon State University
Corvallis, OR 97331

Larry C. Burrill
Crop Science Dept.
Oregon State University
Corvallis, OR 97331

Tim Butler
Uniroyal Inc.
1111 J. Street, Apt. 58
Davis, CA 95616

C

Robert H. Callihan
University of Idaho
Aberdeen Exp. Station
Aberdeen, ID 83210

William F. Campbell
Plant Science Dept.
Utah State University
Logan, UT 84322

Will D. Carpenter
Monsanto Company
800 N. Lindbergh Blvd.
St. Louis, MO 63166

Jerry Caulder
Monsanto Company
6714 Mt. Pakron Drive
San Jose, CA 95120

Keith J. Chapman
USU Extension Service
P.O. Box 568
Fillmore, UT 84631

Richard Chase
USU Extension Service
Courthouse
Price, UT 84501

M. Dale Christensen
CIBA-GEIGY
3516 Gemini Ct.
Concord, CA 94519

Leon Church
Minimoka County
Route 1
Rupert, ID 83350

Donald L. Claeys
Van Waters & Rogers
P.O. Box 2767
Spokane, WA 99206

Donald R. Colbert
Crop Science Dept.
Oregon State University
Corvallis, OR 97331

Floyd Colbert
Eli Lilly & Company
506 W. Palo Alto
Fresno, CA 93704

Mark Cole
Amchem Products, Inc.
Rt. 1, Box 317A
Walla Walla, WA 99362

Ronald L. Collins
229 N.E. 17th Street
Hillsboro, OR 97123

Richard D. Comes
ARS-USDA
Irr. Agr. Res. & Exp. Sta.
Prosser, WA 99350

Lem A. Conn
DuPont Company
2180 Sand Hill Road
Menlo Park, CA 94025

A. Wayne Cooley
Rhodia, Inc.
3383 South View Drive
North Albany, OR 97321

Garvin Crabtree
Horticulture Dept.
Oregon State University
Corvallis, OR 97331

A. S. Crafts
Botany Department
University of California
Davis, CA 95616

Henry T. Craven
Environmental Protection Agency
12th & Independence S.W.
Washington, D.C.

Marcus Cravens
600 Linden Street
Carpinteria, CA 93013

Eugene H. Cronin
Botany Department
Utah State University
Logan, UT 84322

Ted Curry
Diamond Shamrock
2081 Janette Lane
Anaheim, CA 92802

D

Paul R. Daniels
USU Extension Service
56 South 2nd East
Heber City, UT 84032

Jean H. Dawson
ARS-USDA
P.O. Box 30
Prosser, WA 99350

Boysie E. Day
317 University Hall
University of California
Berkeley, CA 96720

Michael Day
NorAm Chemical Company
2205 N. 33rd
Boise, ID 83703

D. W. Dean
932 Singingwood Road
Sacramento, CA 95825

Errett Deck
Wash. State Dept. of Agr.
Rt. 12, Box 602
Olympia, WA 98503

D. G. Denning
Chemagro Corp.
2828 Telegraph Ave.
Berkeley, CA 94556

Stephan Dennis
Rhodia-Chipman
707 Continental Circle No. 1914
Mountain View, CA 94040

J. W. DiVall
Stauffer Chemical Co.
P.O. Box 7222
Omaha, NB 68107

Joseph E. Dorr
CIBA-GEIGY Corp.
225 N. Barranca St., Suite 42
West Covina, CA 91791

Ray Downs
Utah State Dept. of Agr.
Capitol Bldg., Room 412
Salt Lake City, UT 84114

Chuck Duerksen
Stauffer Chemical Co.
P.O. Box 257
Coyote, CA 95013

K. W. Dunster
Amchem Products, Inc.
P.O. Box 2698
Fremont, CA 94536

E

Bert Eddins
Velsicol Chemical Co.
341 East Ohio Street
Chicago, IL 60611

W. Leo Ekins
Fisons Corp.
2 Preston Ct.
Redford, MA 01730

B. R. Ellison
Utah Cooperative Assn.
580 West 13th South
Salt Lake City, UT 84115

W. B. Ennis, Jr.
Staff Scientist – Weed Science
National Program Staff
Beltsville, MD 20705

Duane Erickson
Washington Coop. Extension
510 W. Broadway
Ritzville, WA 99169

Lambert C. Erickson
Plant Science Dept.
University of Idaho
Moscow, ID 83843

John O. Evans
Plant Science Dept.
Utah State University
Logan, UT 84322

Stuart Evans
Chemonics
P.O. Box 21568
Phoenix, AZ 85036

F

B. F. Fay
ICI America, Inc.
Wilmington, DE 19899

Stanford N. Fertig
Amchem Products, Inc.
Ambler, PA 19002

Luis F. Figuerola
Gulf Oil Chemical Co.
9009 W. 67th
Merriam, KS 66202

Herb Fisher
Crop Science Department
Oregon State University
Corvallis, OR 97331

J. R. Fisher
Wilbur Ellis Co.
2460 6th Ave. S
Seattle, WA 98027

Lou Flanagan
Velsicol Chemical Corp.
Box 991
Walla Walla, WA 99362

Forest Service Library
B.C. Forest Service
Parliament Buildings
Victoria, B.C., Canada

R. A. Fosse
Amchem Products, Inc.
P.O. Box 2698
Fremont, CA 94536

Gerald J. Fox
CIBA-GEIGY
Rt. 1, Box 156
Spokane, WA 99204

Farrell J. Francom
Research Agronomist
Utah-Idaho Sugar Co.
West Jordan, UT 84084

Peter A. Frank
USDA-ARS-Western Region
P.O. Box 25007, Denver Fed. C.
Denver, CO 80225

Frank Fraser
Oregon State University
1206 Walnut
Corvallis, OR 97330

Virgil H. Freed
Agricultural Chemistry Dept.
Oregon State University
Corvallis, OR 97331

Dave Fritz
Amchem Products, Inc.
Ambler, PA 19002

Jess Fults
Botany Dept., Weed Lab.
Colorado State University
Fort Collins, CO 80521

G

S. A. Gagnon
P.O. Box 210
Ankeny, IA 50021

Alvin F. Gale
Plant Science Div.
University of Wyoming
Laramie, WY 82070

Tad H. Gantenbein
John Taylor Fertilization Co.
P.O. Box 15289
Sacramento, CA 95813

C. M. Gates
Nor-Am Inc.
1275 Lake Ave.
Woodstock, IL 60098

Pat Gentry
BASF Wyandotte Corp.
P.O. Box 2897
Fresno, CA 93745

Joe Geronimo
The Dow Chemical Co.
Rt. 1, Box 1313
Davis, CA 95616

Walter L. Gould
Agronomy Dept.
New Mexico State Univ.
Las Cruces, NM 88001

George T. Graf
USDA
Irr. Agr. Res. & Ext. Center
Prosser, WA 99350

W. L. Graham
Lincoln County Weed Control
Box 5
Harrington, WA 99134

H. J. Gratkowski
Pacific N.W. Forest Exp. Sta.
P.O. Box 389
Roseburg, OR 97470

Reed A. Gray
Stauffer Chemical Co.
P.O. Box 760
Mountain View, CA 94040

Jim Griffin
Wash. State Univ. Extension
233 Courthouse
Yakima, WA 98901

Bill Griffith
Eli Lilly & Co.
5800 Tulane Drive
Atlanta, GA 30336

H

Irving Hackett
County Agent
Box 951
Elko, NV 89801

Delane M. Hall
Power County
Box 121
American Falls, ID 83211

Donald H. Hall
Progressive Farming, Inc.
1316 N. Highland Drive
Porterville, CA 93257

Tom Hall
Colloidal Products
P.O. Box 394
Yakima, WA 98907

K. C. Hamilton
Department of Agronomy
University of Arizona
Tucson, AZ 85721

C. A. Hanson
American Hoechst Corp.
11312 Hartland Street
North Hollywood, CA 91605

L. T. Hargett
Rhodia Inc., Chipman Div.
120 Jersey Ave.
New Brunswick, NJ 08903

Richard Harle
Stauffer Chemical Co.
1227 So. Jefferson St.
Moses Lake, WA 98837

Gordon K. Harris
U.S. Borax Research
421 Crescent Way
Anaheim, CA 92801

W. A. Harvey
Botany Department
University of California
Davis, CA 95616

E. Lee Hatley
Bingham County Weed Control
P.O. Box 583
Blackfoot, ID 83221

Alan R. Hattrup
U.S. Bureau of Reclamation
P.O. Box 815
Ephrata, WA 98823

Loyd Hauff
Hauff Pest Control
329 E. 14th
Casper, WY 82601

Stanley Heathman
Extension Weed Specialist
University of Arizona
Tucson, AZ 85721

Eugene Heikes
Extension Service
Colorado State University
Fort Collins, CO 80521

James D. Helmer
Eli Lilly Company
7521 W. California Ave.
Fresno, CA 93706

Ernest F. Hesser
U.S. Army, Corps of Engineers
Bldg. 613-A, City County Airport
Walla Walla, WA 99362

Robert Higgins
Univ. of Idaho Extension Serv.
634 Addison Ave. West
Twin Falls, ID 83301

Wayne R. Hillebrecht
Stauffer Chemical Co.
P.O. Box 760
Mountain View, CA 94087

Jesse M. Hodgson
ARS-USDA
Plant & Soil Dept. MSU
Bozeman, MT 59715

Jack Hooker
U.S. Borax
2615 74th Place
Lubbock, TX 79413

Ralph H. Horne
USU Extension Agent
75 East 1st South
Provo, UT 84601

Walter A. Houston
Encap Products Co.
P.O. Box 278
Mt. Prospect, IL 60056

Don R. Howell
County Agr. Agent
1047 4th Ave.
Yuma, AZ 85364

John R. Hughey
Oceanography International Co.
P.O. Box D 3
College Station, TX 77840

Herbert M. Hull
ARS-USDA
2000 E. Allen Road
Tucson, AZ 85719

Roger G. Humphreys
Stauffer Chemical Co.
5809 Ponce Court
San Jose, CA 95120

Robert F. Husted
2385 St. Catherine
Florissant, MO 63033

Don Hyder
USDA-ARS, Crops Res. Lab.
Colorado State University
Fort Collins, CO 80521

J

Bill Jarvis
PPG Industries
199 California Drive
Millbrae, CA 94030

Arthur O. Jensen
American Cyanamid Co.
106 Las Vegas Road
Orinda, CA 94563

Louis A. Jensen
Extension Weed Specialist
Utah State University
Logan, UT 84322

Thomas N. Johnsen, Jr.
ARS-USDA
Forestry Sciences Lab.
Flagstaff, AZ 86001

Roy Johnson
Amchem Products, Inc.
1727 Butler Pike
Ambler, PA 19002

Warren V. Johnson
Calif. Dept. Water Resources
P.O. Box 388
Sacramento, CA 95802

Blaine Jones
USU Extension Agent
Post Office Bldg.
Nephi, UT 84648

Hobe Jones
Wilbur-Ellis Co.
Box 8838
Portland, OR 97208

Lowell S. Jordan
Plant Sciences Dept.
University of California
Riverside, CA 92502

Donald N. Joy
Uniroyal Chemical
902 Crest Drive
Yakima, WA 98902

K

Paul E. Keeley
U.S. Cotton Res. Station
17053 Shafter Ave.
Shafter, CA 93263

Bud Keerkop
Dept. of Horticulture
Washington State Univ.
Pullman, WA 99163

Robert Kehoe
Chas. H. Lilly/Miller Prod.

W 228 Pacific
Spokane, WA 99203

Felix L. Kelly
South Columbia Irr. Dist.
P.O. Box 96
Mesa, WA 99343

Harold M. Kempen
2610 M. Street
P.O. Box 2509
Bakersfield, CA 93303

Ralph W. Kendell
Power County
Neeley Road
American Falls, ID 83211

Gary W. Kennedy
CIBA-GEIGY
1863 So. Pierson Court
Denver, CO 80226

George S. Kido
Om Scott & Son Co.
Box 2079
Oakland, CA 94604

Francis Kopp
Wilbur-Ellis Co.
P.O. Box 661
Caldwell, ID 83605

Ronald Kukas
Botany Department
University of California
Davis, CA 95616

Elvin L. Kulp
Washington State Univ.
P.O. Box 608
Ephrata, WA 98823

L

Margareta Lambert
Nor-Am
Woodstock, IL 60014

Arthur H. Lange
San Joaquin Res. & Ext. Cent.
9240 S. Riverbend Avenue
Parlier, CA 93648

John Lanigir
Mobil Chemical Co.
6091 N. Poplar
Fresno, CA 93704

E. R. Laning, Jr.
Dow Chemical Co.
1308 Dilloway Drive
Midland, MI 48640

Homer M. LeBaron
CIBA-GEIGY Corp.
Agricultural Div.
Ardsley, NY 10502

Gary A. Lee
Plant Science Division
University of Wyoming
Laramie, WY 82070

W. O. Lee
USDA, Crop Sci. Dept.
Oregon State University
Corvallis, OR 97331

Stanley K. Lehman
Ag. Chem. Lab.
Hercules Inc.
Wilmington, DE 19899

Ron Lichti
CIBA-GEIGY Corp.
1524 Falls Ave. East
Twin Falls, ID 83301

Wayland G. Lilly
Room 429, State Services Bldg.
1525 Sherman Street
Denver, CO 80203

E. H. Littooy
Colloidal Products Corp.
P.O. Box 621
Petaluma, CA 94952

O. J. Lowry
Bureau of Reclamation
Herring Plaza H-4377
Amarillo, TX 79101

M

L. D. MacKellar
Del Monte Corp.
P.O. Box 14130
Portland, OR 97214

Robert D. Martin
Bureau of Land Management
710 N.E. Holladay
P.O. Box 3861
Portland, OR 97208

Phil Martinelli
P.O. Box 1209
Reno, NV 89504

Garry Massey
3M Co.
653 E. Dovewood
Fresno, CA 93710

Richard Maxwell
Ag. Chem. Department
Washington State Univ.
Pullman, WA 99163

John W. May
Shell Chem. Co.
Suite 1000, 500 N.W. Plaza
St. Ann, MO 63074

T. W. Mayberry
Nor-Am Inc.
3941 N. Safford
Fresno, CA 93705

Ken McAfee
Stauffer Chemical Co.
42800 Road 96
Dinura, CA 93618

Thomas T. McClure
EPA Herbicides Standards
1107 Dryden Street
Silver Spring, MD 20901

Martin McGinn
ICI America, Inc.
Wilmington, DE 19899

Jim McHenry
Department of Botany
University of California
Davis, CA 95616

James R. McKenley
Amchem Products, Inc.
1452 N.W. Skyline Drive
Albany, OR 97321

Stanley R. McLane
Amchem Products, Inc.
1241 Horsham Road
Ambler, PA 19002

Edward A. McLaren
Pacoast Chemical Co.
P.O. Box 7277
Sacramento, CA 95826

Bruce McQuire
Davenport Chemicals
Davenport, WA 99122

Robert Menges
USDA, ARS, PSRD
P.O. Box 267
Weslaco, TX 78596

Raymond W. Meter
Wash. State Univ. Extension
Rt. 3, Box 85C
Moscow, ID 83843

Ken Migchelbrink
Monsanto Chemical Co.
7 North 59th Ave.
Yakima, WA 98902

John H. Miller
USDA Cotton Res. Station
17053 Shafter Ave.
Shafter, CA 93263

James E. Mitchell
Diamond Shamrock
8757 Westbrook
Boise, ID 83704

Loren C. Moos
Lincoln County
Rt. 1
Edwall, WA 99008

Irvin Morehouse
Del Monte Corp.
Box 71
Toppenish, WA 98948

Howard L. Morton
Crops Res. Div., USDA
2000 E. Allen Road
Tucson, AZ 85719

T. J. Muzik
Department of Agronomy
Washington State Univ.
Pullman, WA 99163

N

Lyle Nagle
Dept. of Agronomy & Soils
Washington State Univ.
Pullman, WA 99163

Tom Neidlinger
Rohm & Haas Co.
13016 N.E. Pacific Court
Portland, OR 97230

Dick Neilson
PPG Industries, Inc.
1500 EN Irving St. No. 365
Portland, OR 97232

Elray L. Neiman
Nor Am Ag. Products Inc.
P.O. Box 342
Indianola, IA 50125

Russell T. Nelson
704 N. Stadium Way
Tacoma, WA 98403

Michael Newton
Forest Research Lab.
Oregon State Univ.
Philomath Blvd.
Corvallis, OR 97331

Richard L. Nilles
Velsicol Chemical Corp.
7606 F. Summit View Ave.
Yakima, WA 98902

Roy K. Nishimoto
Dept. of Horticulture
University of Hawaii
Honolulu, HI 96822

Robert F. Norris
Botany Department
University of California
Davis, CA 95616

Jack Norton
CIBA-GEIGY
10460 Granger Court
Riverside, CA 92505

Chris R. Nowak
Nor-Am Inc.
20 N. Wacker Drive
Chicago, IL 60606

O

Alex Ogg, Jr.
USDA, Box 30
Irr. Agr. Res. & Ext. Center
Prosser, WA 99350

Floyd Oliver
Bureau of Reclamation
P.O. Box 043, 550 W. Fort St.
Boise, ID 83702

G. Ron Oliver
Niagara Chemical Div.
P.O. Box 1669
Fresno, CA 93717

Phil Olson
Crop Science Department
Oregon State Univ.
Corvallis, OR 97331

Jack P. Orr
University of California
650 Capitol Mall
Sacramento, CA 95680

John E. Orr
BASF Wyandotte Corp.
P.O. Box 7562
Boise, ID 83707

Naman E. Otto
Bldg. 56, Room 128
Denver Federal Center
Denver, CO 80225

P

Robert J. Pace
American Cyanamid Co.
10350 El Morado Court
Boise, ID 83705

Robert Parker
Botany Department
Utah State University
Logan, UT 84322

Walter H. Patch
Wyoming Dept. of Agriculture
2219 Carey Ave.
Cheyenne, WY 82001

Dwight V. Peabody
Research and Extension Unit
1469 Memorial Hwy.
Mt. Vernon, WA 98273

John O. Pearson
Ag. Chem., BASF Wyandotte
Box 181, 100 Cherry Hill Rd.
Parsippany, NJ 07054

Earl Pendell
Spokane County Weed Board
Rt. 2
Cheney, WA 99004

Forrest L. Peters
Chemagro Corp.
1918 Wellington Place
Wenatchee, WA 98801

Frank E. Phipps
Thompson-Hayward Chem. Co.
9880 S.W. Pembrook
Tigard, OR 97223

William Pint
U.S. Forest Service
P.O. Box 2623; 319 S.W. Pine
Portland, OR 97208

Richard A. Piper
6132 Holland St.
Arvada, CA 80004

Pete Poulos
Velsicol Chem. Corp.
341 E. Ohio Street
Chicago, IL 60611

C. L. Prochnow
Stauffer Chem. Co.
11509 N.E. 3rd Ave.
Vancouver, WA 98665

Warren G. Purdy III
L.T.V. Corp.
2345 W. Mockingbird Lane
Dallas, TX 75235

R

Steve Radosevitch
Botany Department
University of California
Davis, CA 95616

Dan W. Ragsdale
CIBA-GEIGY Agr. Chemicals
P.O. Box 12398
Tucson, AZ 85711

D. W. Rake
Gordon Corp.
300 S. Third
Kansas City, KS 66118

A. LaVerl Randall
Monsanto
E. 11905 22nd Avenue
Spokane, WA 99206

Eldon S. Ratcliff
3M Company
3M Center, Bldg. 203
St. Paul, MN 55101

James L. Reed
Shell Chem. Co.
1500 Newell Ave.
Walnut Creek, CA 94596

Howard Rhoads
Crops Science Dept.
Calif. State Polytechnic Col.
San Luis Obispo, CA 93401

Robert C. Rhodes
Rhodes Chemical Co.
P.O. Box 149
Rochester, WA 98579

Paul M. Ritty
The Dow Chemical Co.
4210 Johnson Drive, Suite 203A
Shawnee Mission, KS 66205

Bill Roberson
Salyer Land Company
P.O. Box 863
Corcoran, CA 93212

Laren R. Robison
Agronomy-Horticulture Dept.
Brigham Young University
Provo, UT 84601

W. C. Robocker
Department of Agronomy & Soil
Washington State Univ.
Pullman, WA 99163

James E. Robebush
Stauffer Chem. Co.
P.O. Box 760
Mountain View, CA 94040

Cliff Rollins
McGregor Co.
P.O. Box 769
Colfax, WA 99111

Kent Romney
Amchem Products
3110 Butternut
Loveland, CO 80537

Norman Ronemus
Colloidal Products Corp.
4665 N. Delno Ave.
Fresno, CA 93705

Louie Russo
Sandoz-Wander
1610 W. Sierra
Fresno, CA 93705

George F. Ryan
Washington State University
West. Wash. Res. & Ext. Cent.
Puyallup, WA 98371

Jack Ryder
Dow Chemical
4901 W. 77 Street
Minneapolis, MN 55435

S

Cedric Saario
CIBA-GEIGY Corp.
P.O. Box 3068
Visalia, CA 43277

Joe Sagaser
Velsicol Chemical Corp.
6197 N. Millbrook Ave.
Fresno, CA 93710

Dean Schachterle
Bureau of Reclamation
Bldg. 20, Denver Fed. Center
Denver, CO 80225

Roland Schirman
Department of Agronomy
Washington State Univ.
Pullman, WA 99163

David A. Schmer
University of Wyoming
1418 Custer
Laramie, WY 82070

Dale E. Schroeder
DuPont
Rt. 3, Box 98
Walla Walla, WA 99362

D. T. Schulteis
Applied Biochemists, Inc.
5300 W. County Line Road
Mequon, WI 53092

Edward E. Schweizer
Crops Research Laboratory
Colorado State University
Fort Collins, CO 80521

Allen C. Scoggan
Chemagro Div. of Baychem
8075 Boulder Drive
Boise, ID 83705

Bob Scott
Velsicol Chemical Corp.
E. 8622 Maringo
Spokane, WA 99206

Roger G. Scott
CIBA-GEIGY
547 Monte Vista Drive
Twin Falls, ID 83301

Bob Seabury
Wilbur-Ellis
8 N. 24th Ave.
Yakima, WA 98902

D. E. Seaman
Univ. of Calif. Rice Exp. Sta.
P.O. Box 306
Biggs, CA 95917

Clarence Seely
Department of Plant Science
University of Idaho
Moscow, ID 83843

Bill Senske
Weed & Pest Control
Box 3024
Spokane, WA 99220

Edwin A. Sevcik
U.S. Bureau of Reclamation
Box 280
Casper, WY 82601

Dale Severson
Dow Chemical Co.
W. 2311 16th, Box 282
Spokane, WA 99204

C. A. Shadbolt
Thompson-Hayward Chem. Co.
5200 Speaker Rd., Box 2383
Kansas City, KS 66110

Dexter B. Sharp
Monsanto Chem. Co.
800 N. Lindbergh Blvd.
St. Louis, MO 63166

Clay Shelton
Stauffer Chemical Company
P.O. Box 68
N. Portland, OR 97043

Ned H. Shorey
U.S. Borax
6700 S.W. Griffin Dr.
Portland, OR 97227

H. G. Simkover
Shell Development Co.
Box 4248
Modesto, CA 95352

Ross Singleton
Washington State University
Irr. Agr. Res. & Ext. Center
Prosser, WA 99350

Irvin Skelton
University of Wyoming
2513 Coe, Apt. 253
Laramie, WY 82070

H. Broughton Smith
Nor-Am
20 N. Wacker Drive
Chicago, IL 60606

Leslie W. Sonder
California Dept. of Agr.
1220 N Street
Sacramento, CA 95814

Earl C. Spurrier
Monsanto Co.
800 N. Lindbergh Blvd.
St. Louis, MO 63166

J. Dan Stallings
Amalgamated Sugar Co.
1818 Granada Drive
Twin Falls, ID 83301

Sam Stedman
County Agent's Office
City County Bldg.
Casa Grande, AZ 85222

Herbert Steffen
Dow Chemical Co.
777 106 N.E.
Bellevue, WA 98004

Ray Steiner
Wash. State Dept. Agr.
728 Clover Court
Cheney, WA 99004

Lyle W. Stempke
Central Mont. Res. Center
Moccasin, MT 59462

Ronald E. Stewart
Forest Exp. Station
P.O. Box 389
Roseburg, OR 97470

Vern R. Stewart
N.W. Montana Branch Sta.
Route 4
Calispell, MT 59901

E. F. Sullivan
Agr. Res. Center
The Great Western Sugar Co.
Longmont, CO 80501

Mike Svoboda
IMC
450 W. Mulberry Drive
Phoenix, AZ 85015

T

Fred. R. Taylor
PPG Industries
6170 Kip Place
Riverside, CA 92509

Thomas D. Thompson
So. Col. Basin Irr. Dist.
P.O. Box 96
Mesa, WA 99343

Bruce Thornton
1507 Peterson
Fort Collins, CO 80521

Jack A. Thorsen
Spokane Community College
P.O. Box 578
Davenport, WA 99122

F. L. Timmons
1047 North Carbide
Tucson, AZ 85710

D. C. Tingey
653 E. 4th North
Logan, UT 84321

Paul J. Torell
Parma Branch Exp. Sta.
P.O. Box 40-A, R.F.D. No. 2
Parma, ID 83660

V

Dick Van Deusen
Chemagro
4515 S.W. Corbett
Portland, OR 97201

W

Keith E. Wallace
WSU Ext. Service
W. 1116 Broadway
Spokane, WA 99201

Lloyd C. Warner
Eli Lilly & Co.
240 East Braemere Rd.
Boise, ID 83702

Jack Warren
Chemagro Corp.
3 North 7th Ave., Suite B
Yakima, WA 98902

L. E. Warren
Dow Chemical Co.
Rt. 1, Box 1313
Davis, CA 95822

Bryant Washburn
Washburn Agr. Service
Route 1, Box 2650
Davis, CA 95616

Joseph C. White
Chevron Chemical Co.
1052 East Shaw Ave.
Fresno, CA 93726

J. Wayne Whitworth
P.O. Box 3Q
New Mexico State University
Las Cruces, NM 88001

Carroll E. Wilcomb
1450 S. 22nd East
Salt Lake City, UT 84108

Walter E. Willard
Wheatland Ag. Chemicals
P.O. Box 3434
Spokane, WA 99220

Jim Wilkerson
Thompson-Hayward Chem. Co.
P.O. Box 3530
Visalia, CA 93277

M. Coburn Williams
Botany Department
Utah State University
Logan, UT 84322

Robert A. Williams
Extension Service
Box 536
Walla Walla, WA 99362

Robert W. Wocknitz
Stauffer Chem. Co.
P.O. Box 760
Mountain View, CA 94040

V. W. Woestemeyer
Agr. Res. & Dev., U.S. Borax
412 Crescent Way
Anaheim, CA 92801

Z

Ben Zamon
Department of Agron. & Soils
USDA, Wash. State Univ.
Pullman, WA 99163

Robert L. Zimdahl
Weed Research Lab.
Colorado State Univ.
Fort Collins, CO 80521

Jim Zorns
Gulf Oil Chem. Co.
S. 5520 Magnolia
Spokane, WA 99203