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M I N U T E S

EIGHTH ANNUAL WESTERN WEED CONTROL CONFERENCE

CHAMBER OF COMMERCE ROOMS
STATE BUILDING
RENO, NEVADA

February 26 and 27, 1946

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State Building
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B. E. Kuhns, Chairman
Walter S. Ball, Secretary

Tuesday, February 26
Morning Session

The meeting was called to order at 9:30 a.m. by Chairman B. E. Kuhns

Mr. S. B. Doten, Director of the Nevada Agricultural Experiment Station, University of Nevada, made a few remarks and introduced Dr. Cecil W. Creel, Dean of Agriculture and Director of Agricultural Extension for Nevada, who extended the members and guests of the Western Weed Control Conference welcome and greetings in behalf of Governor Vail Pittman and of the University of Nevada and all its agricultural departments. Dr. Creel also commented upon the importance of weed control activities as affecting the ability of the United States to produce the foodstuffs which we shall be called upon to supply for home consumption and for relief purposes in war-torn countries abroad.

Roll call of members by Mr. Ball:

States Represented	Official Representative
California	Walter S. Ball, State Department of Agriculture
Colorado	Bruce J. Thornton, Experiment Station, Colorado A & M
Idaho	B. E. Kuhns, Extension Service, Idaho State College
Montana	H. E. Morris, Botany Department, State College
Nevada	Lee Burge, State Department of Agriculture
Oregon	V. H. Freed, Experiment Station, State College
Utah	George L. Hobson, State Department of Agriculture
Washington	E. J. Kreizinger, Extension Agronomist, Washington State College
Wyoming	George B. Harston, State Department of Agriculture
Arizona	--- ---
New Mexico	--- ---

It was moved by Mr. Bruce Thornton, seconded and carried that the reading of the minutes of the Seventh Annual Western Weed Control Conference should be dispensed with.

Rotary roll call of persons present:

The following persons introduced themselves:

William Abilgaard, Food Machinery Corporation, San Jose, California
Wayne Adams, Department of Foods and Drugs, University of Nevada, Reno
Archie R. Albright, Washoe County Extension Service, 57 Sierra, Reno, Nevada
Archie R. Aldridge, APCO Corporation, 1513 South Grand Ave., Los Angeles, Calif.
Charles E. Allen, State Seed Laboratory, University of Wyoming, Laramie, Wyoming
G. M. Baker, APCO Corporation, Mendota, California
Robert B. Balcom, Bureau of Reclamation Agronomist
Walter S. Ball, Chief, Bureau of Rodent and Weed Control and Seed Inspection, State Department of Agriculture, Sacramento, California

L. M. Barnes, F. M. Speekman Company, 975 Folsom Street, San Francisco, California
John M. Bazzini, Reno, Nevada
W. L. Belfield, County Weed Supervisor, Burley, Idaho
M. J. Benjamin, Van Waters & Rogers, Inc., Spokane, Washington
Bob Bennyhoff, United Press, Reno, Nevada
Adam H. Blackstock, Owyhie County, Murphy, Idaho
A. E. Bonn, Van Waters & Rogers, Inc., Seattle, Washington
Virgil L. Bottini, U. S. Grazing Service, Reno, Nevada
Mrs. Bovett, Nevada State FarmBureau, Reno, Nevada
Luntis Bowser, Bureau of Reclamation, Region III, Boulder City, N.J.
Burleigh B. Boyer, The Cloroben Corporation, 1960 Santa Fe Avenue, Los Angeles 21
Art Bronson, Agricultural Division, U. S. Rubber Co., 1230-6th Avenue, New York
Thomas Buckman, Extension Service, University of Nevada, Reno, Nevada
Ted Bull, Growers Service Co., Watsonville, California
Lee M. Burge, State Department ofAgriculture, PO Box 1027, Reno, Nevada
O. U. Butler, Wm. T. Thompson Co., 1960 South Santa Fe Ave., Los Angeles, California
Frank Campbell, Assessor, 325 Maple Street, Reno, Nevada
Les Cleasby, Aeroil Products Company, 435 Bryant Street,San Francisco, California
Donald R. Cliff, Washoe Valley, Carson City, Nevada
Jack Cliff, Churchill County, New Fallon, Nevada
Norman Cliff, Washoe Valley, Carson City, Nevada
Charles Cody, California Spray Chemical Corporation, 2109 North Albina Street, Portland, Oregon
V. A. Cox, County Weed Supervisor, Box 576, Meridian, Idaho
A. S. Crafts, College of Agriculture, Davis, California
Cecil W. Creel, Dean of Agriculture, University of Nevada, 841 Washington Street, Reno, Nevada
Harold Curran, U. S. Grazing Service, Reno, Nevada
Wynn L. Davis, Brigham City, Box Elder County, Utah
Mary H. Donlin, Nevada State Journal, Reno, Nevada
S. B. Doten, Agricultural Experiment Station, Reno, Nevada
Ted Edholm, Gooding County, Idaho
Jerome Evans, 312 Capitol Boulevard, Boise, Idaho
R. J. Evans, Utah State Agricultural College, Logan, Utah
Thomas Farrell,American Chemical Paint Company, Ambler, Pennsylvania
Mrs. Margaret C. Feast, U. S. Bureau of Reclamation, Reno, Nevada
C. E. Fleming, Nevada Agriculture Experiment Station, University of Nevada, Reno
A. J. Flebut, Niagara Sprayer & Chemical Company, Inc., 339-9th Street, Richmond California
Allen Flock, James Mills Growers Service, 558 Sacramento Street, San Francisco
V. H. Freed, Oregon Experiment Station, Oregon State College, Corvallis, Oregon
H. E. Gallaway, State Department of Agriculture, PO Box 1027, Reno, Nevada
Louie A. Gardella, Extension Service, Yerrington, Nevada
Robert Gardner, Gooding, Idaho
Dr. Gianella, Bureau of Mines, Reno, Nevada
A. P. Gibbo, Essick Manufacturing Co., 1950 Santa Fe Avenue, Los Angeles
Howard J. Grady, California Spray Chemical Corporation, 2109 North Albina Street, Portland, Oregon
Kenyon Greene, Twin Falls County, Twin Falls, Idaho
W. E. Greene, Klamath Basin Weed Control, Tule Lake, California
Jack Greenwalt, Purina Mills, Idaho Falls, Idaho
J. N. Grimes, Twin Falls County Weed Director, Twin Falls, Idaho
T. C. Hagerty, Klamath Basin Corporation, Tulelake, California
Andrew C. Hansen, County Weed Supervisor,St. Anthony, Idaho
H. L. Hansen, Douglas County Extension Service, Minden, Nevada
Lin E. Harris, 6200 N.W. St. Helens Rd., Chipman Chemical Co., Portland 10, Oregon
M. M. Harris, Braun-Knecht-Heimann Co., 1400 - 16th Street, San Francisco, Calif.
George B. Harston, State Entomologist, Powell, Wyoming
P. V. Harrigan, Glenn County Agricultural Commissioner, Willows, California

M. R. Miller, University of Nevada, Reno
W. A. Harvey, Botany Division, University of California, Davis, California
W. D. Hay, U.S.D.A. Seed Technologist, State Office Bldg., No. 1, Sacramento
B. F. Headley, Experiment Station, Reno, Nevada
Mr. Hendreschke, County Pest Inspector, Farson, Wyoming
D. K. Hendry, County Weed Supervisor, Jerome, Idaho
Frank B. Herbert, Shell Agricultural Laboratory, Modesto, California
George Hersley, Idaho Department of Agriculture, Boise, Idaho
George L. Hobson, Weed Supervisor, State Department of Agriculture, 412 State Capitol, Salt Lake City, Utah
J. E. Horgan, Commercial Hardware Company, Reno, Nevada
J. W. Howard, County Agent, St. Anthony, Idaho
Reg Howard, U. S. Bureau of Reclamation, Sacramento, California
D. L. Huey, County Weed Supervisor, Gooding, Idaho
C. W. Jensen, County Weed Supervisor, Rexburg, Idaho
Wilford L. Jensen, Madison County Superintendent, Rexburg, Idaho
Harry H. Jucksch, Wheeler, Reynolds and Stauffer, 636 California St., San Francisco
Fred Kennedy, U. S. Forest Service, Reno, Nevada
Stewart Kern, U. S. Grazing Service, Reno, Nevada
J. W. Kintner, County Weed Supervisor, Idaho Falls, Idaho
E. J. Kreizinger, Extension Service, Washington State College, Pullman, Washington
B. E. Kuhns, Extension Division, University of Idaho, State House, Boise, Idaho
Oliver A. Kurtz, California Spray Chemical Corporation, 4850 Stockton Blvd., Sacramento, California
Hugh C. Landes, Food Machinery Corporation, San Jose, California
Keith Lee, Nevada Nile Ranch, Lovelock, Nevada
Prof. P. A. Lehenbauer, Professor of Botany, Reno, Nevada
Max Lecnard, Braun-Knecht-Heimann Company, 1400 - 16th Street, San Francisco
Clayton L. Long, Regional Agronomist, Bureau of Reclamation, PO Box 937, Boise, Idaho
M. A. Lyman, Idaho State Department of Agriculture, Boise, Idaho
Edwin Lee, Bureau of Reclamation, Exchange Place, Salt Lake City, Utah
E. A. Madsen, State Department of Agriculture, Salt Lake City, Utah
John T. Maletic, Bureau of Reclamation, Region 7, 522 Continental Oil Bldg., Denver
P. Malone, Nevada Extension Service, Reno, Nevada
Warren G. Marshall, Bureau of Chemistry, State Department of Agriculture, Sacramento
V. L. Martinean, County Agricultural Agent, Salt Lake City, Utah
Frank McKennon, State Department of Agriculture, Salem, Oregon
W. H. Mercer, U. S. Bureau of Reclamation, Region 5, Las Cruces, New Mexico
J. M. Mills, James Mills Growers Service, 558 Sacramento Street, San Francisco
E. V. Molander, Twin Falls, Idaho
Nic Monte, U. S. Division of Grazing, Reno, Nevada
Willis T. Moran, U. S. Bureau of Reclamation, Denver, Colorado
H. E. Morris, Montana State College, Bozeman, Montana
Howard Mosor, University of Nevada Agricultural Experiment Station, Reno, Nevada
R. E. Murray, California Pest Control Company, 730 Clementina Street, San Francisco
A. B. Nielsen, U. S. Engineers, Fort Douglas, Utah
H. E. O'Harra, U. S. Indian Service, Stewart, Nevada
H. R. Offord, U. S. Bureau of Entomology and Plant Quarantine, 26 Giannini Hall, University of California, Berkeley, California
A. T. Olsen, Farm Bureau, 49 West 4th Street, Winnemucca, Nevada
Chester E. Otis, Oregon State College, Corvallis, Oregon
Elwood Oxborrow, College of Agriculture, University of Nevada, Reno, Nevada
William B. Parker, California Spray Chemical Company, Richmond, California
David A. Prendergast, The Dow Chemical Company, 310 Sansome Street, San Francisco
J. K. Primm, E. I. DuPont de Nemours Company, San Jose, California
Clegg Raymond, County Commissioner, McCammon, Idaho
R. N. Raynor, The Dow Chemical Company, Pittsburg, California
Al Reed, Agricultural Extension Service, Lovelock, Nevada
William Pedroli, Washoe Valley, Carson City, Nevada
Edward C. Reed, Production and Marketing Administration, USDA, Reno, Nevada

J. F. Renfrow, J. F. Renfrow Company, Gooding, Idaho
H. B. Reynolds, County Weed Supervisor, Rupert, Idaho
Fred M. Righter, Pacific Coast Borax Company, 1520 Sansome Street, San Francisco
W. W. Robbins, University of California, Davis, California
F. J. Roberti, Fernly, Nevada
G. C. Schweis, State Department of Agriculture, Reno, Nevada
Alvin Schwendiman, Utah State Department of Agriculture, Salt Lake, Utah
Otto R. Schulz, Extension Service, Reno, Nevada
H. Clay Scott, Bureau of Reclamation, Billing Office Region 6, 605 South Hower Street, Fort Collins, Colorado
C. I. Seely, Department of Agronomy, University of Idaho, Moscow, Idaho
E. A. Settelmeyer, Reno, Nevada
Charles J. Sheeran, College of Agriculture, University of Nevada, Reno, Nevada
Mark A. Shipley, Agricultural Extension Service, Reno, Nevada
W. A. Simanton, Shell Oil Company, Inc
Keith Sime, Chipman Chemicals, Inc., 6200 N.W. St. Helens Road, Portland, Oregon
Kirt Skinner, Van Water and Rogers, 2133 Northwest York, Portland, Oregon
O. F. Smith, Bureau of Plant Industry, U.S.Department of Agriculture, Reno, Nevada
M. B. Smith, Route 2, Pocatello, Idaho, County Weed Agent
Howard N. Snyder, APCO Corporation, 1513 Southern Grand, Los Angeles, California
A. Stark, Wasatch Chemical Company, Salt Lake City, Utah
A. A. Stiele, Albert Dickenson Seed Company, Nampa, Idaho
T. P. Strand, California Spray Chemical Company, Richmond, California
Stanley Strew, Chipman Chemical Company, Bay Road, Ravenswood, Palo Alto, California
F. L. Timmons, Hays Experiment Station, USDA, Hays, Kansas
Professor Louis Titus, College of Agriculture, Reno, Nevada
La Var W. Thatcher, Wasatch Chemical Company, Salt Lake City, Utah
William T. Thompson, William T. Thompson Company, 2727 Hyperion Avenue, Los Angeles 27, California
Bruce J. Thornton, Colorado Experiment Station, Fort Collins, Colorado
Ben Tomlin, Chaney Wholesale Company, Fruitland, Idaho
R. W. Underhill, Dow Chemical Company, 310 Sansome Street, San Francisco,California
George Van der Hoff, Supervisor Owyhee County Weed Control, Homedale, Idaho
L. R. Vawter, Vet. Science Control, University of Nevada, Reno, Nevada
Warren J. Welch, College of Agriculture, University of Nevada, Reno, Nevada
W. A. Westgate. Standard Agricultural Chemical Company, Forum Building, Sacramento
J. E. White, Indian Service, Department of the Interior, Salt Lake City, Utah
Ray Whiting, County of Weber, Ogden, Utah
B. D. Wilbrand, Jr., F. M. Speekman Company, 975 Folsom Street, San Francisco
Forrest M. Willhite, USDA, Fallon, Nevada
T. F. Yost, State House, State Weed Supervisor, Topeka, Kansas
Andy Young, Lovelock, Nevada
A. W. Young, APCO Corporation, 1513 South Grand Avenue, Los Angeles, California
Harold B. Scheiferstein, Supervisor, Klamath County Weed Control

REPORT OF THE TREASURER:

1944 Balance Forwarded		$ 377.20
1945 Collections		180.00
Expended for stamps, supplies, bank service charge..	$ 34.60	
Expenses of Walter S. Ball at North Central States Weed Control Conference at St. Paul	143.00	
Balance on hand	379.00	
	$ 557.20	$ 557.20

It was moved by Mr. Kenyon Green and seconded by Mr. A. S. Crafts, and carried that the Treasurer's report should be accepted as read.

MR. HARVEY: I would like to bring up at this time the matter of individual memberships or registration fees to help defray the cost of mimeographing and distributing minutes of the meetings.

MR. BALL: Some time ago this question arose and the Executive Committee stated that if we needed more money it should be requested from the official representatives. In other words, if this $15 is not sufficient so far as the State representatives are concerned, we should step up the dues to $25 annually, the reason being that the States pay dues from State funds and these funds, being public, should be adequate for all residents of that State who are interested in attending the conferemce and receiving the minutes.

MR. BALCOM: If you have any suggestions for paymemt of dues by other than State organizations attending the meeting, we should like to have them. We would like some way of paying for at least the expemse of the annual minutes which we like to receive.

DR. EVANS: I had some correspondence from the Forest Service stating that the U. S. Forestry people thought they should become members. I have been just a little dubious as to what arrangements can be made to make collections from Federal set-ups for dues. Now if that is provided in your organization, I think it would be a very good idea for us to have Federal members and I think that that might be brought up in our Executive Committee meeting. I think they would add quite a lot to our organization.

CHAIRMAN KUHNS then asked for reports of State Delegates.

WYOMING WEED REPORT -- Dr. George B. Harston:

The general Wyoming weed control program has not changed appreciably since the last Western Weed Control Conference with the exception of the increased interest in 2,4-D products.

County weed control organizations have continued with their clean cultivation programs which were in progress, but no expansion in this practice occurred. When Atlacide became available, in the latter part of 1945, the counties obtained two carloads for fall application. They also found a small demand for carbon disulphide, sinox and ammate. Burning and the use of oils for seed control continued in most of the counties having weed control programs. The use of agricultural mesh borax continued. Borascu was more popular and gave good results when it was applied when and where the snow, rain or irrigation water slowly dissolved the borax and carried it into the soil.

The Bureau of Reclamation has shown increasing interest in the weed problem on their projects. In addition to the actual control work as an operations and maintenance program, they have shown active interest and given cooperation in the educational work in the State.

Local officials of the Indian Service are very interested in the alarming spread of the noxious weeds on Indian Lands, but have been unsuccessful in precipitating action from Washington. The Indian land weed menace represents a serious problem in Wyoming.

The University Experiment Station did some experimenting with 2,4-D products on dandelions; but, it is regrettable that the data was not made available in a written form for the State representatives to present at this conference.

Field tracts treated with 2,4-D products were observed throughout the season by State Department of Agriculture personnel. These observations will likely

be brought out in the panel discussion this afternoon.

Landowners throughout the State were enthusiastic about 2,4-D products. This seemed to be partially due to the publicity given the products; and, also to favorable results obtained from their personal application of the products. Although the State Department has not recommended 2,4-D, because of the need for further experimental information, many individuals purchased it for personal use -- outside the county program.

Our control and eradication expenses are carried equally by the State, the County and the landowner. Never have State and County funds been adequate to permit work on all farms needing weed control. Those working closely with the problem for several years are now advocating that the State should spend their funds on State-owned property; the County funds should be spent on county-owned property and the landowner should stand the total expense on his property. The need is being felt for weed control operators acting as private contractors with equipment, training and facilities which the average landowner does not have and cannot afford to obtain privately.

A change of the Wyoming State Seed Analysts has occurred since the last Western States Weed Control Conference. Although we regretted the loss of the former analyst, Mr. Lambert C. Erickson who went to Idaho, we are fortunate in obtaining the services of Mr. Charles Allen who is starting where Mr. Erickson left off and proceeding to build up on the foundation of a good seed laboratory. This laboratory is considered to be vital in the fight against noxious and common weeds.

In accordance with the decision at the last conference the Wyoming representative furnished his Congressmen with a copy of the resolutions pertaining to the weeds on Federally-owned lands. A favorable reply was received from all the Congressmen. Senator C. V. Robertson presented the problem to the Secretary of Agriculture, Clinton P. Anderson. The reply from Mr. Anderson's office expressed an interest in the weed problem and suggested a more thorough study by Federal, State and farmer organizations.

WASHINGTON WEED REPORT -- E. J. Kreizinger:

Weed control work in Washington is developing at a progressive, increasing rate and farmers are becoming more interested in their control.

At the present time there are eleven of the thirty-nine counties in Washington in which there are weed districts or weed extermination areas organized. Several more are in the process of organization. Some of the areas are organized on a county-wide basis while others are limited to certain isolated areas. It is the hope in developing the districts that the natural drainage or watershed areas can be recognized and weed control developed for the entire area affected.

Bindweed, Canada thistle, Russian knapweed and whitetop are the weeds receiving major attention at the present time. New work is being initiated by the experiment station this year on Klamath weed.

The various types and kinds of chemicals used for weed control are being tested on various weeds and also on these weeds at various stages of maturity.

REPORT OF THE SUBCOMMITTEE ON WEEDS TO THE NATIONAL ASSOCIATION'S PLANT INDUSTRY COMMITTEE -- Memphis, Tennessee, November 1945 -- Hon. Fred J. Martin, Chairman, Department of Agriculture, Olympia, Washington.

Several states have passed laws and have set up fairly good constructive weed programs. However, the majority of the states have inadequate weed control programs or no program at all. Too often, however, action is taken by a state legislature setting up provision for inspection and control without appropriating ample funds to carry out the enforcement for these purposes.

Most of the state weed control programs now in operation follow along the same general lines as the weed control program in the State of Washington. The Washington law makes it possible for 50 per cent of the landowners in any area by mutual agreement to form a weed control district or a weed extermination area. This method of forming weed control districts was adopted on the theory that any public program to be effective must have the wholehearted support of the group affected if it is to accomplish definite results. The law provides for the proper financing and enforcement of weed control practices decided upon by the group concerned within the area. It also makes possible the formation of an area of any size from one section to a whole county. It has worked fairly effectively where it has been tried out and it is now being used in several counties. The law provides for the inclusion of public rights of way, for Federal, State and County lands. These inclusions are necessary in any weed control program because of watersheds or other means of re-infesting land where weeds have once been eradicated.

There are several weaknesses in the Washington law which is true of the weed laws of other states. It does not provide for definite coordination with the existing seed law, nor does it provide for control of the movement of livestock from weed infested areas through weed control areas. It also fails to provide for prevention of the movement of vehicles along public highways carrying weed infested materials. Also there are no regulations regarding the sale or movement of weed infested feed grains.

In many cases the cost of eradication of weeds on the more marginal types of land would be greater than the value of the property on which the weed eradication program might be carried out. It, therefore, would seem that the eradication of weeds must of necessity be a long range program.

The constant increase and wide distribution of noxious weeds constitutes a very serious menace to the farming industry of the United States. Almost all lands in all the states are infested with one or more varieties of noxious weeds. Infestation is spreading rapidly causing a tremendous loss to the farmers each year.

Several years ago the Agricultural Service Department Committee of the United States Chamber of Commerce made a survey of the weed conditions and reported that noxious weeds caused the farmers of the United States to lose each year $3,000,000,000 in crops. The loss probably is much greater at the present time due to the increasing weed infestation and the increased value of farm crops.

It is apparent that noxious weeds cause greater loss to the farmers than all livestock diseases, plant diseases, and insect pests put together. While all farmers realize the menace of noxious weeds, many seem to have an apathetic attitude toward the problem of weed control. We believe the reason for this is weed infestation has developed slowly over a period of many years and many farmers seem to believe nothing can be done about it, and that weeds are just something they have to put up with. This undoubtedly is the reason why there has been no great demand on the part of the farmers for an aggressive Federal-State Weed Control Program in past years.

If some new livestock disease or a new plant disease or insect pest should develop that took even a fraction of the toll that noxious weeds do, we believe that the farming industry would be very vehement in their insistence that control measures be taken by the federal and state Departments of Agriculture immediately. However, at the present time, more farmers are coming to realize that the noxious weed problem is one that must be solved and that some method of control be developed if we are to save hundreds of thousands of acres of good farm land in this country from complete infestation.

If extensive control measures can be carried out, it will result in greatly increased yields of practically all crops and will increase farm income several billions of dollars. What is more important, it would lower the cost of farm production which will be the most important single factor in successful farming in the future.

It appears that the logical approach to the problem would be that of weed control in the more productive farming areas, of course, with complete weed eradication some time in the future as the end in view.

A weed control program must of necessity be a long-time program (necessary for the control of perennial weeds). When established in any state, section or nationally, it should be set up to extend over a long period of time -- not just one or two years and then neglected. If neglected after such a short period, the money spent on the initial investment is entirely wasted.

Recommendations

It is unanimously agreed among those who have made a study of noxious weeds that there is a critical need for a strong, aggressively administered, and fully financed National Weed Control Program.

It is further agreed that the United States Department of Agriculture should create within the Bureau of Plant Industry, a Weed Division to deal with the various phases of the nation's weed problems and extend its research, investigations and experiments with noxious weeds on a national scale to assist in developing the most efficient and economical methods of control and eradication.

1. Research: First and undoubtedly the most important approach to an adequate solution of the weed problem is through research. It is agreed that Congress should appropriate sufficient funds to carry out such a program. Federal research should be expended to better cover all the states, and state research should be conducted on a uniform and correlated basis with federal projects where possible.

An intensive research program is especially necessary now that the field of organic chemistry is being tapped for herbicides and more complex materials are being used than has been true in the past. These studies require the work of plant physiologists, plant chemists, soil chemists and others in the field of research to work out in detail all that can be learned relative to the various chemicals and their reactions on plants and soils, in order that basic information can be developed and passed on to field workers for practical application.

2. Education: Second and equally important is a program of education. Education in weed control has generally been lacking throughout the United States. There are certain outstanding examples, however, which do prove that an educational program is most helpful and in many cases necessary in order that the farmers may come to know the more serious weeds and in order that the results of research can be properly applied. It is not only important to educate the farmer and the stockman, but also those from all industries which have to do with agriculture, including

financial interests, and others who have either a direct or an indirect part in the agricultural field.

It is felt that the office of Experiment Stations in the U.S. Department of Agriculture should employ a weed specialist who could work with the various states to promote better research, educational methods, and laws in weed control.

3. Control Practices: Following the research and educational program, control practices can be more understandingly developed and utilized. Past experience has proved that thousands of dollars have been lost due to the lack of proper research, proper education, and proper application. In order to carry out a successful weed control program, it is necessary that all three of these steps be given equal consideration. This can best be done where good organizational work will coordinate and correlate the fundamental factors so that all interested individuals and groups concerned are cooperating to the same ultimate goal, namely: suppression of noxious weeds.

4. Regulation: Regulation is necessary in many of the fields of pest control and there is no exception as far as weed control is concerned. So long as large areas of the United States are being farmed by tenant farming, regulation is going to be necessary in many instances to complete a weed control program in any given area or county. Formation of legal districts and areas have been used to some extent in various parts of the country, and in most cases when founded upon an adequate law has been found to be successful. Some states follow a pest abatement procedure for weeds (e.g. State of California) which is similar to the clean-up method utilized against insect pests, plant diseases and rodents or other pest animals. Regulation relative to the movement of infested commodities, especially crop seeds, feed grains and inspection of incoming lots of seeds or plants is most essential.

Conclusions

Fundamentally, this Subcommittee on Weeds believes the foregoing to be the basis on which an overall weed program should be organized, whether it be state, sectional, or national. Further, in order to carry through a successful long-time program, the organization of all forces to work cooperatively and coordinately is very important. The program must, as stated previously, be strong, aggressively administered, and adequately financed.

UTAH WEED REPORT -- George Hobson:

Weed Eradication Report

At the close of 1945 we will have released out of the cultivation program 31,600 acres of land upon which White Top, Wild Morning Glory, Canada Thistle, and Russian Knapweed make up the major portion. In most cases, this land has been kept reasonably clean since its release. Some, however. has been allowed to re-infest almost as badly as in the beginning. The amount that has been improperly handled would approximate about 8%. The land proper has not been neglected as much as fence lines, canals and ditches running through and bordering the areas. Landowners cannot be given full blame for this condition because in the past three years chemicals have not been available for proper treatment. One of the most important factors that has contributed to the continuation and effectiveness of the weed project is the large crops produced on these lands. Usually the amount produced as against former years has been from one-third to one-half more; this extra increase justifying the expense of eradication.

We are looking forward in the future years to a very much reduced number of areas in cultivation due to the effective possibilities of the new chemical

2,4-D. This chemical has been so widely advertised that landowners are willing to take a chance on the use of 2,4-D in preference to cultivation. It may or may not take the place of cultivation when all of the factors with reference to its effectiveness are known.

Cultivation -- The lowest acreage in the past five years have been cultivated this season, which acreage is 6,210 acres. About 1,500 acres less than in 1943 and 1944. The reduced amount has not been because of the introduction of new chemicals but from a desire upon the part of the landowners to utilize the land while the prices of farm produce is bringing an attractive price. Another factor affecting reduction in acres is that counties have had difficulty in prodiving equipment and manpower to cultivate the acreage available. If the late spring and cold weather has not permitted the plants to restore their root system, we are looking forward to the 1945 cultural program being the best of any previous year. In some former years we have attempted to cultivate more land than we should properly cultivate with the amount of equipment available. This year, the load has been about the proper amount. With few exceptions all counties have had more land offered for cultivation than the counties were willing to accept. We expect to open the 1946 season also with more land available than can be handled.

Chemicals -- Chemicals have been very scarce. To date only 1,500 drums have been available; the bulk of which has gone to Boxelder, Weber and Cache counties. Five hundred drums were distributed to the balance of the counties. This amount was only about one-third that the program would require. However, beginning the latter part of October and continuing the balance of the year, we should get another 1,500 drums. Except for the control of seeds, scarcity was not too serious because it is much more effective applied in the fall or early winter. Supervisors have been advised to stake off areas so that when the chemical is available, they will be able to locate areas to be treated. Borax and carbon bisulphide have been available throughout the season in any quantity desired, but because of the excessive amount of labor required in the application of the latter, very little has been used in comparison with former years. In fact, considerable will be held over by a number of the counties until next season.

The New 2,4-D Chemical -- The new chemical known as 2,4-D has been used quite extensively in Weber, Salt Lake and Millard Counties. However, nearly all counties have experimented with it in limited amounts. Results have varied from 20% to 100% eradication and it has been used on many of the troublesome weeds as well as noxious ones. It has been found to be quite as effective as advertised. It is more effective on plants which are at their greatest degree of growth and activity and which have sufficient foliage to absorb enough of the chemical to kill the plant. Plants do not reach their most active growth until the approach of warm weather. The 70 degree temperature and above does assist the plant in acquiring its most active growth. We have not found temperature to be too important for any other purpose. Plants which have developed beyond the blossom stage react much slower to the chemical and when the weeds are developing seed and ripening, it is almost ineffective. Plants out in the early part of the season and having produced second growth respond to the effectiveness of the chemical as well as first growth. Plants becoming too old, can be cut in the earliest part of the season, and successful kills can be made any time from the first of June until the latter part of August. In low altitude areas, the time may be extended to September 15th, provided at this time there is sufficient second growth to absorb enough material. The second growth should approximate half the size of a normal plant. There has not been too much difference in the eradication effectiveness of Wild morning glory and White top when the blossom time on each has been properly observed. Some importance should be given to plants being subjected to considerable sunlight. This may not be so important in the long-run but in short experience, this would seem to be the case. Best kills have been obtained when the plants are in isolation. Excessive growth seems to hinder the

effective coverage of the plants by the chemical. Also competitive plants do not allow sufficient growth so that the plant can absorb all of the chemical necessary. In some cases, rain following too soon after application has hindered effective kills while some have just completed the application when rains have driven them out of the fields and yet have experienced 100% kill. It would seem that when plants are at their best in active growing conditions, the plant begins absorbing the chemical at once. Some failures have occurred by walking through the plants before the spray has dried off. It is quite easy to shake 50% of the solution off.

Future Recommendations on the Use of 2,4-D

Experience with 2,4-D and results obtained this season justify recommending its use in 1946 on the following basis:

1. That counties order 2,4-D in large enough quantities to justify the purchase of power spray equipment for general use in the program and also to make available small individual spray pumps for sale to private landowners.

2. That orders be placed as early as possible so that this State may be ahead on the heavy demand there will be for its use.

3. That counties determine conditions under which it can be used such as cost of application, cost of the raw material to individuals, etc.

4. That power equipment be provided or rented in view that it will be in readiness by the 15th of May or earlier.

5. That a study be made of the proper power and hand equipment for the benefit of counties and individuals who desire to provide such equipment.

6. That where possible, land be ploughed and smoothed and all other growth removed before treatment.

7. That where possible, cultivated land in its second year of cultivation be treated on the spotted infestation which has not been eradicated in the process of cultivation. This practice may be tried also at the close of the first year's cultivation if the land was properly prepared in the falltime preceding.

8. That we do not abandon the use of chemicals previously used in eradication. Even if 2,4-D is successful, there will be plenty of ways where it will be advisable to use the old chemicals.

DR. EVANS: We haven't anything by way of completed experimental data. Our weed man, who had been loaned to the Bureau of Plant Industry for war work on the guayule project, returned late in the season and, although he has set up some rather extensive experiments, they have not been completed at this time. We plan now to set up a lot of work in the Spring; a really thorough test, and it is my impression that if we go ahead on this schedule we will be able to give a good report at the next meeting.

OREGON WEED REPORT -- V. H. Freed:

In this past year considerable interest in weed control has been evinced by the farmers of Oregon. In the county farm planning conference of the past winter, weed control received a good deal of attention. Some of the conferences had special committees on weeds, and in others the crop committee handled this phase of the work. It is the purpose of these conferences to make plans for the agriculture of the county to best fit in with the times. Under weed control, these conferences made certain plans for the post-war era, aiming at more active weed

control work in their localities.

While many of our counties now have very active weed control programs, more counties are now entering the picture. The extension service of the college has been carrying on educational work on weed control and will probably devote more time and energy to this part of their program in the future.

In the research field, we have, of course, devoted a good deal of attention to 2,4-D this past year. It has been tried on a number of different plants with varying degress of success. We have found this material to fit in quite nicely as a selective herbicide on grains and grasses, but we feel that there is still considerable work to be done on the material before final recommendations can be made for it as a general toxicant on pernicious perennial plants.

One of the things which we consider a major achievement for the year was the establishment of a gorse control experiment sub-station. This is being financed by match money of the state and counties involved. Both chemical and cultural methods of control will be studied as well as a combination of the two. We are attempting to evaluate some of the new chemical herbicides as well as finding new uses for some of the older ones. Work on the chlorinated hydrocarbons as soil fumigants has proved satisfactory. This, in brief, summarizes the progress of Oregon's weed control program.

MONTANA WEED REPORT -- H. E. Morris:

Weed Control Work in Montana - 1945

Weed control work in Montana is carried out under two distinct programs:

(1) Under a definite county program in which legalized weed control districts are created. The weed program is authorized by a board of three Weed Supervisors and the field work supervised by a field man selected by the supervisors.

(2) Under the regulations of the State A.A.A. Committee, in which certain allowances are made for various procedures.

In January, a two-day meeting was held in Bozeman for Weed Supervisors and field men. Almost 100 persons attended this meeting and the general opinion of the group was that such meetings should be held occasionally in order to coordinate more closely the control work of the counties. Suggested amendments to the weed law were also discussed at the meeting. In general, however, these amendments were considered of a minor character. In 1945, eighteen counties appropriated $136,484 for weed control work; the largest county appropriation was $31,316 and the smallest $237. Eight counties appropriated $7000 or more. Approximately 463,500 pounds of chlorates, 2700 gallons of carbon disulphide, 44,000 pounds of borax, and 40,000 gallons of crude oil for searing and spraying were used in weed control; 18,228 square rods were treated with 2,4-D, 26,000 acres were under cultivation, and 4000 acres were turned back for growing crops.

Montana has 38 weed control districts in 17 out of the 56 counties. The districts comprise more than 3½ million acres.

Recently two counties have organized on a county-wide basis, and the trend appears to be for this form of organization.

The progress in weed control has been steady since 1940. County appropriations have doubled; the use of chlorates and borax has materially increased; the use of carbon disulphide has remained steady; searing and burning reached a peak

in 1941 and 1942 and rapidly declined. Acres under cultivation have steadily increased. The weed control districts have increased from 14 to 38 and the acreage in the districts from 850,000 to 3½ million.

NEVADA WEED REPORT -- Lee M. Burge:

Weed control operations have, due to labor and material shortages, been confined to old organized control programs and to survey and experimental activities. Control programs on puncture vine, camel thorn, Canada thistle, white top, morning glory and knapweed have been continued in some locations.

Surveys have continued to show a rapid spread of the poison plant, Halogeton glomeratus, and a surprisingly heavy spread in established areas. Sheep losses from this plant have again been reported, the latest from Pershing County, where 130 head were lost. This same flock suffered losses last year amounting to over 200 head that may have been caused by the same plant.

During the 1945 season, a survey was made of the 200 miles of main canals in the Truckee Meadows area for water hemlock and narrow leaf milkweed. These canals were all found to be generally infested over practically the full length with either or both water hemlock and milkweed. Cattle losses and, possibly, deer losses have been directly traced to these hemlock infested canals and ditches, especially during the Spring months when other feed is more or less short.

Preliminary surveys in other valleys of Western Nevada have indicated a similar condition, it being estimated that between 130 and 150 head of cattle are lost annually in the Mason Valley area. Other hemlock losses are believed to have been noted in the Carson and Paradise Valley areas.

Preliminary steps have been taken to organize a control program in the Truckee Meadows area, involving the cattle owners, Forest Service, Ditch Companies and the Power Company.

Experimental plots have shown some promise for 2,4-D. However, final observations on some forty-five plots will not be made until this coming Spring. This material is being compared in adjoining plots with Ammate, Chlorate and Sinox.

Test plots on Halogeton have shown the oils as the most practical control material. A one-gallon treatment of straight fuel oil to the square rod in heavy growth has given control. Sinox in the dust form was not effective and Chlorates and Borax are both out of the picture because of cost. 2,4-D was not effective in amounts up to 1½ pounds to 100 gallons of water.

IDAHO WEED REPORT -- B. E. Kuhns:

PROGRESS REPORT ON WEED CONTROL FOR STATE OF IDAHO

County Programs

The Idaho weed control program, as conducted under county supervision, has made quite satisfactory progress during the past year.

The total amount of money budgeted by counties for weed programs was $625,000. This is nearly double the amount budgeted in 1944. Fourteen of the thirty counties conducting organized weed programs raised a part of their budget through special tax levies, ranging from one-half cent to the legal limit of ten cents per hundred dollar valuation. Substantial assistance was also provided to counties by a State contribution. The State appropriation of $70,000 per year is

used to purchase chemicals which are pro-rated to the various counties on the basis of the amount of money spent for weed work in each county.

Slightly over 15,000 acres of farm land were under a cultivation program in 1945. Most of this land was cultivated with county equipment on a three-year contract between the county and the farmer. Rates charged for this service varied widely. Nine counties charged $1.00 per acre for cultivation and $2.00 to $3.00 for the initial plowing. One County charged $1.50 per cultivation and one charged $2.00. Twelve counties performed this service on a seasonal basis at rates ranging from $4.50 to $12.50 per acre for the season's work; the most common rates being $10 and $12 per acre.

On the basis of actual cost accounts kept by some counties, this service actually costs the counties from $15 to $20 per acre. This would indicate that in most cases the counties are assuming a substantial part of the cost of this program.

Carbon bisulphide and sodium chlorate are still the standard chemicals used in Idaho for weed control work. The amount of chemicals applied in 1945 was considerably less than in 1944. A total of $150,000 gallons of carbon bisulphide was used, which was about 80% of the 1944 use, and about 1,200,000 pounds of sodium chlorate, which was about 60% of the amount used in 1944. The use of these chemicals was seriously limited by the amount made available.

Eighteen counties employed full-time weed supervisors. This represents an increase of two counties over the previous year.

2,4-D in the Idaho Weed Program

2,4-D in various commercial preparations was used on an experimental and trial basis in most of the counties of Idaho. Applications were made under widely varied conditions of soil, temperature and weather. Several counties purchased 2,4-D products and sold them to the farmers at cost. A total of 1,277 gallons of liquid products and 125 pounds of powder were thus handled. Eight counties conducted spray programs for farmers on a limited scale. The basis of charges for this service varied. In most cases the farmers were assessed the actual cost of the work and material. One county charged 10 cents per square rod for the material and one-half the actual cost of labor. One county charged $35 per acre for material and labor.

Reports on about 125 trials were tabulated and furnished to the Extension Agronomist by weed supervisors and county agents. Many other trials were made of which we have no record.

Research

Under a special research appropriation made by the State Legislature in 1945, a state-wide weed control research program was established under the supervision of the University Agronomy Department. Lambert C. Erickson, a graduate botanist, was employed to take direct charge of this work.

Mr. Erickson started his duties on July 1 and as a start on this program applied 221 plots with 2,4-D in ten counties on twenty major perennial weeds.

An intensive research program on 2,4-D was also conducted by C. I. Seely, representing the Bureau of Plant Industry, and cooperating with the College of Agriculture at Moscow. Mr. Seely's weed research work is conducted largely at the Genesee Weed Station near Moscow.

Halogeton

Eight hundred sheep were lost in Cassia County during the fall of 1945 from eating Halogeton.

Educational

Renewed emphasis has been placed on the educational program for weed control and eradication by County Agents, County Weed Supervisors and the College of Agriculture. Community and county meetings relative to weed control were conducted in most of the counties during the year.

COLORADO WEED REPORT -- Bruce J. Thornton:

The research program in weed control at the Colorado Experiment Station has been greatly expanded. Extensive field tests were conducted the past season with the 2,4-D herbicides. These tests involved 4 concentrations, 5 rates, 15 formulations, 10 perennial noxious weeds and lawn weeds and were conducted at sub-stations in 5 sections of the state. In addition, uniform tests to determine optimum date of application as affecting different perennial weeds were conducted in cooperation with the Extension Service in 38 counties in the State. Results apparent to date, although in no way final, emphasize the great need for further information especially as pertaining to the physiological aspects of the use of the 2,4-D herbicides.

The efforts in fundamental research are divided into the physiological phase under the direction of Dr. Fults in the Botany Department, the chemical phase in cooperation with the Chemistry section and the electrical phase in cooperation with the Electrical Engineering Section. The physiological studies, which involve the laboratory and greenhouse activities, are conducted in close cooperation with the chemical and electrical phases as well as the field tests and are revealing some very interesting phenomena.

Considerable 2,4-D was used in the state last year by individuals. Although results were frequently disappointing, especially as compared to the advance claims made for herbicides of this type, indications are that they were sufficiently satisfactory to encourage a much wider use of the materials this coming season. Efforts will be made to obtain as much information from this source as possible in addition to that gained from the controlled tests.

Colorado does not have a recognized State weed control program. However, many of the counties are conducting weed control programs through the setting up of weed control districts as provided by the State weed law. This permits the County Commissioners to set up a weed fund either from the general funds or by levying an assessment, not to exceed one-half mill, as may be desired. In counties having weed control districts the cultivation of weed areas and the application of chemicals may be conducted with county equipment and county labor under county supervision, but the county is reimbursed in full by the land owner for the cost of the operations and the materials used. In regions where weed districts do not exist the individual land owner must carry his own program. All the weed districts in Colorado are at present set up on a voluntary basis. The law provides for compulsory districts but it is felt that such should not be resorted to until the need is fully apparent.

CALIFORNIA WEED REPORTS -- Walter S. Ball

Mr. Chairman, I am very glad that you reversed the order this time as California has given the first report on the weed activities for many years and I have always been a little nervous thinking that I would set a poor example.

Today would have been no different as I requested all the state officials to prepare talks and have them ready to present to the secretary so we would not have to hold up our minutes for them. As you will note, my speech is made up of about four statements, but now that I am last, and have noted that a couple of the other boys have not prepared theirs, I do not feel quite so badly about this situation. I will, however, have mine written.

I requested that we discuss subjects of major interest to the States and subjects which would not be repeated in our formal program. All of the States have done just that and I believe it has been of much interest. I wish to thank each of you at this time for this cooperation.

We have always looked on Klamath Weed-or St. Johnswort-as one of our major weed problems and it is still a major project in California. It has caused such heavy losses to our stockmen, through depletion of the ranges, that it is worthy of attention and we will continue to discuss it as long as it is of importance.

The most recent important phase of this program is the work being started on the biological control of Klamath Weed. A beetle which belongs to the Chrysomelid group feeds upon the Hypericum species in Australia and in some instances has actually killed out heavily infested areas.

The entomologist of the Experiment Station, of the College of Agriculture, working with the Federal quarantine officials as well as the State officials, has taken all the precautionary steps in introducing this insect to California in the hope that it might find favorable conditions where it will breed and increase, and at the same time assist in the control of this weed. Starvation tests were carried on at the Experiment Station in Berkeley to further assure workers the beetle would not injure other crops; that it favors and will live only on Hypericum species. Releases of the insect have been made in three or four areas in the State under slightly different ecological conditions. In one of these areas, located in Marin County the insect has fed upon the plant and is starting to increase in numbers. This is the first encouraging report we have had. The work is in a purely experimental stage and we feel it may be years before the population is increased to a point where it will reach economic importance.

Our chief problem now is to maintain interest on our other methods of control, such as the use of Borax, and cultural practices. Many individuals interested in this program have learned of the biological control method. Already they are asking for insects and considering abandonment of their present programs.

Another form of weed control to which we are looking more and more is our selective spraying, especially in flax and vegetable crops. The selective spraying in grain, of course, has become very well established.

In addition to our selective spray work, we feel there is a place for pre-emergence spraying, which as most of us know, is spraying the planted area a day or two prior to emergence of the crop plant. As has been shown in our selective spray program, this can be done with oil with low volume per acre which will successfully kill young weeds. Successful pre-emergence spraying requires knowledge relative to the period of time needed for certain weed seeds to germinate. I have delegated a member of my Bureau to collect weed seeds in the vegetable growing areas in order that we may have this information available. There are certain crop seeds which require such a long period for germination that many of our annual weeds have ample time to germinate and be treated prior to emergence of the crop.

Undoubtedly you have noticed the stream-lined electrical machine on the lawn. A year or so ago this was brought into California from Wyoming where the owners felt that they could kill deep-rooted perennial weeds. They have been given every opportunity to use this machine. The most extensive work was carried on in the Mendota area of Fresno County where it was found that morning-glory was not too successfully handled, although there were indications that Russian Knapweed was being killed and that they could handle shallow-rooted perennials such as Johnson Grass and Bermuda grass. The areas I have seen have not gone through a complete growing season and I am waiting until this Spring to check on some of them.

One interesting thing worth mentioning is that whether or not this machine successfully handles a weed, the growers seem to be sold on this practice, and some of them are giving contracts for this type of weed control. I am in no position at this time to make any recommendations and I will not make any until I have actually observed and studied the effect of the machine on plants which have had a full year in which to recover. The owners of this machine are in the audience and I am quite sure they will be glad to discuss it with you, individually.

Another problem that I believe is going to develop in all of the Western States is the elimination of common roadside and ditchbank species that are alternate hosts of plant diseases or insect pests which may be carried over on these weeds and injure crop plants. We have had several cases in California where the elimination of such host plants has materially increased yield.

The last point I wish to stress is my belief that we must give further attention to the question of using commercial pest control operators. Our Agricultural Code provides for registration and is so set up that the individual must know what he is doing or his license will be revoked. I make this statement primarily because I feel that we are going to experience a great deal more trouble in the use of 2, 4-D and its mis-handling than we have heretofore unless operators know the material, know how it is applied, and know when to apply it.

NORTH CENTRAL STATES WEED CONTROL CONFERENCE - T. F. Yost.

It gives me a great deal of pleasure to be able to attend this meeting as the official delegate of the North Central States Weed Control Conference. Please accept my thanks for your kind invitation. Your Conference has been in existence much longer than we have been working as an organized group in our section. This is the third of your annual meetings that it has been my good fortune to attend. May I congratulate your organization on the good work which you have been and are doing. We only hope that our conference will be able to do as much good in the future as you have done in the past.

Everyone here knows of the colossal loss caused by weeds to agriculture and to all mankind. The overall loss from weeds to the nation is increasing by leaps and bounds. It is my personal opinion that the natural and normal rate of spread by perennial weeds is much greater than is the amount which is eradicated plus that brought under control each year. Like one weed worker stated, "It is necessary to work at top speed at all times with everything in your favor in order to keep from slipping backwards." Because of the serious aspects of the weed problem, it is the duty as well as the opportunity of your and our conference, and indeed of all weed workers and others who realize the weed situation, to keep before the people and the leaders of our states and of the nation the utter seriousness of the weed problem and the necessity for an all-out national effort against the weed menace.

The North Central States Weed Control Conference was organized at Omaha in the fall of 1944. The second annual meeting was held at St. Paul last fall. We are indebted to your Conference and especially to your delegate, Walter Ball, who attended both of our meetings, for his splendid advice and assistance in helping us to lay a foundation on which we organized the North Central States Weed Control Conference. We hope to build an organization that will join and work with your group in order that we may find better ways of handling our common weed problems. Our conference is young and largely inexperienced when compared with your Conference. Therefore, we may not be able to hold up our end of the doubletree but we want you to know that we desire to cooperate and do our part in anything that will be for the common good of all.

I have been requested by your Secretary, Mr. Ball, to give a report of our second annual Conference at St. Paul. The meeting started at noon on Monday and closed late on Wednesday afternoon, with a Smorgasbord on the first night and a banquet the second night. All member states were represented at the Conference with near 100 delegates in attendance. In addition, almost 100 commercial representatives were registered and in attendance. Three of the western states and three Canadian Provinces were represented. After the usual preliminaries of opening a convention, the first session consisted of committee meetings lasting from 3:00 o'clock until 6:00 o'clock. The committee meetings consisted mainly of discussion and adopting plans of procedure and course of future action. We have standing work committees consisting of (a) Research (b) Uniform State Weed and Seed Laws, (c) Federal Extension Weed Specialist, (d) Federal Legislation to Control Interstate Movement of Noxious Weed Infested Seed, Feed and other Material, and (e) movement and sale of weed infested materials by Federal agencies. The two latter committees have been combined under one head.

The Research Committee did an excellent piece of work under the able leadership of Mr. F. L. Timmons, Agronomist, U.S.D.A. of the Bureau of Plant Industry, who is representing the Bureau at this meeting of your Conference. This committee set up a uniform plan for conducting research work with 2,4-D which was adopted and used by most of the Federal and State Weed Research workers in this area, as well as several other states and several provincial workers and the Dominion Experimental Farms of Canada. This committee was divided into several sub-committees, each of which summarized the results of various phases of the plan and made their report at the St. Paul Conference. This committee has already revised its plan of work for 1946 in the light of experience during 1945. This committee has done a considerable amount of work which has been recognized the nation over by weed research workers. The remaining committees are working at their job diligently but are working on problems that will require a longer time to accomplish results. The conference has appointed two new committees, one for the purpose of drafting a model herbicide law for states, and also a committee to draw up a constitution and by-laws for the organization

The second day was devoted entirely to a discussion of the results with 2,4-D as carried on by the various research workers who followed the uniform plan. Dr. E. J. Krause, University of Chicago, Dr. J. W. Mitchell and L. W. Kephart, Bureau of Plant Industry, Washington, and your Walter Ball made important contributions to this meeting.

It might be of interest here to state that the general opinion of most workers seemed to be that results of 2,4-D for the first year were not sufficiently conclusive to warrant recommending its use for perennial weeds. It was recognized by all that the per cent of kill and plant counts made according to surface indications did not correspond with live roots found by digging at six to eighteen inches beneath the surface. It was further recognized that 1945 results could not be conclusively appraised until the Spring of 1946 and also that much more experimental work needs to be done to determine the proper place and use of 2,4-D

for perennial weeds. According to the reports of the committee and some other workers, 2,4-D gave good results generally with certain annual weeds but not with all of them. The use of 2,4-D as a lawn herbicide was generally accepted and recognized by all workers. The speaker personally believes that 2,4-D can be accepted as the best dandelion killer and general lawn herbicide that has come to the attention of the "lover of nice lawns" in over1900 years. According to Dr. Krause the near future should bring forth new weed killers far superior to 2,4-D.

The last day was devoted to state reports, giving important changes in their laws and program since the previous year. A few states made notable improvements in their state weed control laws. Several states in the North Central area have excellent weed laws which are supporting a good program and which are producing worthwhile results. Several other states have excellent laws on the statute books but are not supporting an active program. Other states have antiquated weed laws which need to be modernized and brought up to date and put on an active basis. The agricultural leaders in each of the various states in our area are looking forward, as far as their weed problem is concerned. It is my belief that in a few short years most states in the area will have an up-to-date weed law and an active program in the field to get results. The remainder of the last day was devoted to committee reports, which were previously discussed, and to routine convention business matters.

I believe that I am safe in saying that the North Central States Weed Control Conference is a going concern and that it is the recognized agency to deal with weed matters for the area. The organization is established and can speak for the 13 north central states on the weed problem with any organization, group or agency.

Before closing, I desire to pay special tribute to the excellent research work done by the U. S. Bureau of Plant Industry, to the Triple A program for making practice payments for noxious weed control and to the other Federal agencies who have properly assumed their weed responsibilities. Each agency should be given credit for what they have done and for their contribution to the cause of weed control.

The weed menace is of such tremendous importance to each of the individual states and to the nation as a whole that the program to fight weeds should be activated on a national scale, with the U. S. Government taking an active part and giving financial backing. In most problems of national scope or character, Washington usually takes the lead in a control program which is largely financed by Federal funds. Notable examples are: Soil conservation, Control of Livestock Diseases and Pests, Control of Insects and Plant Quarantine, The Grading of Agricultural Products, etc. Where interstate problems have existed, suitable and adequate Federal regulations have been set up to properly handle the situation which usually are enforced by Federal officials. At the present time, the Federal Government is doing two important things bearing on the weed problem, which are research dealing with eradication or control, and administration of the Federal Seed Act. Both of these activities are being conducted in an excellent manner.

In the weed control program the National Congress has curiously adopted what seems to be a hands-off policy. Maybe it would be better to say that the Congress seems not to be interested in the national weed control problem. Some of the states, in order to protect themselves against the weed menace, have been forced to initiate and support their own eradication and control program, while the Federal Government has set idly by and has not even done a good job of looking on. The weed problem is so broad in scope, so devastating in effect, and so complicated when

considered from the overall standpoint, that we believe the time is here when Congress should sit up and take notice that there is a weed condition in our country that is of national importance, which if not properly handled will undermine the greatest resource of our nation, which is the soil. There are some aspects of the weed problem that cannot be handled on a state level. These problems cut across state lines and can only be handled by Federal action.

In closing, I bring you greetings from the North Central States Weed Control Conference and invite each of you to attend our third annual meeting which will be held at Des Moines, Iowa, sometime during the middle of December, 1946.

REPORT OF THE UNIFORM RESEARCH COMMITTEE, NORTH CENTRAL STATES WEED CONTROL CONFERENCE:* F. L. Timmons**

The uniform program of experimentation with 2,4-D and other selective herbicides in the North Central States Weed Control Conference is a project of our Conference Research Committee. The uniform program is the result of a rather interesting and opportune series of developments. Our Research Committee was originally set up prior to the first meeting of the North Central Conference at Omaha, Nebraska, in November, 1944, with instructions to survey the field of weed research and bring to the meeting a report on the status of weed research and recommendations for future activities in that field. The Committee prepared a rather comprehensive report in which a number of recommendations were made. In that report No. 3 of the ways suggested for accomplishing closer cooperation among weed research workers read as follows:

> "3. The coordination of the various experiment station and Bureau of Plant Industry plans of experiment or methods of attack on certain weed problems of regional importance to permit direct comparison of the results in different parts of the region and a quicker solution of the problem than would be possible through independent research at the various stations under different plans."

The committee report was adopted by the Conference but this recommendation was not immediately applied to the 2,4-D situation.

The course of events to come was accurately prophesied at the meeting in Omaha by Mr. L. W. Kephart of the U. S. Department of Agriculture in his discussion of "Chemical Weed Killers After the War." After reporting briefly on preliminary results with 2,4-D in 1944, he advanced the opinion that revolutionary developments in chemical weed control would soon present weed research workers and control officials with problems that they were hardly prepared to handle. He predicted widespread publicity and sensational claims for the new weed killers and pointed out the need for a disinterested agency to assemble information, correlate the facts and act as an umpire in the situation. He suggested that our Research Committee was the logical group to do this in the north central area.

By the end of January, 1945, much of Mr. Kephart's prophecy had materialized. Several sensational articles and advertisements about 2,4-D had appeared in print, and the barometer of public interest was rising rapidly as indicated by the sudden flood of inquiries received by nearly every weed control and research

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* Presented at the annual meeting of the Western Weed Control Conference, Reno, Nevada, February 26 and 27, 1946.

** Agronomist, Bureau of Plant Industry, Soils & Agri. Engr.; Chairman, Research Committee, North Central States Weed Control Conference.

worker in the country. It was immediately evident that our meager facilities and personnel for weed research would not be able to gain information rapidly enough to protect the public interests except through organized effort.

After considerable correspondence five members of our 9-man Research Committee were able to get together for two days, February 15 and 16, and work out the first draft of a uniform plan of experiments, using the limited amount of information available at that time about 2,4-D. During the next six weeks two revised drafts of the plan were circulated among the committee members and on March 31, copies of the final draft of the plan were mailed to the Directors of the thirteen state experiment stations.

The uniform plan in its final form was a 20-page mimeographed booklet with seven distinct features. These were: (1) a statement of the objectives of the plan; (2) a list of the chemicals to be tested and their sources; (3) a uniform code system of designating the different experiments and various treatments (4) outlines of six suggested experiments on different weed problems showing the chemicals, concentrations, rates of application and stages of weed or crop growth; (5) suggestions for conducting the experiments as to plot plan and replication, determination of results and retreatments; (6) a set of solution tables showing the amounts of the various products necessary to prepare different concentrations of 2,4-D spray solution in quantities up to 10 gallons and (7) a complete list of references to technical and popular articles on hormone-like chemicals published up to that date.

Thus the uniform plan contained or referred to about all of the information that was available at that time on 2,4-D and other hormone-like chemicals as herbicides, and it had developed out of the composite of the thinking of nine men who are among the most active weed research workers in the region.

More than 80 copies of the uniform plan of experiments were sent to prospective cooperators and others interested. Many requests for copies were received from persons outside our North Central Conference, in states as far east as New Jersey, as far south as Texas and as far west as California and Oregon. Several copies of the plan were sent to workers in Canada.

A total of 35 cooperators reported the results from a total of 160 different experiments on different weeds. Thirty-six of the experiments were conducted by cooperators in Canada at stations distributed from Newfoundland to Alberta.

Our Research Committee was divided into four 2-man sub-committees for the preparation of regional summaries and each sub-committee assigned the task of summarizing and reporting upon the results from one or two or the uniform experiments. The task of summarization resulted in many a headache for these sub-committees. Despite the fact that the results reported were from experiments based on uniform plans, there were some variations in treatments and other details in nearly all cases, so that the problem of correlating the results and arriving at conclusions as to what they showed was a tedious and difficult problem.

The reports on the regional summaries of results from the uniform experiments were presented in a symposium on the program of the second annual meeting of the North Central Weed Control Conference held at St. Paul, Minnesota, in November, 1945. These reports demonstrated the value of our uniform program of research and also revealed some of its weaknesses. The uniform program was as successful in 1945 as could have been expected in the first year. Undoubtedly, the mimeographed uniform plan outlining suggested experiments and giving much of the available information on 2,4-D resulted in considerable experimental work that would not have been done otherwise. Bringing the result data together in regional

summaries for study and discussion made the most efficient use possible of those data. The outstanding weakness of the program in 1945 was the lack of uniformity in conducting the experiments and the resulting inability to make direct comparisons in many cases. As one of the sub-committees stated it, "the only thing uniform about the individual experiments reported was their lack of uniformity." This variability in treatments in the supposedly uniform experiments in 1945 is understandable when one considers that the uniform plan was developed hastily and presented suddenly to the experiment station directors and research workers too late in the season for careful plans to be made. In many cases, it was not possible to obtain supplies of all of the different 2,4-D products, and new 2,4-D preparations were being introduced into the picture throughout the season. It is small wonder that the individual experimenters became too dizzy to keep up with the rapidly changing situation in a uniform manner.

Our research Committee of the North Central Conference has recently completed a careful revision of our uniform plan of experiments for 1946. We believe that we have been able to make a considerable improvement in our plan as a result of the experience gained in 1945. This time we used ten weeks in making a careful revision and still were able to distribute the final plans to the cooperators by February 15, which is six weeks earlier than the plans were distributed in 1945. This should make possible more careful planning on the part of the individual cooperators and result in much more comparable data being reported for the regional summaries in the Fall in 1946. We are looking forward to a much more successful year for our uniform program of research in 1946 than in 1945. The Canadian Department of Agriculture has expressed the desire to cooperate again this year in our uniform plan in experiments on their Dominion experimental farms.

Our 1946 uniform plan of experiments is again a comprehensive mimeographed booklet of 19 pages. One of its features is a classified and descriptive list of 36 different commercial preparations of 2,4-D that have been developed by 20 different companies. Solution tables are included giving the amount of each of the commercial preparations that is necessary to prepare a given quantity of spray solution at various concentrations of 2,4-D. We have outlines for six different suggested experiments covering the various phases of the 2,4-D problem. These are as follows:

I. The effect of time, concentration and rate of application of different types of 2,4-D formulations on perennial weeds or undesirable woody plants.
II. Concentration of 2,4-D and other selective herbicides on annual and winter annual weeds in cereals, grasses or flax.
III. Date of application and concentration of 2,4-D on broad-leaved lawn weeds.
IV. A comparison of commercial preparations of 2,4-D on perennial, annual or lawn weeds.
V. Effect of 2,4-D spray on cereals, flax, grasses, corn, or sorghum.
VI. The effect on crop plants of residual 2,4-D in the soil.

Perhaps you would be interested in a brief resume of the general trends that were apparent in the regional summaries of results from our uniform experiments in 1945. The results were extremely variable and indicate that the effects of 2,4-D on plants are influenced more strongly by differences in the stage and rate of growth of the plant, in temperature, air humidity, soil moisture, fertility, and

texture than are those of most other weed-killing chemicals. In general, the best results were obtained when the weeds were growing most rapidly and before they reached the blossom or fruiting stage. Results were less satisfactory when temperatures were too low or the soil was too dry to promote rapid growth. Increasing the quantity of spray above the amount necessary to uniformly wet the vegetation did not appear to give better results. One to one and one-half gallons per square rod appeared to be sufficient in most situations and even less was frequently enough. On the other hand, increasing the concentration of 2,4-D in the spray solution did seem to give much better results on certain weeds.

At individual stations there were wide differences in the effectiveness of different commercial formulations of 2,4-D. However, these differences were not consistent over the region and tended to smooth out in the regional summaries. With few exceptions, there was no significant average advantage for any one product over another. The differences between products tended to be greater in cases where conditions were less favorable to good results with any of the treatments.

The various 2,4-D preparations gave good results more consistently on dandelion and other broad-leaved lawn weeds than on any other type of weeds. The results with dandelion were not as uniformly good in Kansas and Nebraska as in states farther north and east. The optimum concentration of 2,4-D spray solution on lawn weeds appeared to be 1000 to 1500 ppm under favorable conditions and at least 1500 ppm under less favorable conditions. Applications made any time during the growing season when temperatures and soil moisture were such as to promote active growth seemed to give good results on dandelion. Sprayed plots were frequently re-infested by seedlings by the end of the season, indicating that spraying once or twice each year will be necessary to control dandelion and other broad-leaved lawn weeds.

Most of the lawn grasses were not seriously injured by 2,4-D sprays. However, buffalo grass frequently showed some discoloring and stunting of growth, especially when sprayed in mid-summer. The stand of buffalo grass was definitely reduced at Hays, Kansas, when sprayed two or three times in 1945.

Our results in 1945 showed 2,4-D sprays to be rather uniformly effective in killing a majority of the species of broad-leaved annual weeds, particularly in early stages of growth. However, none of the grass type weeds were seriously affected, and a considerable number of broad-leaved species proved highly resistant. 2,4-D did not appear to be superior to Sinox for controlling annual weeds in cereals, flax or grass crops.

The results in 1945 showed the use of 2,4-D to be more or less hazardous in all kinds of growing crops. Most of the vegetables, ornamentals, and legume crops were killed or severely damaged even by low concentrations of spray. Some of them proved extremely sensitive and were injured by wind drifted spray or by volatilized fumes from nearby sprayed areas. The small grains and other grass type crops in most cases were not seriously injured. However, in some instances reductions in grain yield were as great as 50% and even 100%. The cases in which serious injury resulted to grass type crops were frequent enough to show the need for more experimental work and study before enough information is available to recommend methods that will guarantee the profitable use of 2,4-D for controlling weeds in these crops.

The injurious effects on crop plants of residual 2,4-D in the soil from spray applications were apparent during periods varying from only a few weeks to

several months, apparently depending upon the amount of rainfall received after the spray application. The residual effects seem to persist longer in the soil in the drier states like Kansas and Nebraska than in humid areas like Ohio. The residual effects of 2,4-D were most injurious to the more sensitive vegetable and legume crops and less detrimental to the grasses and cereals.

None of the results obtained in our uniform experiments on deep-rooted perennial weeds are considered complete at this time. The concensus among weed research workers in our conference is that final results of 2,4-D spray applications on deep-rooted perennial weeds must be based entirely upon the amount of root kill and that this cannot be definitely measured until the year following the spray application. We are therefore delaying our final judgment on results of 1945 treatments on these weeds until we have the data recorded after growth begins this Spring.

The first results on field bindweed were almost as favorable as those described in the sensational articles and advertisements that appeared in farm magazines during 1945. The top growth was nearly always killed completely and regrowth did not appear in many cases for 30 or even 60 days after the spray application. However, examination of the root system showed that the roots had not been completely killed. Frequently taproots were killed to depths varying from 6 to 18 inches and occasionally deeper. The lateral roots were not so easily killed and a considerable number of these roots nearly always remained alive. The living portions of the root system usually developed new shoots beginning forty to sixty days after the spray application and increasing throughout the season. The amount of regrowth at the end of the season in 1945 usually did not exceed 40% of the original stand and frequently was not more than 10% of the original stand. Very few complete kills for any 2,4-D treatment on bindweed or other deep rooted perennial weeds were reported by cooperators in our uniform experiments. County agents and farmers in our region quite generally reported more favorable results with 2,4-D on deep-rooted weeds than did research workers. This difference may have been due to a tendency on the part of the former group to base their judgment on surface kill and to reach their conclusions sooner after the spray applications.

For the most part, the results with 2,4-D on other deep rooted perennial weeds were less favorable than the bindweed. Burr ragweed and dogbane appeared to be about as sensitive as bindweed but Canada thistle, hoary cress and leafy spurge seemed to be more resistant. Perennial smartweed and Russian Knapweed were very resistant. As would be expected, Johnson grass was hardly affected at all even by high concentrations of 2,4-D spray.

The preliminary results from our uniform experiments on deep rooted perennial weeds were thus more negative than positive. The results indicated that a single application of 2,4-D usually willnot give a complete kill of any of the weeds of this type. Of course, the effect of the winter on the weakened root on treated areas is yet to be determined. Also, it remains to be seen whether repeated applications of 2,4-D over a period of two or more years will prove effective in completely eradicating any of the species of noxious perennial weeds.

The statements of policy on the use of 2,4-D in 1946 as adopted by the North Central States Weed Control Conference at its last annual meeting might be of interest here. These recommendations were drawn up by the Policy Committee of our Conference after a thorough study and discussion of the results of our uniform program of research in 1945. The statements of policy as approved by the Conference are as follows:

The Policy Committee of the North Central States Weed Control Conference RECOMMENDS to the Conference the following statements of policy for 1946.

1.- That the uniform plan of experimentation with 2,4-D and other chemicals be continued as a conference project in 1946.
2.- That the conference approve the use of 2,4-D for the control of certain lawn weeds, the qualifications and details of recommendation to be set up by each State.
3.- That, based on experiments to date, this conference is not prepared at this time to approve the general use of 2,4-D on annual weeds in growing crops.
4.- That the conference approve the general use of 2,4-D on certain annual weeds, not in growing crops, the list of such weeds to be prepared by the Research Committee. A list of resistant weeds will also be prepared.
5.- Due to variable results and the short experimental period, this conference is not in position to recommend 2,4-D for general use in eradicating deep-rooted perennial weeds.

Adopted by Conference vote November 27, 1945.

List of annual weeds, winter annual weeds, and a few perennial lawn weeds, classified as "generally susceptible", "intermediate", or "resistant" to 2,4-D.

Obviously no clear line can be drawn between these different classes. Among many other factors, the age and condition of the plant are important. Many of the weeds in the "susceptible" list below are moderately resistant to 2,4-D at the bloom or older stages. There are also discordant reports concerning many plants, so that this is to be considered a temporary progress report, not a final placing of the weeds listed. We know far too little as yet about the variations in susceptibility within and between species and the reasons for these variations. Also, obviously the lists are in no sense complete.

Generally Susceptible to 2,4-D

Ball mustard (Neslia paniculata)
Beggar's ticks (Lappula echinata)
Bitter wintercress (Barbarea Barbarea)
Black mediok or yellow trefoil (Medicago lupulina)
Buckhorn (Plantago lanceolata)
Burdock (Arctium minus)
Cockle-bur (Xanthium sp.)
Dandelion (Taraxacum officinale)
False flax (Camelina sp.)
Ground ivy (Glecoma hederacea)
Hare's-ear mustard (Conringia orientalis)
Henbit (Lamium amplexicaule)
Indian mustard (Brassica juncea)
Kochia (Kochia scoparia)
Mallow (Malva rotundifolia)
Marsh Elder (Iva xanthifolia)
Mouse-eared chickweed (Cerastium vulgatum)
Peppergrasses (Lepidium virginicum and apetalum)
Prostrate amaranth (Amaranthus blitoides)
Prostrate Vervain (Verbena bracteata)
Puncture vine (Tribulus terrestris)
Ragweed (Ambrosia artemisiaefolia)
Rough Cinquefoil & Other Five-fingers (Potentilla sp.)
Rough Pigweed (Amaranthus retroflexus)
Shepard's purse (Bursa bursa-pastoris)
Speedwells (Veronica sp.)
Spotted spurge (Euphorbia maculata)
Stinkweed, Fanweed, Frenchweed (Thlaspi arvense)
Sunflower (Helianthus annuus)
Sweetclovers (Melilotus sp.)
Tansy mustard (Sophia sp.)
Tumbling mustard (Sisymbrium altissimum)
Wild mustard (Brassica arvensis)
Wild rape (Brassica napus)
Wormseed mustard (Erysimum cheiranthoides)

Intermediate

Common chickweed (Alsine media)	Marestail (Leptilon canadense)
Common Plantain (Plantago major & rugelii)	Mayweed (Anthemis cotula)
Goatsbeard (Tragopogon pratensis)	Oak leaved goosefoot (Chenopodium glaucum)
Knotweed, doorweed (Polygonum aviculare)	Prickly lettuce (Lactuca scariola)
Lamb's quarter (Chenopodium album)	Wild lettuce (Lactuca sp.)

Resistant to 2,4-D

Barnyard grass (Echinochloa crus-galli)	Red Sorrel (Rumex acetocella)
Black nightshade (Solanum nigrum)	Russian thistle (Salsola pestifer)
Buffalo bur (Solanum rostratum)	Sand burs (Cenchrus pauciflorus)
Corn cockle (Agrostemma githago)	Smartweeds (Persicaria persicaria and pennsylvanicum)
Cow cockle (Saponaria vaccaria)	
Crabgrass (Syntherisma sanguinale)	Squirrel-tail grass (Hordeum jubatum)
Dock (Rumex sp.)	Tartary buckwheat (Polygonum tartaricum)
Foxtails (Chaetocloa sp.)	Violet (Viola sp.)
Goose-grass (Eleusine indica)	White cockle (Lychnis alba)
Mullen (Berbascum thapsus)	Wild buckwheat (Polygonum convolvulus)
Night-blooming catchfly (Silene noctiflora)	Wood-sorrel (Oxalis sp.)
Nimblewill (Muhlenbergia schreberi)	Yarrow (Achillea millefolium

SOME RESULTS OF TESTS WITH 2,4-D IN KANSAS IN 1945 - T. F. Yost, State Weed Supervisor

In March, 1945, the Kansas Agricultural Experiment Station issued, in mimeograph form, a brief statement regarding the new widely publicised weed killer called 2,4-D. The use of this chemical was not recommended at that time because information regarding its use was not sufficient to justify such recommendation. Through the summer of 1945 extensive experiments were carried on at Manhattan, Hays and Canton. More than 500 experiment plots were used in Kansas alone for testing various preparations of this chemical. Tests were also carried on in several other states by state experiment stations and the U. S. Department of Agriculture. As a result of these tests, much more information is now available on 2,4-D as a weed killer.

2,4-dichlorophenoxyacetic acid, commonly called 2,4-D, is a white powder that is nearly insoluble in water. When mixed with certain other substances it can be dispersed in water and used as a spray. Proprietary products vary in content of 2,4-D or its salts from 9.6 percent to 90 percent and may be either in the form of a liquid, powder, or tablets. Several preparations were on the market last year and more than thirty will be available this year.

Results of the use of 2,4-D have been quite variable and in most cases must be considered incomplete. The Kansas Agricultural Experiment Station is therefore not in position to recommend the general public use of 2,4-D on deep rooted perennial weeds. It can be recommended for use only on lawn weeds and on certain annual weeds not in growing crops. Much more experimental work must be done to develop methods of safely using 2,4-D on weeds in the relatively tolerant grass and cereal crops. At least one more year of extensive experimentation will be required to determine which of the deep rooted perennial weeds, if any, can be effectively and economically controlled. Several years of careful experimentation and study will probably be necessary to determine the influence of the many climatic, plant growth, and soil factors on results with 2,4-D. While these details are being worked out by research workers, farmers and others will probably find it to their advantage to

confine their use of 2,4-D on noxious weeds generally and annual weeds in growing crops to very small areas on an experimental basis. The commercial products containing 2,4-D are still too expensive for large scale use until we have more definite information on how to get the best possible results.

Effect upon different species: Different plants differ widely in their susceptibility or resistance to 2,4-D. In general the grasses are much more resistant than the broad leaved weeds. Likewise, the deep rooted perennial weeds are more resistant than the annuals. Some of the species upon which the chemical has been moderately to quite effective are:

Dandelion	Chickweed
Common plantain	Kochia
Buckhorn plantain	Wild Lettuce
False strawberry	Puncture vine
Daisy	Velvet leaf
Annual sow thistle	Pigweed
Cocklebur	Three seeded mercury
Annual morning glory	Wild mustard
Mares tail	Burdock
Sunflower	Door Yard Knotweed
Ragweed	

Several species of the nightshade family, notably bull nettle, black nightshade, and buffalo bur, appear to be highly resistant, as are also such weedy grasses as Johnson grass, crabgrass, foxtail, goosegrass, sandbur, nimblewill, and quack grass. The leaves of certain woody plants as posion ivy, buckbrush, and sumac are killed by the chemical, but it is not known whether new growth will arise from the woody stems or roots. More time will be required and further tests necessary to determine the effectiveness of 2,4-D on these plants.

Extensive tests on field bindweed, hoary cress, Russian knapweed and Canada thistle show that the tops are usually killed, and the roots often to a depth of 6 to 18 inches but regrowth usually occurs even after a second treatment has been made. Whether repeated treatments will kill these weeds can be determined only by continuing the tests over a longer period of time.

Value of selective action: The selective action of 2,4-D permits its use on lawns to combat dandelion, plantain, and certain other broad leaved weeds without injury to bluegrass. However, bent grass and buffalo grass may be damaged by a single spray application under certain conditions and should not be sprayed twice in the same season. White Dutch clover is seriously injured and may be killed by the application of 2,4-D. Treatment of weeds in grain crops has not been tested sufficiently to determine whether the weeds can be eliminated without damaging the crop.

Concentration and method of application: For general use a concentration of one part of 2,4-D to 1000 parts of water is satisfactory. For less sensitive weeds and under less favorable conditions one part 2,4-D to 650 to 700 parts of water is necessary. Since the various preparations contain varying amounts of 2,4-D the amount of each to use per gallon of water will vary. The recommendations of the manufacturer should be followed. The solution should be applied as a spray and in sufficient quantity to thoroughly wet all the foliage of the weeds. From to 2 gallons per square rod will usually be required, the actual amount depending upon the amount of growth on the area to be treated.

Weeds are apparently more sensitive to the chemical when they are growing rapidly and before they have reached full growth or full bloom stage. The chemical

seems to act more rapidly when the temperature is moderate to warm rather than very cool. The influence of these factors have not been definitely determined, however.

Effect upon the soil: The effect of 2,4-D upon the soil seems to be rather severe but temporary. In most cases it disappears within 4 to 8 weeks, especially when rains come during that period. Whether there is a cumulative effect from repeated treatments has not been determined.

Other possible hazards: 2,4-D in itself is not corrosive to spray equipment, and is not inflammable. It has not been known to produce any ill effects upon persons handling it or upon animals consuming vegetation sprayed with it. However, when applied near shrubs, flowers, or vegetable plants there is great danger of wind carrying sufficient spray solution to seriously damage the valuable plants. A sprayer used for 2,4-D should not be used for spraying garden or fruit plants because of the difficulty of cleaning the sprayer sufficiently to avoid endangering the useful plants.

Chairman Kuhns called for committee reports -

REPORT OF EXECUTIVE COMMITTEE -- Walter S. Ball

Following our meeting in Boise, Idaho, last year, the executive committee had a rather short meeting to discuss a point or two which they thought should be given some attention and presented at this meeting.

The first point that was given consideration was that of inviting the manufacturers of weed control materials and equipment to join the group as paid members with the understanding that the State officials only would have the voting power: This action was taken primarily because the various manufacturers and chemical concerns are taking the research men that we formerly have had in our State Service and in order to receive the benefits derived from the training of these men and the knowledge which they are going to continue to get, we thought it important that they become affiliated with our group so that we could all derive the benefits of their research and experimental work. It was further felt that the dues of these individual organizations or companies should be the same as the State dues - $15.00 a year.

Another point which was discussed was that of having some kind of a get-together, such as an annual stag dinner or buffet dinner, more or less informal, which would give everyone an opportunity to meet and become better acquainted. The amount of money in the Treasury, however, will control this to some extent but it is felt that with new membership this can be carried out and it will be a satisfactory move.

That is, Mr. Chairman, the most important points and if there is reaction from the group relative to the action taken by your executive committee, we will appreciate having it at this time.

MR. HARVEY: We should like to defer the report of the Research Committee until tomorrow. I should also like to request that the members of the 2,4-D panel discussion to meet and go to lunch together.

MR. KUHNS: The Committee appointments shall be as follows:

RESOLUTIONS COMMITTEE:
H. E. Morris, of Montana, Chairman
C. E. Otis, of Oregon, Member
R. J. Evans, of Utah, Member

NOMINATIONS COMMITTEE:
L. M. Burge, of Nevada, Chairman
Lin Harris, of Oregon, Member
Geo. B. Harston, of Wyoming, Member

Mr. Burge announced a stag dinner at the Nevada Game Farm for the evening of February 26 and made arrangements for transportation for those not having cars.

The morning session adjourned until 1:30 p.m.

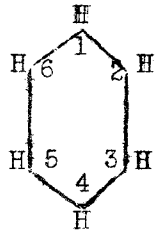
The after noon session was called to order by Chairman B. E. Kuhns, who turned the meeting over to W. A. Harvey, Panel Leader, for a discussion on 2,4-D. Mr. Harvey asked Mr. Freed to give some introductory remarks relative to the chemistry of 2,4-D.

MR. FREED:

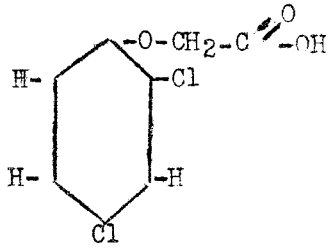
The advent of the "wonder" weed killer 2,4-D has aroused a good deal of interest, both on the part of weed control men and the general public. For that reason, let us consider briefly the chemistry of this material.

The parent compound of all 2,4-D preparations or derivatives is an organic acid, 2-4-dichloro phenoxy acetic acid. This material, physiologically speaking, belongs to the class of compounds known as growth regulators. These materials, in minute quantities, effect plant growth in a manner similar to naturally occurring auxins.

To show how 2,4-D gets its name, let us first consider the benzene nucleus, which is the essential building block of 2,4-dichloro-phenoxyacetic acid.



Taking the benzene nucleus and numbering in a clockwise manner we have a start on 2,4-D. Let us now add the prosthetic appendages to our "foundation."

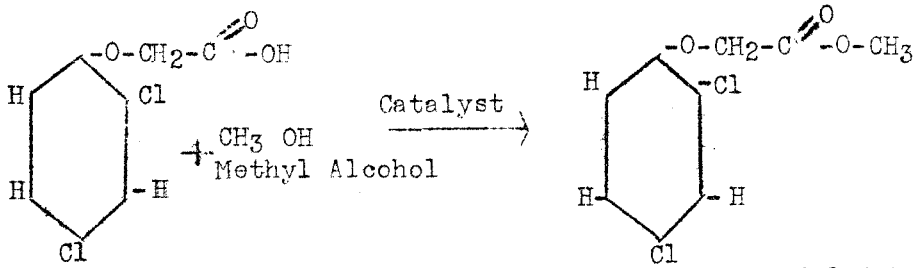


The acetic acid group is attached to the nucleus through an oxygen in the one position. In the 2 and the 4 position is found chlorine atoms. This then gives the name 2,4 dichloro (for the chlorine) phenoxy (Benzene and oxygen) acetic acid.

2,4-D acid is essentially insoluble in water; therefore, in order to use it, the material must be treated in order to get it into solutions. This may be accomplished in one of two ways. The 2,4-D may be dissolved in a water soluble or emulsifiable solvent, or it may be converted into a water soluble salt. There are a number of these salts, to enumerate a few there are sodium, potassium, ammonium, calcium and triethanolamine salts possible. In general, these salts are sufficiently soluble in water for our purposes. A number of the common so called sodium salt preparations of 2,4-D now on the market are a mixture of sodium bicarbonate and 2,4-D acid which form the salt when introduced into water.

Organic salts, such as the triethanolamine salt are possible. In general these will be salts of the various types of amines or nitrogen bases.

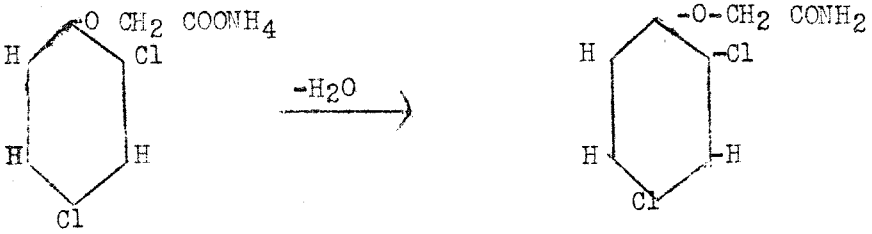
Another class of derivations of 2,4-D that are of interest in weed control are the esters. These derivatives are the result of the reaction between the acid and an alcohol.



2-4-dichlorophenoxyacetic Acid — Methyl Ester of 2-4-D

There is a possibility for a homologous series here as was the case in the salts. For example, it is possible to have methyl, ethyl, propyl, butyl, octyl and cyclohexyl esters. These compounds are insoluble in water but are soluble in oil and most organic solvents. Concurrently, it would be expected that these derivatives would be more soluble in the cuticle of plants. Therefore, one might reasonably expect better results with the methyl ester of 2,4-D on a plant having very waxy leaves than with the sodium salt, for example.

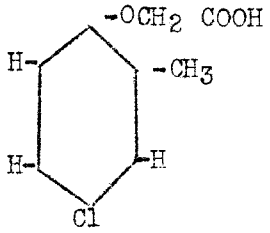
There are other derivatives of 2,4-dichloro acetic acid possible, but at the moment they are of little importance in field work. For example, one may have the amide of 2,4-D.



Ammonium Salt of 2-4-D — Amide of 2-4-D

There is little evidence to indicate that any particular derivative of 2,4-D is superior to another when compared on an equal basis. That is to say, the functional portion of the molecule is the 2-4 dichloro phenoxy acetic acid. It must be recognized, of course, that the problem of physical properties of the various derivatives must be taken into consideration, as cited in the case of the methyl ester. Limited trials in Oregon tend to substantiate this conclusion.

2,4-D itself is not the final possibility in this class of compounds. It is possible to have a homologous series of acids ranging through acetic, butyric and many others. Varying substitutions on the benzene nucleus give rise to an infinite variety of compounds. The British investigators working independently have capitalized on this fact and have discovered a weed killer which they claim is more selective and in some cases more toxic than 2,4-D. This material is 4 chloro 2 methyl phenoxy acetic acid. The structural formula of this product is as follows:



2 methyl 4 chloro phenoxy acetic acid

This opens up a new field of investigation in phyto toxic materials, which could lead to some worthwhile investigations.

The following is a summary of the Panel discussion.

Physical Qualities

The 2,4-D itself is not inflammable and thus its use presents no fire hazard. Likewise, as far as is known, 2,4-D is not poisonous to humans or other animals. This applies only to the pure 2,4-D. It is possible that the emulsifying or solubilizing agents could be somewhat toxic although none of the current commercial preparations are known to be hazardous. There may be some slight corrosiveness to the material although here, again, the effect may be increased or decreased by other materials incorporated with the 2,4-D. Certain oily products may have some effect on rubber spray hose but most sprayers are equipped with resistant hose which should resist such action. The effect would normally be much less than from diesel or other oils frequently used in sprays.

Rate (Dosage)

Considerable confusion exists in the current recommendations and suggestions of the amount of 2,4-D to use. The rate has been stated in pounds of parent acid per acre, in parts per million in solution, or in percentage solution. In the latter two cases the volume must be considered. Extended discussion indicated that pounds of parent acid per acre would probably be the best method of making recommendations. Greater uniformity of labeling commercial products would be of value in calculating the amount of each to use. It was suggested that the products might state on the label the number of pounds of parent acid contained

per unit, either pound or gallon. Current labeling of liquid preparations as to per cent 2,4-D gives no definite figure on amount of 2,4-D contained unless the weight per gallon is also indicated or known.

Final recommendations of rates were left to the research committee.

Volume (Gallonage)

The amount of solution to use per acre will, of course, depend on the concentration but if rates are given in pounds of parent acid per acre it should be possible to vary within limits the number of gallons applied per acre. Applications as high as 400 gallons per acre and as low as 15 gallons per acre (by airplane) were reported. Apparently the amount of water used is of little consequence as long as uniform coverage of the plants is obtained. With a ground spray rig 100 to 200 gallons per acre is usual. Exact information on gallonage must await further experimentation.

Time of Application

One of the most important factors in successful use of 2,4-D is proper timing of the application. At present, the best suggestion is treatment when the plants are actively growing, probably up to time of early bloom, on most species, if growing conditions are good. Too early an application may give poor results because all the plants have not emerged and too late an application may give poor results because of advanced maturity of the plants. Actual dates of application for optimum results will depend on location, weed species, and growth conditions.

Repeat Applications

Reports from many applications of 2,4-D on perennial weeds indicate that in few, if any, cases did the kill reach 100 per cent with one application. This, in itself, is not surprising in view of our limited knowledge of the action of the material and of optimum conditions for its use. Complete eradication with one treatment is extremely rare, regardless of the herbicide used. Nevertheless, it is important to know if eradication is possible with repeat applications. The amount of information on this point is exceedingly meager. Reports from one area indicated that repeat applications on morning-glory gave very little increase in percentage kill over a single application. Definite statements on this phase of the problem must await further experimental work.

Spray and Dry Application

Practically all the applications to date have been by spray. The few dust applications showed promise although somewhat more of the chemical may be required. The danger to other plants from drift of the dust may be greater than from spray. Weather conditions for best results with dusts must also be considered. Again, there is not as yet sufficient information on dusts vs. sprays to evaluate the differences.

Species Susceptibility

It was decided to let the Research Committee make a list of plants which have been found to be susceptible, intermediate, and resistant. This list appears

elsewhere in the report. It should be mentioned again that this list is provisional and will undoubtedly be revised as out information accumulates.

Absorption and Translocation

2,4-D may be absorbed in two ways by plants. If it is present in the soil it may be taken up by the roots and translocated up in the xylen to the leaves and growing points. If applied as a spray or dust to leaves, it penetrates directly into the tissues and, if high enough in concentration, it may be moved downward, presumably with food materials, going into storage organs or upward again to growing points. A third type of translocation is possible. Being a growth regulator, 2,4-D may move downward through living cells by polar transport as does auxin. This type of translocation may explain the superior killing action on tap roots as compared with laterals that has been observed with some species of weeds.

Soil Sterility

This question was discussed at Boise last year and considerable work has been done since. In general, 2,4-D breaks down within a month in warm, moist soils but may persist for 6 months in cool or dry soils. A comparison of soil types under greenhouse conditions shows a higher toxicity of 2,4-D in sandy soils than in clay soils, but a more rapid leaching from the sandy soils. Under field conditions, the toxicity in the soil will depend on the amount of 2,4-D applied, the soil type, temperature, and moisture conditions. It is important to take into consideration the possible residual soil toxicity when planning a cropping program following an application of 2,4-D. Certain crop plants, such as tomatoes, peas, beets, and seedling alfalfa, are sensitive to small amounts of 2,4-D in the soil, while grains or grasses will tolerate a larger amount.

Injury to Adjoining Plants

Numerous cases of injury to adjacent plants have been reported from applications of 2,4-D to weed growth. Such injury may be due to spray drift or to irrigation water flowing through treated area onto an untreated field. Drift injury can be avoided by using lower spray pressures, spraying only under calm conditions, and keeping the spray boom low. Even under optimum conditions, some injury to very sensitive plants, such as tomatoes, may result if 2,4-D is used within a few feet of the plants. Some of the 2,4-D products are somewhat volatile and sufficient vaporization may take place from sprayed plants or soil to injure nearby sensitive species. On irrigated land it would perhaps be safer to dike the sprayed areas and irrigate around them if sensitive crop plants are growing below the sprayed areas.

In general, most injuries to nearby plants can be avoided by careful application.

Cleaning Equipment

Injury to crop plants and ornamentals has been reported when using a spray rig previously used with 2,4-D. This can be avoided by thoroughly cleaning the sprayer after 2,4-D is used. Wash the tank several times with warm water, if possible, in which lye or sal soda has been dissolved. Run this alkaline solution

through the pump and spray boom or hose lines. Then wash again with fresh water. The screens should be cleaned to remove any accumulations of 2,4-D and the pressure equalizer cylinder on power rigs should be drained out.

Uses of 2,4-D

There appear to be three types of problems where 2,4-D may be applicable:

(1) Selective spraying of grasses, grains, etc., to remove broad-leaved weeds.

(2) Prevention of seed formation by weeds.

(3) Control of certain susceptible field weeds.

The suggestions of the Research Committee on these items appear elsewhere in this report.

Summary

Our information on 2,4-D is limited as would be expected since only one year's data are available from most of our Western States. The apparent confusion of much of the available information is no doubt due in part to our lack of sufficient information to give a clear picture of the action of 2,4-D and the factors involved in its successful use. On no other herbicide has so much work been done under such a wide range of conditions in so short a time with so little advance information. It would be surprising, indeed, if we should find all the answers in one year. As our information increases, we will undoubtedly clarify the present confusion. The only way to do this is to acquire all the information we can and attempt to integrate it into a unified whole.

This is one of the most promising chemicals to appear in the field of herbicides. It will not solve all of our weed problems nor will it perform miracles. But the intelligent use of this chemical should provide us with another potent weapon in our fight against weeds.

Chairman Kuhns asked if there were any further questions or discussion and inasmuch as there were not, the meeting was adjourned until the following morning at 9:30 a.m.

The meeting of the second day of the Western Weed Control Conference was called to order at 9:25 a.m., on Wednesday, February 27, at Reno, Nevada, by Chairman R. E. Kuhns, of Idaho.

MR. KUHNS: Since most of the work recently has been done on 2,4-D. Mr. Ball has some ideas relative to future activities.

MR. BALL: For the past few years research workers have spent their time on 2,4-D. I wonder if it would not be a good idea to consider weed control in a broader way. We are going to have other chemicals and other methods of weed control such as we have seen here. For example, the electrical equipment. We should have information as to how the plant is affected by electricity, proper time for treatment, and soil factors, which may or may not influence results. I think that we should suggest that our Research Committee take into consideration all phases of weed control.

DR. ROBBINS: I think the Committee has rendered a fine report, but I am of the opinion that there is no reason why the Research Committee should confine its activities to 2,4-D, which is only one phase of the weed problem. We must not overlook cultural and cropping methods, etc., and I imagine that sooner or later the Research Committee will take these matters up.

MR. HARVEY: The original statement that I made that the Research Committee for the coming year be instructed to consider a coordination of weed control research included the same sort of thing as is being brought up; that 2,4-D is not our full answer and that various other things and various other methods should be depended upon for some of our information on that particular subject. We also thought of making recommendations on particular phases of research in some of the States that are going on, but which are not important enough for long papers or panel discussions.

It was moved by Mr. Otis, unanimously seconded and carried that the report of the Research Committee be accepted.

Mr. Kuhns introduced Mr. Lin Harris, of the Chipman Chemical Company, to discuss Weed Control Equipment.

MR. HARRIS: Mr. Chairman, Gentlemen: I want to make two comments, one of which is that I do not know very much about the development of equipment, but depend on a lot of you fellows to give me the "dope". Equipment for spraying is on the increase again, due to 2,4-D, and apparently a lot of spraying is being carried on. As Drs. Robbins and Crafts have stated, there is a lack of knowledge about spray equipment to be used for weed control work, and many orchard sprayers and some discarded sprayers were fixed up to be used for weed control, rather than low pressure spray equipment, such as is suitable for this type of work. We are having some development in equipment in Oregon and are starting a series of meetings to discuss this viewpoint. Some designs have been developed and we are going to talk it over and see what we can do about it. Right now we are getting away a lot from the high-pressure pumps for weed work. In the first place, low-pressure pumps are more easily handled and are not as expensive to operate.

In the last couple of years, we have had word that the commercial concerns are primarily concerned with doing weed work on a commercial basis, which would fit into the picture of having commercial men with well-founded knowledge of weed work. They are doing work for railroads and on turfs with 2,4-D.

They have a new piece of equipment on which they maintain two 200-gallon tanks and are placing a small motor beside the pump, making it very adaptable to move around in all types of terrain. They have a pump they have used some in selective work and for grass turf work. They have used two or three different types of pumps and have decided that the rotary pump fills the bill as well as anything. We should also consider other types of spray equipment. The Mack Weed Gun people are thinking about equipment for weed work and they have a machine that looks very promising, designed primarily for small users and for use with carbon bisulphide.

I would also like to have comments from some of the men in the field and would like to see what they have to say. Bill Harvey handed me a sheet that is already written out and all you have to do is read it. I would like to know if Bill has done anything by way of research on spray equipment.

MR. HARVEY: We had a man doing some work on spray nozzles and spray equipment and we are trying to get him assigned back again. He has been doing experimental work on the Guayule project. At the present time, we just don't have the information on the types of distribution. We need some tests on plant and ground application. We feel that we have pretty good nozzles and are at least better satisfied with our nozzles than with some other phases of spray equipment. Most of our large-scale equipment is going along with low-pressure type spray, usually centrifugal. We did a little work on carrot spraying with oil. One of the things is that you should have at least 400 pounds of pressure on oil and with other things, 100 pounds is sufficient. We thought we liked our pressures from about 85 to 125 pounds per square inch, rather than the higher pressures, which makes the spray go all over the country. We certainly do need more work on spray work.

MR. OTIS: This equipment problem is certainly on us and the important thing seems to be the lack of information. There is going to be a large-scale spray program in the West with 2,4-D this year and we have little or no true facts to give these people. We have quite a few observations, but we do not have much experimental evidence. Equipment people are interested in developing spray equipment for sale; chemical companies are also interested, besides farmers and others. The Oregon Department decided a couple of weeks ago that it was time that they tried to do a little work on weed control equipment. They are working out a design for a soil injection outfit and developing a design for a spray outfit. I think it is the plan to have representatives of equipment companies and chemical companies meet with them in Portland in March, at which time these designs could be presented to the group to be picked to pieces and then they plan to go back to the College and put the final touches on those designs and release them to anyone who might be interested.

MR. HARRIS: I understand the Food Machinery people are making some designs on a spray unit, which I believe is the very thing you are talking about. Could you say a few words on this, Mr. Abilgaard?

MR. ABILGAARD: (Food Machinery Corporation Representative). I came here very much as a listener to find out as much as I could as to what you want, and I presume the other manufacturers who are interested in going into it are pretty much like myself. First, we have to find out what the larger percentage of you want - how much pressure, how many different sized nozzles, types of tanks, gallonage, and all of those things, so I think that the meeting you mentioned at

Portland is fine. I think that the same kind of meeting should be held at Davis. I am sure that all of us manufacturers would be glad to send our chief engineers, as well as our sales managers. In normal times, we could have such a meeting, go home knowing what you wanted and in possibly three months we could be in production. Today, we go home from such a meeting, turn the matter over to our production planning department and our purchasing department and the best answer we will get from a machine manufacturer today is that if the strikes are over, eight months. Others say sixteen or eighteen months. So I think you can see from that that it is impossible for any manufacturer to produce anything new or different for 1946 delivery and I am telling you that unless these labor troubles iron out, we couldn't hope to have anything new in production for 1947. We are just as anxious to make this equipment as the chemical companies are to have them, but until these labor troubles settle down, it is very hard for us to plan.

MR. BALL: You mentioned 1946 delivery. Do you have spray equipment in stock?

MR. ABILGAARD: Our entire production for 1946, up until October 1, has been sold out for many months. There are, of course, a few of our dealers who may still have a few unsold machines in stock. As far as I know, our competitors are pretty well in the same boat. Those machines are your regular orchard high-pressure type capable of delivering 300 to 500 pounds pressure. Most of them can be adjusted down as low as you may want them. While I will agree that for most weed control work, the lower pressures are to be desired, you will have some cases, especially the Forestry Service, where they are going to have to run long lines of hose or have higher elevations. But there is another angle to be considered. A great many of the fellows will buy combination machines for cattle spraying, orchard spraying, etc. However, there will be some who will buy for weed control only who would want the low-pressure machines.

MR. OTIS: May I make one addition? If anyone here would like to have an invitation to that March equipment meeting in Portland, see me sometime today.

DR. CRAFTS: I think all manufacturers should include an instruction book showing the table of pressures, amount of delivery, etc.

MR. GIBBO: The Essex Manufacturing Company has two units, which are two of the many models designed for the non-cultivation spraying at a maximum pressure of 85 pounds with a capacity up to 8 gallons per minute. They use the air-pressure method, which has been used over twenty years, and one of the points to remember when using this equipment is not to let the dirty oil contact any of the moving parts. It is used around ranches for high-pressure greasing, spray painting, etc. The maximum capacity of the tanks, unless built especially, is 140 gallons. All units come equipped with or without agitator. Exhaust is out of the top, giving a constant stream of air.

MR. HARRIS: Is that a unit particularly used with a Ford Tractor?

MR. GIBBO: It was designed especially for the Ford Tractor in two sizes. We have not started to build units adaptable to other tractors. The range in size is from 65 to 140 gallons capacity and the price ranges from $240 to $500. The Ford Tractor Company here has been very courteous and helpful.

DR. ROBBINS: Mr. Gibbo was kind enough to donate to the University, at Davis, one of these machines and we have it under operation. He has supplied a 200 gallon tank so we can use it for experimental work. We use it very conveniently in any type of orchards, fields, gardens or yards. We would be glad to accept any kind of demonstration equipment you might want to send.

DR. EVANS: Since we have more weeds in Utah than you have in California, we do not see why they passed us up.

MR. KUHNS: Do any of you in the group have any comments?

DR. HARSTON: I would like to ask if any of you have tried any of the new soil stirring equipment.

MR. THORNTON: I can answer, in a very limited way. It is too expensive an operation to make extensively.

MR. JUCKSCH: We have improved on our old type mechanical or power drawn carbon bisulphide applicators. We have three pumps on it, which are very efficient, but up to the present time we haven't sent any out of the State. In fact, we are not in the manufacturing business, but these are very efficient machines. There is no lack of accuracy and all the pains necessary have been taken to make them accurate. They are used in California on weeds. I have nothing new to offer, outside the improved machines we have already had.

DR. EVANS: I think this question just raised is very important. I do not know whether we have some new species or super-species of Bermuda grass, which is the worst thing you have ever seen. All of these chemicals we have talked about are probably not effective on the grass. It is very widespread. I took samples and weighed them. There were sixty tons of green weeds per acre, 90 per cent of which were root stocks. These were dried at the laboratory, reweighed one year after, and we have 16.3 tons of dry weed per acre. How are we going to get rid of stuff like that? Now this seems to be the baby on the doorstep you have been avoiding. Chlorates are not effective; this new chemical is not going to be effective, and I think it is a very serious problem how we are going to get rid of these root stocks before we begin cultivation.

MR. COX: What we use in our county is a 15-inch duckfoot with hydraulic leverage. However, we do make a practice of plowing, using a 21-inch John Deere plow, with an alfalfa share. On quackgrass we use a Kiliper spring-tooth field cultivator with a shovel about 10 inches long, which is excellent for raising this debris from the ground.

MR. YOUNG (Apco Corp.): We are here to learn your trouble and see what you have been doing in attempting to control this hazard. We hear so much about electricity, but it is nothing new. We have had it for many years and we know it kills organic matter and that anything with a circulatory system is a conductor of electricity. Our operations so far have been very satisfactory. This equipment is one of our first models. There will be a number of variations designed for vineyards, orchards, irrigation canals, etc. We wish we had had a little more time to present it to you in order to give you more data. I do not presume that this group would be greatly interested in the electrical science involved. All we do is send an electric current down the roots of one plant and up the roots of the other plant, thereby destroying the cell structures of two plants. We went into

Mindoka last April and, in going there, it was necessary to tell the farmers what we were trying to do. The first six months our operations represented a little better than $9,000 for 13 operators and involved 950 acres of weeds. Those 13 now have repeat business to the extent of between $25,000 and $65,000. I say it only to show you that those who have treated their weed problems with electrovation have found it so satisfactory that they have come back with about seven times the volume of original business. The theory itself is simple. As I say, it probably does not in any way interest the body here. The service will be rendered by territorial representatives who own their own equipment and who will service their customers by this particular treatment. The established price per acre is running from $30 to $60 an acre. We have guaranteed up to the present time in order to introduce the process of weed elimination. That will no longer continue. From here on it will be on a treatment basis of $10 per acre per treatment, going on the basis that the weeds belong to the farmer and we do not know what condition his ground is in. In most instances, our services have been considerably cheaper than other methods used. It runs from 3 to 6 treatments. This machine has been generally field tested. We have no equipment available. We have had quite successful operations in Bermuda grass. We have run into almost every type of weed. Morning glory has been our toughest problem. The machine destroys only what it touches.

MR. HANSEN: In the first place, we have more quackgrass than any place in the State of Idaho, or any place else. Our method of taking that out is cultivation with a cultivator. Our first trip through, we cut strips about 1 foot apart, then we cross it and when we go across the second time, it just about turns the ground upside down. We try to let it dry out before we go over it again. When we get it cut fine enough, we use a duckfoot after the first five or six times.

SUMMARY OF AN ILLUSTRATED TALK BY MR. H. R. OFFORD, ENTITLED "CONTROL OF HOST PLANTS IN A PLANT DISEASE PROGRAM WITH SPECIAL REFERENCE TO RIBES AND WHITE PINE BLISTER RUST DISEASE."

INTRODUCTION - The Bureau of Entomology and Plant Quarantine has a continuing interest in chemicals, equipment and methods for practical control of insect and fungus pests through the suppression and eradication of host plants. The scope of this interest may be indicated by mentioning a few of the jobs that the Bureau is doing in this general field. There is the eradication of wild cotton for pink bollworm control in Florida, the killing of abandoned pear trees and escaped pear sprouts in the Pacific Northwest for the control of the pear psylla, the eradication of barberry for the control of black stem rust of cereals in the principal grain-growing states through the country, and the eradication of currants and gooseberries (hereafter referred to as Ribes) for the control of white pine blister rust disease in the Northeastern, Southern Appalachian, North Central, Northwestern, and Pacific Coast Regions.

Methods, equipment, and chemicals developed and used for Ribes eradication relate to widely varying field conditions. A report on this work should be of interest to this conference as information pertinent to the suppression of deep-rooted shrubby perennials. First, let me outline briefly the blister rust control problem and the accomplishments to date in the development of methods of Ribes eradication. Later, during the showing of the lantern slides, I can make more detailed comments on the disease on pine and Ribes, typical specimens of white pines and Ribes, and the equipment, methods, and results relating to the eradication of Ribes.

THE DISEASE AND ITS CONTROL - White pine blister rust (Cronartium ribicola Fisher) is a destructive fungus disease which attacks and kills 5-needle white pines. The disease spreads by wind-blown spores from pine to Ribes and then back to pine again; it cannot spread directly from one pine tree to another. Fortunately the spores that are blown from the Ribes and that infect the white pines are delicate and short-lived. Thus, the spread from Ribes to pine is a short one and usually does not exceed 1,000 feet. By suppression or elimination of Ribes from the more valuable stands of white pine, the damage caused by the fungus can be held in check, and white pine may be grown and harvested as a timber crop. In the practical control work accomplished during the past 20 years in the several white pine areas of the United States, most of the work has been done by crews equipped with simple and light-weight hand tools. For Ribes that are difficult and costly to eradicate by pulling or grubbing (because of their large numbers, size, or habitat) special tools and chemical methods have been developed. Consideration has also been given to possible methods of biologic control and to natural control by proper management of the land and the timber crop.

The present objectives of control work may be briefly stated as follows: (1) to suppress the incumbent population of Ribes to the point where the number of residual Ribes on any given pine area meets control standards, (2) to prevent any significant number of new Ribes from becoming re-established within the control area, and (3) to maintain full stocking and vigorous growth of white pine and associated trees so that Ribes will be suppressed naturally and control can be maintained at the lowest possible cost.

CONTROL METHODS

Biologic Control - Biologic control will have to be dismissed in a rather cavalier style by stating that to date there is nothing of practical value to report. The basic requirements (see Imms' text, "Recent Advances in Entomology") for successful biologic control are not found in the combination of native white pine, Ribes, and blister rust disease

Control by Effective Management of Land and Crop - When experimental work in the control of white pine blister rust was started in the Far Western States 20 years ago, it was recognized that the direct eradication of Ribes by physical and chemical methods could be aided materially by minimizing the regeneration of Ribes through suitable logging practices in the white pine areas. Ribes seeds, often found in the duff and soil of forest areas, are hard coated and can retain their viability under certain storage conditions for long periods of time.

We are just now beginning to capitalize on our knowledge of the ecologic requirements of white pine and Ribes obtained from investigative work, so that it is possible to make general recommendations for timber-cutting practices that should favor the establishment of pine reproduction and at the same time minimize Ribes regeneration. Methods of logging, intensity of grazing, occurrence of fires, methods of slash disposal, and timber losses from insects and fungus diseases, all affect the germination of Ribes seed, the establishment of Ribes plants, and the Ribes eradication problem. These considerations for the growing of white pine and the suppression of Ribes parallel the problems of land management, crop production, and weed control on cultivated lands.

Control by Direct Eradication - The suppression of Ribes by effective management of forest land, or the suppression of any insect or plant pest by good husbandry, is sometimes a long-term job. Emergency methods must be employed to carry us through the initial phases of the work. For the practical control of blister rust we have developed and used special tools for hand grubbing, special equipment and accessories for the eradication of large and numerous Ribes by power machinery, and various chemicals and equipment for applying chemicals. We have also tested and used burning and dynamite for special problems of Ribes eradication.

The following is an outline of the principal chemicals and equipment that have been successfully used in practical Ribes eradication work. Details of most of the methods and equipment to be described will be found in U. S. Department of Agriculture Tech. Bulletin. 692, "Chemical and Mechanical Methods of Ribes Eradication in the White Pine Areas of the Western States," by H. R. Offord, G. R. Van Atta, and H. E. Swanson.

I. Tools Used in Hand Methods

1. Claw mattock (special tool designed for Ribes work).
2. Pick mattock
3. Pulaski (tool developed by U. S. Forest Service for fire fighting).

II. Equipment Used in Mechanical or Power Methods

1. Bulldozer with front-end brush rake.
2. Bulldozer with front-end brush rake and rear-end logging winch operating special Ribes hooks or grapples.
3. Special hooks or plows to be drawn by a team of animals or by a truck.

III. Equipment and Chemicals Used in Chemical Methods

A. For spraying aqueous or liquid chemicals on intact plants.

1. Equipment

(a). Five-gallon knapsack mounted on pack board, spray delivered by trombone pump.
(b). Three-gallon compressed-air sprayer, motor cycle pump attached to extension and spray nozzle, unit mounted on a light pack board.
(c). Portable power pumpers (70 lbs. or less).

2. Chemicals (arranged in decreasing order of amounts used)

Sodium chlorate, Diesel oil, ammonium thiocyanate, ammonium sulfamate, 2,4-dichlorophenoxyacetic acid (known as 2,4-D)

B. For applying dry or liquid chemicals to the crown of intact or decapitated plants.

1. Equipment

(a). Dusters.
(b). Cartridge belts, canvas bags.
(c). Two-quart canteen with friction fitted tapered syringe.
(d). Pulaski, or long-handled pruning shears for decapitation.

2. Chemicals (arranged in decreasing order of amounts used)

Borax plus common salt, borax, Diesel oil, borax plus sodium chlorate, ammonium sulfamate, ammonium thiocyanate, 2,4-D.

The wide variety of Ribes species, soils, and climatic factors which prevail throughout the range of the white pines have necessitated modifications in chemical, dosage, and method of treatment for each species of Ribes. In our experience of the past 20 years, we have recognized that the following variables should be evaluated before large-scale use of a chemical spray is recommended:

1. Chemical formula, including instructions on spreader and sticker (and penetrant, stabilizer, and activator if any).

2. Dosage (per unit area or plant unit).

3. Concentration of active chemical.

4. Soil type, ground litter, and associated vegetation.

5. Species of Ribes and age and development of plant seedlings or young or mature plants.

6. Weather at time of treatment.

7. Season or time of year for effective treatment.

Elements of cost and hazards to operator, to the soil, to associated vegetation, to animal life, and to equipment, as well as watershed protection, all have to be considered before chemicals can be used in blister rust work. You can readily appreciate, therefore, that the effective and economic use of a chemical for Ribes eradication involves much more than reading the label on the can containing a proprietary weed killer. Even with established herbicides, such as sodium chlorate, Diesel oil, ammonium sulfamate, and borax, it is risky to predict what a specific chemical will do on an untested Ribes species in a new location. The growth-regulating substance 2,4-dichlorophenoxyacetic acid (or 2,4-D,) which has recently been attracting such widespread attention as a herbicide, is considerably more unpredictable than the older type of conventional herbicide, and one or more of the several factors just mentioned may make a difference between almost complete kill of treated plants, and little or no effect whatsoever.

Final results of 2,4-D on Ribes will not be known until the growing season is well under way in the spring of 1946. The following comments are based on preliminary observations of field plots and on completed greenhouse and laboratory tests with this material:

(1) Ribes species vary in susceptibility from highly susceptible to highly resistant. Of 16 Ribes species tested to date in the Far Western States, 2 appear to be highly susceptible, 5 moderately susceptible, and 9 moderately to highly resistant.

(2) 2,4-D should not be applied to Ribes until a week or 10 days after the plants are fully leafed in the spring and they are making active vegetative growth. Work should be terminated prior to hardening of the plants in the late summer.

(3) No significant difference in effectiveness is apparent among several chemical derivatives of the parent 2,4-D acid. The water-soluble sodium or ammonium salt and the ester in oil emulsion or suspension form are convenient, effective, and practical for field work.

(4) For susceptible Ribes, the plants are killed by 2,4-D in concentration as dilute as 250 p.p.m. (0.025%) of the parent acid when applied only to their aerial parts. With stronger concentrations the entire above-ground parts of the plant do not need to be covered. In practical work, however, it is considered desirable to use a more dilute solution to save chemical wherever transportation of water is not a major cost item.

(5) The effect of aqueous 2,4-D salt or ester in oil on a susceptible Ribes is rapid. Rain probably will not reduce the ultimate effectiveness of applied 2,4-D spray if the spray has once dried on the leaves.

(6) 2,4-D will kill highly susceptible Ribes when applied only to aerial plant parts. It will kill moderately susceptible Ribes if applied to the tops plus soil in sufficient dosage. For resistant Ribes little or no effect can be secured via the stems and leaves regardless of concentration or dosage, but such plants can be killed by soil treatment with 2,4-D provided enough chemical is used. Plants in the last category can probably be killed more cheaply by other well-known herbicides.

WHAT THE INDIAN SERVICE IS DOING IN WEED CONTROL WORK -- Mr. J. E. White, of U. S. Indian Service, Salt Lake City, Utah

Mr. Chairman, members, and friends of the Western Weed Control Conference: The Bureau of Indian Affairs is pleased to participate in your meetings because they afford an excellent opportunity to keep advised concerning the latest scientific developments in the control of weeds which bring about annoying and troublesome problems on cultivated tracts, along canal banks, and on range areas.

I have been asked to make a brief report to your conference on the subject "What the Indian Service is Doing in Weed Control Work."

The weed problem on Indian lands is in the same general category as the weed problem on non-Indian lands; that is, it is particularly serious in some districts and in general troublesome at all times.

It is definitely the policy of the Indian service to work in close harmony with state and county weed control organizations wherever Indian lands are located. We are fully cognizant of the fact that your organization has the most up-to-date information concerning workable plans for attacking the weed problem in the most effective way.

During the past season (1945) some very good work was done on whitetop and Russian Knapweed control and eradication on Indian irrigated land through clean cultivation. At Duckwater in Nevada a demonstration plot of 100 acres of land, made useless through noxious weed infestation, was set up in cooperation with the Nevada weed control board. The Indians faithfully carried out their requirements of the agreement with respect to frequent and adequate cultivations. The results were very encouraging. It is planned to continue this work again during the 1946 season. Other sizeable weed eradication projects were carried on at Uintah and Ouray in Utah and at Fort Hall, Idaho.

With the exception of a few small demonstration plots, little or no work has been done with the new wonder chemical weed eradicator, 2,4-D. On one small plot of morning-glory at Owyhee, Nevada, very promising results were obtained by using one of the commercial weed eradicating chemicals containing 2,4-D. We hope that these early favorable findings prove to be of a permanent nature.

On our irrigated lands we have a real problem in some districts in controlling willows on canal banks. Tentative plans have been made for experimenting this season with 2,4-D weed eradicating compounds in an attempt to combat this problem.

At this point I would like to digress from the problem of noxious weeds on cultivated tracts and briefly mention an innovation with respect to poisonous plants on non-cultivated areas. Some 90 to 95% of our Indian land holdings in the Western states are classed as grazing areas with only a comparatively small portion listed as irrigable lands. In the Western states the agricultural economy of our Indians is based largely on livestock, principally cattle with some sheep.

In 1937 largely through the efforts of the Superintendent of the Carson Agency at that time, a campaign was made to collect, classify and preserve for Indian schools and agencies specimens of native plants used for food and for medicinal purposes by pre-Caucasian Indians of Nevada, California, and the Great Basin Plateau region.

The results of this campaign were so satisfactory in implementing valuable collections and stimulating interest on the part of Indians and others in native plant and weed problems that ways and means were found to extend this work to include poisonous plant surveys of Indian range land. A field botanist, Mrs. E. V. Murphey of Mendocino County, California, was placed in charge of this educational campaign. Mrs. Murphey, who is no longer with the Service, has just completed a pocket-sized handbook for range stockmen. The book is four by six inches, contains illustrations, photographs, general information and a bibliography. I am informed that the book will be off the press in the near future and available to the public.

The range survey work was carried on seasonally from 1937 through 1945 and was conducted on reservations in Oregon, Idaho, Montana, Wyoming, Utah, California, and Nevada.

The general objectives of this survey were:

1. To determine the prevalence and extent of such plants on Indian grazing areas.

2. To assist the Indian stockmen in becoming familiar with plants dangerous to livestock.

3. To teach Indian children in day and boarding schools how to recognize these plants through field collections, by drawing specimens, by learning the common and scientific names of the more common offenders, and the kind of animals affected by eating these plants.

4. To teach the Indians recognized and practical means of control.

Paraphrasing Mrs. E. V. Murphey's description I may say that visual instruction has been the bait to catch the Indians' interest. Collections were made by range botanists which were later mounted in scrapbook form and made into individual mounts for the use of Indian councils and agencies. Indian children at boarding schools and day schools and their parents contributed valuable information which was incorporated in texts which accompanied poison maps of reservations. The blanks of reservation maps were filled in colors representing the dangerous plants, thus localizing danger spots. Photographs of plants and of the terrain were placed in the scrapbook adjoining the plant and the text referring to it. The celluloid covered plant mounts were washable, light and unbreakable. A piece of plyboard served as background for the mount. These could be passed from hand to hand with all the information enclosed with the plant.

Study and identification of the collections were made in cooperation with the Oregon State Agricultural College at Corvallis, Oregon; the Utah State Agricultural College at Logan; the Wyoming State University at Laramie; the University of California at Berkeley; and Brigham Young University at Provo, Utah.

Today it is interesting to note that Indian school children as well as many of the Indian cattlemen on reservations where this work was carried on readily recognize the following major poisonous plants:

Death Camas or Poison Sego - Zygadenus paniculatus S. Wats.
The Indians learned that one-half pound of this plant to a hundred pound sheep would be fatal. According to Mrs. Murphey, poultices of the raw bulb pounded were used on rheumatic knees by early Nevada and California Indians with good results.

Larkspur - Delphinium
There are at least four common varieties of this plant: Delphinium Scaposum (low larkspur), Delphinium Barbeyi Huth (tall larkspur), Delphinium Occidentale (tall larkspur), and Delphinium Glaucum (tall larkspur). The last one has given considerable trouble to cattlemen in the Ruby Mountain district of Nevada. The other two varieties of tall larkspur are considered only mildly toxic. According to Dr. O. A. Beath, research chemist of the University of Wyoming, larkspur, as well as some other plants, contains moinital, a substance which animals crave after months on dry feed.

Loco - Astragalus
According to Dr. O. A. Beath, one of the Locos, Astragalus Haydenianus, is very toxic to cattle and sheep as the plant always carries selenium. Another Loco, Astragalus Dyphysis Sheld, is reported by Dr. W. T. Huffman to be toxic the year round.

Lupinus

One of the most common toxic lupines (Lupinus Caudatus) according to Dr. Huffman has seeds and leaves toxic to cattle and sheep during the summer period. Another lupine (Lupinus Laxiflorus, Var. Calcaratus) as reported by Mrs. Murphey is exceedingly toxic to cattle and sheep.

Hemlock

There are two common varieties; one Cicuta Occidentalis Greene, the other Conium Maculatum. The Indians used the name "Hah-ta" to refer to the mountain form, while "Hakinop" means the one that is common along irrigation ditches. This is probably one of the most poisonous plants in the whole United States. According to Mrs. E. V. Murphey the early Nevada Indians split the raw root of the Cicuta Occidentalis and applied it as a poultice to draw out the poison from rattlesnake bite.

Horsebrush - Tetradymia

One species, Tetradymia Glabrata (green rabbit brush) is considered extremely toxic to sheep according to C. E. Fleming in Nevada Bulletin No. 104. In the species Tetradymia Canescens according to Dr. W. T. Huffman was the cause of heavy sheep losses in the Hill Creek district in Utah some years back.

Klamath Weed or St. Johnswort - Hypericum Perferatum

Cockleburr - Xanthium

Arrowgrass - Triglochin Maritima

According to Dr. Huffman this plant is considered particularly toxic only when stunted in growth. Its toxic nature appears to depend upon its condition.

Longleaf Milkweed - Asclepias Labriformis

According to Mrs. Murphey and Dr. Huffman, this is toxic to most animals at all seasons.

Whorled Milkweed - Asclepias Galioides

Sneezeweed - Helenium Hoopesi

Leaves of this plant are considered particularly toxic to sheep during the summer and fall season.

Halogeton

Some of the minor poison plants are:

Chokecherry - Prunus Melanocarpa

According to Dr. Huffman and Mrs. Murphey the leaves of this plant are particularly toxic to sheep and cattle during May, June and July.

Greasewood - Sarcobatus Vermiculatus

According to C. E. Fleming (Nevada Bulletin No. 115) this is particularly toxic to sheep.

Big Milkweed - Asclepias

Fiddleneck - Amsinkia Intermedia

This is common in wheat fields and in waste places in Northern Utah and Idaho and according to Dr. Huffman the ripe seeds are particularly toxic to horses, hogs and cattle.

No General Classification of Poisonous Plants

With respect to classification of poisonous plants I wish to read a quotation from Muenscher's "Poisonous Plants of the United States":

"It is not possible to divide all known plants into two groups, poisonous and non-poisonous. Most plants are harmless. Many are poisonous under some conditions. A few are poisonous under nearly all conditions.

"Poisonous plants are those that contain or produce under natural conditions toxic substances in sufficient amounts to cause harmful effects in animals, including man. The quantity of a poisonous plant ordinarily consumed may contain enough of the toxic principle to cause death or only a diseased condition.

"The poisonous nature of a plant is caused by the presence of one or more of several kinds of substances:

1. Substances themselves toxic to the animal organism; e.g., the alkaloid, Coniine, is the toxic principle in Poison Hemlock. (Poison parsnip).

2. Substances themselves harmless, but which may decompose to form toxic products either before or soon after they are eaten; e.g., the non-toxic glucoside, Amygdalin, produced in wild cherry, hydrolyzes to form the highly toxic Prussic acid. (H.C.N.)

3. Substances formed by the action of micro-organisms on plants or plant products; e.g., fungi under certain conditions produce moldy hay or ensilage, forming decomposition products, some of which may be toxic."

Control and Eradication

The following was extracted from a letter from Mrs. E. V. Murphey as of February 8, 1946:

"Many plants are not poisonous all the time. Seasonal poisoning occurs in some plants, such as Cocklebur in seedling stage.

"Certain plants are poisonous the year round, but the time at which cattle have access to them is limited; for instance: Poison Parsnip or Hemlock, when green forage is scarce, the noticeable leaves and with them the more poisonous roots are easily pulled up. Most cases of poisoning occur very early before grass comes.

"Seasons vary - in very wet years, or very dry years, or in years when too many cattle or sheep are kept on a given area because prices are high. Too few springs may cause overgrazing in the vicinity of water. In rocky areas,

cattle become tenderfooted and will not leave the water. The best plants are eaten first, and later, weeds and poisonous plants. This is the cause of Loco eating, which becomes a fixed habit. Also, because of the close grazing of forage plants, the poisonous plants and weeds having less competition, form a higher percentage of the available herbage than under normal conditions. Overgrazing: Whenever the number of animals to a given area exceeds the number of good plants required to satisfy their appetites, the incidence of plant poisoning increases.

"Usually Reservation ranges are too far flung to permit of any form of eradication. Blackfeet Reservation in Montana has two and a half million acres. Wind River in Wyoming has about two million. Prevention is better than cure. Knowing where your animals are ranging, how the water supply is, and what they are grazing is the stockman's best bet.

"For some plants, such as Larkspur and Loco in fenced pastures, near corrals and loading pens for Spring Rabbitbrush and Milkweed, and where water is scarce, in the vicinity of springs for Water Hemlock, some grubbing about four inches down has been done with good results. Care must be taken to destroy the plants thus grubbed up, preferably by fire."

The Indian Service is constantly working with Indian stockmen on plans for managed and controlled grazing as the most practical method of avoiding losses from poisonous plants on range lands. There appears to be no panacea for feasible eradication of these dangerous plants. Hence, a practical way must be found to maintain the grazing areas in such condition that the livestock grazed thereon can find ample forage on non-harmful plants and thereby lessen the temptation to eat the toxic varieties.

THE U. S. BUREAU OF RECLAMATION'S FIGHT AGAINST WEEDS AS SHOWN IN MOTION PICTURES - Presented by Mr. R. B. Balcom -

Mr. Balcom showed motion pictures of fighting weeds as carried on by the U. S. Bureau of Reclamation. This picture was a very interesting one, showing the various ways the U. S. Reclamation Service are approaching the weed control problem. It not only was a very interesting picture to see but it was very educational, showing in detail many of the methods used for the control of various weeds. In this, they rather completely covered the field of weed control with all the known practices they have proven practical in the field of weed control.

The meeting was adjourned at 12:30 p.m., to be continued at 1:30 p.m.

The meeting was called to order at 2:00 p.m., February 27, by B.E. Kuhns, Chairman, who turned the meeting over to Dr. A. S. Crafts, Panel Leader, for a discussion on selective and contact herbicides.

DR. CRAFTS: I am going to introduce this panel with just a brief discussion of the mechanisms involved in the killing actions of contact herbicides. These herbicides destroy only the tissues with which they come in contact. There are two types: the selective and the general, or non-selective, types of contact herbicides. There are several mechanisms involved in the selective action of contact herbicides; that is, we recognize three that may act separately or together and there may be others not recognized. (1) There is differential wetting. I think most of us are familiar with the fact that if you spray a mixed crop with aqueous solution, you can wet the broad-leaf plants more readily than the cereal plants and probably a large percentage of the differential action in weed killing is done in this way. In the use of dinitro compounds, or 2,4-D, where wetting agents are not added, much of the differential killing is done by differential wetting. However, when we try to carry this action further by adding a wetting agent, we find we can push the contact killing just so far and then we fail to get further results. We tried to make a contact killer out of sulphuric acid. We could kill the tops of grass plants, but it is almost impossible to get aqueous solution down into the crowns of the grasses and kill them. The difference between cereal and broad-leaved plants is, most of the cereals have their growing parts down under the ground and it is almost impossible to get a killing solution into those parts. Broad-leaved plants have their growing points at the tip. When we want to kill cereals, we have to go to oils. Finally, we have biochemical differences. These are most noticeable in the use of selective oils, such as stove oils on carrots. The carrots are wet as much as the weed, but the carrots are not killed and the weeds are. The differential action of 2,4-D is evidently very largely of a biological character. We can use it in an aqueous solution, or we can put it into non-toxic oils and still get a selective action.

There is one other part of the mechanism of the selective action and that is activation. I think you are familiar with the term "activation" and most of you actually know the process by which we activate dinitro weed killers. We add an acid material; a plain acid, an acid salt or ammonium sulphate. I have a few copies of a reprint describing this process and you may want to have them. Briefly, with the dinitros, the chemistry is this: the dinitro phenols are more toxic to the protoplasm of plants than their salts. Dinitro cresol is more toxic than its sodium salt. Sinox is the sodium salt. By putting in an acid salt which converts a certain proportion of this to the parent compound, we get an increase of toxicity and a much more desirable effect. The amount of original material can be cut down because there is in the solution a certain proportion of the undissociated compound. As this compound is absorbed by the plant, more is formed from the sodium salt until all of it goes in.

MR. WESTGATE: I guess you have all heard of Sinox. It is used for killing mustard and radish out of grain, flax, onions, alfalfa, and peas. It is chemically a dinitro cresylate, and, as has been explained, we recommend the use of ammonium sulphate with it as an activator. I am wondering if we couldn't best get to the point by having you ask me questions about Sinox. If anyone has any questions, go ahead.

MR. ALBRIGHT: We used Sinox last year with very bad results. We are wondering if this was due to temperature or humidity, or just what the explanation might be.

MR. WESTGATE: What was it used on?

MR. ALBRIGHT: We used it to control weeds in onions.

MR. WESTGATE: Well, there have been a lot of bad results along with the good in the use of Sinox in onions. There are two difficulties that we have run into, one of which is that very commonly the grower waits until the weeds become too resistant for best results. We recommend strongly the use of one of the pre-emergence sprays before the onions come through the ground. One uses from 60 to 80 gallons per acre of stove or diesel oil, which kills the first crop of weeds. Later, when the onions have two or three leaves, we use the Sinox, at which time the weeds are small enough to kill without killing the onions. Another factor involved, particularly in Nevada, is that the humidity is very low and you just won't get results with Sinox when the humidity is below 25 per cent. It does not pay to try to spray with it under those conditions. It evaporates so rapidly that it crystallizes and is not absorbed by the plant.

MR. THORNTON: What is the rate of oil application?

MR. WESTGATE: Generally from 60 to 80 gallons per acre.

VOICE: Would early morning or late afternoon spraying be advisable?

MR. WESTGATE: Yes, it would. That is another means of getting around the humidity situation. Some spray in the evenings and some spray at night. Adding a little oil will also be of some help. We have run into that in the Bishop area, of California, which has a high altitude and very dry climate. We were spraying potato tops with Sinox, but by adding a little oil to the Sinox we got very rapid and good kills. Of course, I would not advise using oil on onions.

VOICE: That is a case of turning Sinox into a contact herbicide?

MR. WESTGATE: That's right.

MR. BALL: Have you done a great deal of work with dry forms of Sinox, or are you going to touch on that subject?

MR. WESTGATE: We do quite a bit of work with the dry forms of Sinox. We can and are manufacturing in a limited way the ammonium salt. When you add ammonium sulphate, you convert Sinox over to ammonium salt. We are manufacturing the ammonium salt directly in a limited way, due to war conditions. Eventually, Sinox will be in a dry form, 3 pounds of which will equal a gallon of the present Sinox.

MR. HARRIGAN: Could Sinox be used for fence line or roadside spraying?

MR. WESTGATE: I would not recommend Sinox or 2,4-D on fence lines or roadsides. In grain, we recommend the Sinox but care should be taken in case of star thistle to get it in an early stage and not let it form a large rosette. Along fences, however, 2,4-D is more practical, as you do not have to be so careful about the stage of it. Also, we put out a product, Stantox, which could be used in this case. We have sprayed several hundred miles of railroad rights-of-way during the past year.

VOICE: How does it work out on puncture vine?

MR. WESTGATE: We do not recommend it for puncture vine. There, again, one should use an oil contact killer.

VOICE: Is puncture vine killed quite readily with 2,4-D?

MR. WESTGATE: I do not know if 2,4-D would be practical on puncture vine. You would have to question someone else on that. How about that, Mr. Ball?

MR. BALL: Sinox is very effective. Oil is, of course, used quite generally. I understand this is our best herbicide for control of puncture vine.

DR. CRAFTS: If those are all the questions on Sinox, I will have Mr. Raynor tell us a little about their new Dow selective herbicides.

MR. RAYNOR: Regarding concentrations and applications of this material, they are as follows: For general broad-leaved annual weeds in grain, we suggest the use of 2 quarts per 100 gallons, applied at around 100 gallons per acre. For use on onions, flax, and peas, we suggest the use of some 2 or 3 pints per 100 gallons. When used at these concentrations, we have had excellent results in the control of broad-leaf weeds in these crops. I feel that alfalfa could also be sprayed to good advantage at the rate of 2 quarts per 100 gallons.

VOICE: Was your suggestion for alfalfa a selective action?

MR. RAYNOR: Yes.

DR. CRAFTS: As was brought out during our discussion and by the recommendations of the Research Committee, 2,4-D has possibilities as a selective herbicide. In this use of 2,4-D, the inclusion of a wetting agent might be a very serious matter. You want to get differential wetting and you don't want a wetting agent in the material.

DR. CRAFTS: If there are no questions, we will go on to selective dusts.

MR. BALL: Could you give us any information on airplane application of this dust?

MR. RAYNOR: Last year we treated considerable acreage of grain in the Midwest using a dinitro dust. It was applied by airplane, using 20 pounds to the acre. It is available in two forms, one the 15 per cent dust and the other the 10 per cent dust. Generally, the 10 per cent dust is used. Also, we used 10 per cent dust in the northern part of California. However, in California, under winter conditions, 15 per cent dust gives better results. In the Midwest, the weeds grow more rapidly in May and June, when they are more easily killed than under cold conditions.

MR. FREED: You implied a while ago that humidity was quite important in using a spray. Is that true of your dust, too?

MR. RAYNOR: Yes, we had quite a bit of experience last year in California, Montana, and the Mid-western States and found this to be the case.

DR. CRAFTS: We talked a little about 2,4-D dusts yesterday. I think we need to consider them from the standpoint of selective herbicides. Does anyone have any questions concerning 2,4-D as a dust?

MR. RAYNOR: What is the minimum of 2,4-D dust used non-selectively? From what little I know about it, it appears that about 30 pounds to the acre does a job equivalent to a spray.

VOICE: I would like to know if anyone concerned with this work would recommend about how much 2,4-D dust to put on non-selectively.

MR. HARRIS: We have made a very limited test on 2,4-D dust. We find that the dosage should be increased to compensate for lack of humidity.

MR. FREED: With 2,4-D as a dust, you are not going to control the drift, it is certain, in areas with a lot of susceptible crops adjacent. In other regions of large wheat areas in Washington, Oregon, and Montana, the dust may have possibilities, where other factors such as soil conditions and water supply have to be considered.

MR. JENSEN: Do you use the dust with an applicator on roadsides or fence lines?

MR. RAYNOR: Any kind of duster - knapsack duster, power duster, etc.

MR. JENSEN: We have never done that kind of work and I just wondered how that was handled.

MR. WESTGATE: About the main thing is that the usual duster is underpowered and in order to get an even distribution of dust in killing weeds in grain, it takes considerably more power than it takes to dust row crops like tomatoes. About the only difference, however, outside of the power requirement, is that you use a solid piece of boom about 2 inches in diameter, with 1/4 inch holes every 3 inches and your dust is blown into this boom and comes out of these 1/4 inch holes. With sufficient power, you can get an even distribution. The dust should be directed straight down to the weeds and not depend on a drift. Our experience is that drifts are ineffective.

MR. JENSEN: In your experience with using dust, does it reach all parts of the plant as does liquid spray?

MR. WESTGATE: It does not seem to make any difference. There is one difference, however, that we have observed. During certain stages of the development of some weeds, like wild radish, the crown is protected and the dust does not get into the crown as well as the liquid. In mustard, which does not have a crown, you can contact the growing points at most any time and the dust is as effective as the liquid.

DR. CRAFTS: Selective spraying on weeds in carrots with stove oil has become standard practice in the Imperial and Salinas Valleys of California.

VOICE: I notice there has been some selective oil spraying on celery beds in San Diego County. Can you tell us about that?

DR. CRAFTS: Selective oil spraying of celery should be limited to beds and on plants having one or more true leaves.

MR. BALL: Would you care to mention anything about oil in seed carrots?

DR. CRAFTS: Oil has been used in the production of seed in many of these crops that are resistant to the oil spray, such as carrots, parsnips and celery. Apparently, oil does not have any effect on germination of seed. Selective oil spray is used in the carrot seed crops.

MR. GARDELLA: What could you use to control wild flax in pastures?

DR. CRAFTS: Fortified oil should give good results. You could use dinitro cresol as a fortifying agent.

MR. JENSEN: I want to ask about radish seed. Have you anything to control annual weeds in radish seed crops? They are raising radish seed extensively in our county and that is one of the problems.

VOICE: There is a possibility radishes are more difficult to kill and actually are not susceptible to oil.

DR. CRAFTS: During lunch, someone mentioned 2,4-D as a selective in strawberries. Does anyone know about that?

MR. FREED: Very limited tests in Oregon show a high resistance to 2,4-D when used on small patches as a selective herbicide.

VOICE: The same thing is true with some of our bulb crops, like gladioli, which show a high resistance to 2,4-D.

MR. DAVIDSON: One small test was made in Gooding County this year and morning glory was killed and the spray did not hurt the strawberries.

MR. OTIS: We have been using selectives in Oregon for control of poison hemlock and also for the control of some of our perennial grasses. We have been using, principally, Sinox in a liquid form and the dosages vary from a little under a gallon to 1½ gallons per acre, with some ammonium sulphate added as an activator. We have been spraying fescues and several others and have had pretty good results. Most of that work is done with those annual grasses during the seedling year. We have treated a couple of them during the season with these selective sprays to control weeds. 2,4-D as a spray was used last year in a trial way, but it is my belief that a lot of 2,4-D will be used selectively on grasses for seed purposes this year.

MR. BALL: Have you had any experience with selective sprays on seedling grasses of milo or kafir corn types?

MR. OTIS: We have had no experience with selectives on this type of grass.

MR. RAYNOR: We used 2,4-D on milo without any apparent injury when dosage was kept below 1½ pounds per acre.

MR. WESTGATE: The same results have been obtained in corn.

MR. OTIS: In this discussion on selective spraying of grasses for seed production, we used in a small way some Dow selective dinitro compound which did a good job. In adding ammonium sulphate to Sinox as an activator, our growers have

gone one better and stepped up the ammonium sulphate to where it acts as a fertilizer as well. We have gone up to 50 pounds per acre on these seedling plants. However, that requires a little experience, as ammonium sulphate is a pretty good weed killer itself. I noticed a press release the other day stating that the Bureau of Plant Industry announced that nitrogen fertilizer did not affect the 2,4-D in any way and would give fertilizing benefits.

DR. EVANS: What is the limit of safety on ammonium sulphate with Sinox in most plants?

MR. OTIS: I don't know because I don't think there is any answer to your question. In the first place, each plant will have a different limit. We couldn't use as much on some susceptible plants, such as peas or flax, as we could on resistant grasses. Even in grasses we might have difficulty, as inferred by Westgate a few minutes ago. I mentioned we went up to 50 pounds per acre in ammonium sulphate for the 100 gallons per acre.

VOICE: What about quack grass?

DR. CRAFTS: Quack grass is a perennial and I don't think there is any place for contact herbicides on perennials. Now, I am going to ask Mr. Raynor to discuss dinitro herbicides.

MR. RAYNOR: Dow contact herbicide contains the same chemical as Dow selectives, but in a different form. Whereas ammonium salt is used in the selective, for general contact or general top killer, we use Dow contact in which the dinitro phenol is put into an oily carrier solvent. This solvent is then emulsified. Three gallons of this preparation to 100 gallons of water is effective in killing quite a variety of weeds and grasses. In some cases, it may be advantageous to add a little extra oil to the final spray solution. This is particularly true in long grass growths. We have used Dow contact herbicide in spraying alfalfa fields during the dormant season and in that case we used 2 gallons of concentrate per 100 gallons, plus about 10 gallons of diesel oil per hundred gallons and that particular solution took out foxtail, volunteer barley and chick-weed. Some applications were made by airplane, in which case no water was used, but the Dow contact herbicide was diluted with about 27½ gallons of diesel oil and that applied at the rate of about 30 gallons per acre.

MR. DAVIDSON: I was interested in spraying alfalfa. Would it be satisfactory to spray for dandelions during the dormant season?

MR. RAYNOR: I would not guarantee 100 per cent eradication of dandelions in the dormant season. It does not hurt the alfalfa crowns, even if they come out of dormancy.

MR. HARRIGAN: In using oil mixed with water, does the herbicide act as an emulsifier?

MR. RAYNOR: It will act as an emulsifier for limited additions of oil up to 10 gallons to the hundred. If you have good agitation, there is no difficulty in emulsifying.

MR. WESTGATE: Mine is the same story as Mr. Raynor has reviewed, except that Sinox General contains no oil. The grower would supply his own oil and that

would vary according to the conditions, generally 10 gallons to the 100 gallons of spray solution. About 1 quart of Sinox General, 10 gallons of diesel oil, and 90 gallons of water for general contact killer for ditch banks. It does the job of 100 per cent diesel oil, only where diesel oil runs to 6 or 7 cents per gallon, it is cheaper. As far as herbicidal activity is concerned, it is equivalent to diesel oil, only you use one-tenth as much.

DR. CRAFTS: Has anyone used a contact spray for killing potato tops?

MR. OTIS: There are several reasons why you kill potato vines. In areas suffering with late blight, it is important to have the tops dead so that there would be no need for early digging. Many things have been used in the past to artificially frost down potato vines. In Nebraska they are using an agricultural cutter. In Western Oregon we have used copper sulphate as a dust. I established a series of test demonstrations on different kinds of potatoes in different sections of the state. All are weed killers. I don't know what the effect is on yield. My guess would be that a vine frosted later will continue to grow and put on weight on the tubers, whereas those treated with weed killer may not gain. As far as I know, there has been no damage to the tubers or soil and that applies also to some of the commercial applications in Oregon. Usually, we can dig anywhere from 48 hours to 2 weeks after treating, depending on how well you want the skin to set on the potatoes. Blight organisms will be taken care of by any materials that will kill down the potato vines. We get rid of the blight spores that way.

Many things affect the ease of the kill and these determine the dosage. Mature vines that are yellowing kill easier than green succulent vines. On the other hand, commercial operators think the opposite. Temperature and stage of maturity are important. Both dusts and sprays are effective, and you can classify the sprays as fast and medium; you can classify the dusts as medium and slow. Copper sulphate dust and Sinox 15 per cent dust when properly applied will kill satisfactorily. It is important to have really high humidity or dew. We are recommending use of dust in Eastern Oregon. Spray materials were used and all of them worked rather satisfactorily. Ammonium cresylate dust is not readily available but when we can obtain it, it will do the job nicely at 45-50 pounds mixed with water and applied as a spray. Copper sulphate used as a spray is rather corrosive. Dow contact and Sinox general can be improved by the addition of some oil.

The Chairman introduced Mr. Fleming, Chairman of the POISON PLANT PANEL.

MR. FLEMING: Gentlemen, this is a subject usually given before a group of livestock men and I presume, possibly, one of the reasons we are discussing poisonous plants here today is that some of you may have the idea that some of these plants may be controlled by some means upon our range and pasture lands. If you will look into the literature you will see that many plants are listed as being poisonous but those that actually cause livestock losses are relatively few in number. I am now going to list the plants responsible for the deaths of livestock within the State of Nevada and the other gentlemen here belonging to the panel will probably enlarge upon it according to the poisonous plants not included but found in their States. The plants are death camas, greasewood, lupine, spring rabbit-brush, water hemlock, fit-weed, larkspur, several species of loco, various species of milkweed, meadow arrow-grass, chokecherry, and last but not least the recently introduced plant from Russia, Halogeton glomeratus. These are the plants, which year in and year out are responsible for losses of livestock in the State of Nevada. Some of them only occasionally cause losses; others are responsible for a large number of deaths. Are there any other plants any of you wish to add to this list? Dr. Robbins?

DR. ROBBINS: Well, as far as California is concerned, we have Klamath Weed or St. Johnswort and, also, you probably have heard of the work they have done on Datisca, the common name of which is Durango root.

MR. FLEMING: Does this list include the plants we may commonly expect death losses from here in the western country.

DR. ROBBINS: On the range on the western slope of the Sierras, it has been rather definitely determined as poisonous, outside of those you have mentioned.

VOICE: Did you list whorled milkweed?

MR. FLEMING: I just listed milkweed which includes the narrow-leaf milkweed in Nevada and the whorled milkweed in some of the other States.

MR. ALLEN: In Wyoming, salvia sage is poisonous to livestock.

MR. FLEMING: It is a new poisonous plant to me; I have no information concerning it as a poisonous plant.

MR. ALLEN: Tetradymia. Why do you call it spring rabbit-brush?

MR. FLEMING: Tetradymia, we call spring rabbit-brush in Nevada and in Utah they call it coaloil brush. It is called spring rabbit-brush because in late summer it has largely lost its leafy floral parts and appears as a somewhat leafless shrub. It might be well to briefly discuss each of the plants mentioned so that we can have a few minutes at the end of the discussion to take up the new poisonous plant Halogeton glomeratus which seems to be taking our ranges at an alarming rate. Death camas has been with us for many years and is found widely and abundantly distributed on all of our ranges. Years ago it was considered as being one of our most important range plants insofar as being responsible for the deaths of livestock. In the twenty to twenty-five years that I have been working with poisonous plants, I am beginning to view this plant with suspicion. Those losses I attributed to death camas in the years past, today I know were caused by other plants. I can cite you an instance of any area which supports a rather scattering stand of death camas. When all of the forage plants are grazed down, including the relatively unpalatable black-sage, you will still find the death camas untouched. If you intend to make feeding tests to cattle, you will find long before they have taken a lethal amount, that they become extremely sick. If you want to give them a lethal amount you have to force to feed them. Right now, I cannot visualize any loss that I can attribute to death camas, in spite of all that has been written and said about this plant. What do you think about it, Fred?

MR. KENNEDY: Well, I pretty much agree with you. There has been considerable literature written whereby they claim many losses of sheep from death camas. I have no definite proof that these deaths were caused by death camas. In fact, I heard of a sheepherder one time who boiled the roots of death camas and ate them. It made him pretty sick after eating boiled death camas.

MR. FLEMING: I would be rather reluctant to take a chance on boiling up the bulbs of the death camas because I am afraid it would do something rather than make me sick. Gentlemen, on account of the wide and abundant distribution of this plant, I think you can readily see there is no opportunity to try to eliminate or control it on our range lands. It covers so many acres of land that it would be a hopeless proposition. The common Greasewood is a plant that grows more or less in semi-alkaline areas. It is a plant that contains at its maximum a content of

around 12 per cent of oxalic acid. It is grazed by both sheep and cattle and is looked upon favorably as range feed. We have had rather large losses of sheep coming upon a very succulent growth and filling up on it, with resulting heavy losses. It is another plant which has a very wide and abundant distribution and we wouldn't want to consider banishing it from our rangelands. Does anyone want to add to this very brief discussion concerning Greasewood?

VOICE: When is it most poisonous?

MR. FLEMING: It is most poisonous from June until about the middle of August, when the oxalate content begins to decrease. The only cattle losses we have had have been down in Southern Nevada where the losses were caused more from mechanical or physical injury than from the toxicity of the plant. The plants were so heavily grazed that the animals ingested the larger woody stems and spiny parts.

MR. BALL: I think it might be of interest if, as we discuss each of these poisonous plants, anyone having control measures would bring them out.

MR. FLEMING: I think that is a very fine suggestion and if any of you do, I wish you would kindly stand, give your name and experience concerning the control or eradication.

VOICE: How much oxalic acid content is there?

MR. FLEMING: It varies, but the maximum is from 12 to 13 per cent.

VOICE: Is that on the green portions of the plant?

MR. FLEMING: Mr. Miller, will you kindly answer that question.

MR. MILLER: I recall an instance when the sheep accidentally ate the dead dry leaves. The green leaves and stems are the best part of the plant and I think the oxalic acid content in the small stemmed leaves ran equivalent to 25 per cent of the dried leaves.

MR. FLEMING: I think the analyses which have been made are of those portions which are edible to sheep and cattle. In other words, that would be the succulent stems and leaves. The lupine is another plant we have on most of our ranges in this western country. It is found on practically all of our range lands, particularly the sage type. It is more or less palatable, particularly in the Fall after frost. It is grazed by both sheep and cattle, with practically no losses among cattle but some rather heavy losses in sheep when the plant is in the pod stage and before the pods have opened and lost their seeds. Frequently the seeds are eaten by a weevil which helps to reduce losses.

MR. BALL: Would there be any information on control?

MR. FLEMING: Is there anyone who has tried to control lupine? It is a plant with a rather scattering growth, but in some places it is rather dense.

MR. HARRIGAN: What is the poison in lupine? Also, how much would it take for a fatal dose for cattle?

MR. FLEMING: As I said, we have had no losses that have been reported on the range where cattle have grazed upon the lupine plant. We have had losses in sheep in the pod and seed stage and it took 1 pound, 1-1/2 pounds, or two pounds to give the animal a lethal amount.

VOICE: What about the poison in small annual lupine that grows in pastures and fields?

MR. FLEMING: I do not know. We formerly had an annual lupine in this State, but it was rapidly disappearing about the time I came into Nevada and I doubt very much if you could find any of the annual lupine in any quantity at this time.

DR. ROBBINS: Is there any information, when chemicals are used to control lupine, of the chemicals attracting stock to the poisonous plants?

MR. FLEMING: Well, the only thing I would think would attract the animals to those plants after spraying would be if the animals were salt hungry and the spray contained some sodium or salt.

DR. ROBBINS: We had trouble one year where ordinary chlorate spray was used and cattle ate the plants primarily for the salt.

MR. OFFORD: We had similar trouble in Idaho a number of years ago. I believe the sheep ate some hemlock because the hemlock was sprayed and they went to the hemlock rather than to other forage.

MR. JENSEN: Do you think adding oil to the chlorate spray would make it sufficiently unattractive to animals so they would pass it by?

MR. FLEMING: I would be unable to answer that question. I am not familiar with the tests of the oil spray. Spring rabbit-brush (Tetradymia globrata) kills more sheep than any other plant in Nevada. It is a plant which has a very pungent odor when the tissues or green succulent buds are crushed. It makes its growth during the Spring and early Summer and has large flower buds, which are at times highly palatable to sheep. I remember the loss of 485 sheep just north of Reno, near the California line. The animals had trailed along the foothills for miles and miles over a range free of poisonous plants or at least not in sufficient quantity to cause such a large death loss. The sheep commenced to die after they had reached the shearing corrals. By trailing back fully eight miles we found a patch of the spring rabbit-brush that they had grazed; which brings up the point that sheep may commence to die at least eight miles away from where they picked up the poison.

Now let us discuss the larkspurs. The small larkspur has a wide and abundant distribution on our western ranges. It kills many cattle each year. It is non-poisonous to sheep as is the tall larkspur. The tall larkspurs are found in the mountainous areas, usually in isolated patches among the aspen groves, along streams and among the growth of snowberries or in moist deep soil. It is from these small isolated patches that we get a large loss of cattle each year and it would seem to me that we should consider the elimination of these so-called death patches. I think it would be a highly profitable operation. I will leave that for discussion.

MR. KERNS: I have been in the Grazing Service in Nevada and have a knowledge of cattle dying from eating larkspur. These larkspur are known to be abundantly found in the northern part of Washoe County, in Lassen County and also in Elko County.

MR. FLEMING: In that connection I would like to make this remark. Upon a pasture called Golliher Mountain Pasture, we have a considerable loss of cattle each year from larkspur poisoning. Year before last Mr. Mark Shipley went out onto some of those larkspur patches and placed a small handful of red rock stock salt on each clump of larkspur with the result that he practically eliminated the larkspur on the patches which he treated. I am quite certain that even red rock salt would greatly aid in the elimination or control of tall larkspur. Are there any more comments? We have only a very limited amount of time and therefore I am hurriedly skimming over the plants we have for discussion. I am going to skip over fitweed. It has a rather limited distribution and grows in the higher elevations along streams and near water. It is highly toxic to both sheep and cattle and its poisonous principle is more deadly than even strychnine.

MR. MILLER: I have not done any work on that plant for a number of years. Before the war, a chemist in Canada by the name of Mansky was working on the poisonous constituents of a number of plants and he and I had considerable correspondence and did several joint papers in regard to the alkaloids in the plants. There are a number of alkaloids in the plant and I thought I did pretty well to get four or five, but he worked out eight or nine more. Another alkaloid is narcotic. I don't think it is a great menace to the livestock industry, except in snow areas, but it is interesting to chemists. Perhaps if some of us would start work again, we would find four or five more alkaloids. The plant is highly toxic. In the area where we collected the material, it was very difficult to get enough material to work on because the cattle had gone in and eaten it all off. It was deadly to sheep.

MR. FLEMING: Water hemlock is deadly to all classes of livestock. It is found along irrigation ditches, in swamps and wet pasture lands. It grows quite tall and luxuriantly. The roots or tubers are highly toxic. The floral parts are not poisonous except in the early Spring when the plants are commencing to make their Spring growth. At this time the early greenish stems and early leaves are as toxic as the tubers. There have been many animals killed from eating water hemlock, particularly among cattle. It is a plant we should make some attempt to eliminate or control.

DR. ROBBINS: We have the same problem as you have.

MR. FLEMING: We have a plant growing in Nevada called Halogeton. It is of foreign introduction, having been introduced from Russia. It is an annual. Mr. Ben Stahlman was the first one to discover it growing on the range in the vicinity of Wells, Nevada. It was with considerable difficulty that he was able to get a positive identification. In 1942, 160 head of sheep died on the bed ground south of Wells, Nevada. We had the stomach contents of the sheep sent in together with some of the plants that the sheep had grazed. It was found that the sheep had eaten a considerable quantity of Halogeton. Up until that time it had been listed as a fair grazing plant for both sheep and cattle. Feeding tests to sheep proved it to be highly poisonous. Chemical analyses revealed that it had an unusually high oxalate content; running up to 20 to 22 per cent. It is a plant that has made a tremendous invasion on our ranges. I have brought in one of the plants and this

is the way it looks. This is the plant which is causing so much trouble on our Fall and Winter ranges. It is unpredictable when sheep will eat it. Apparently there appears to be a desire on the part of the animals to satisfy a salt hunger. Its spread in the State of Nevada has been very rapid. It is also in Utah and I understand it is in Wyoming, and this year we helped to identify the plant in Idaho in connection with a sheep loss that occurred in that State. Dr. Robbins, when this weed gets over into your State I don't know what will happen, especially upon lands where barley is grown and used for cattle and sheep grazing at a later date.

DR. ROBBINS: What was the year of introduction?

MR. FLEMING: We do not know when it was introduced but we do know it was first found in the vicinity of Wells in June of 1934. It has been listed as a fair feed for sheep and cattle. It is a plant that likes to invade the open bare spaces, particularly where there has been a surface disturbance of the soil, caused by the hoofing of livestock, along roadways or where road machinery has been working. On these disturbed and open areas it comes in with a high density of plants. We find it growing scatteringly in our sagelands, and even in areas where it is slightly alkali. It is found on some of our mountainous areas and on the alluvial fans. It is gradually working from the eastern part of the State to the western part. It is grazed very sparingly during the Spring and Summer months. All of the sheep losses have occurred during the late fall and early winter. Most of the time sheep will pass by and not graze it. At other times they will seek and graze it in preference to all the other available forage plants. Cattle show but little preference for it except when being trailed. Under such a condition they have but little chance to select their forage. They will grab a mouthful here and a mouthful there of any edible plant and under these conditions they have been observed to consume varying amounts of Halogeton. In the Fall the plant is dried like the specimen we have here. It has an oxalate content of about 20 per cent. On a range where we had a rather heavy loss it ran 20 to 22 per cent in oxalates. Immediately after the loss, a heavy snow storm came. Within a period of two weeks, there had actually been a loss of 64 per cent of the oxalate content in the plants between the time of the sheep loss and the melting of the snow.

It is now found in competition with the so-called alkali-weed (Bassia). In the Lovelock region we have a rather high invasion of Bassia and Halogeton is now coming into this area and you can find the two plants in competition. Which will get the upper hand I do not know.

MR. BURGE: I want to add my observation that it is invading the white sage areas, one of our best sheep feeds.

VOICE: Have you found any appreciable amount outside of your semi-desert types or sagebrush types in the invaded areas and at high elevations?

MR. FLEMING: I do not know what you call high, but we have found it as high as 5500 feet. We have found it in the sagebrush type. As a matter of fact, just outside of Elko, about 1 to 1½ miles, there is a small patch. A flock of sheep came along and cleaned out the Halogeton so thoroughly that all that was left was a few seedlike remnants on the ground. It is a plant that is getting into our sagebrush land and there are very few types it will not invade. We had a rather unusual loss down at Lovelock the latter part of December. 4,000 head of sheep were being fed alfalfa. They decided to move the sheep from this range to another range six miles distant. 2,000 head were put into each flock, one flock to go the foothill

trail and the other the fence line trail. The sheep along the foothills had no loss. The sheep along the fence lines in six miles began to die. They lost 130 head in that flock over that short distance of trail. I inquired whether the sheep had been salted and I found that they had not been. I could tell you a great many things about when sheep will eat it and when not, but I am imposing on someone else's time.

VOICE: Regarding the control of these poisonous plants out on the range, I think it is going to be quite possible to control some of them by means of chemicals. I refer particularly to tall larkspur in patches, the hemlock along streams and, possibly, the whorled milkweed. We can look forward to the employment of dust we have been talking about.

MR. KUHN: This concludes our formal meeting, and I will now open the meeting for reports of committees and any other business that you might wish to present. Let us first have the report of the Research Committee and Mr. Harvey.

REPORT OF THE RESEARCH COMMITTEE RELATIVE TO THE USE OF 2,4-D - Mr. W. A. Harvey: Chairman, Experiment Station, University of California, Davis, California.

The committee would like to emphasize the need for further coordination of the research programs of the various State, Federal, and commercial agencies. It is felt that a greater interchange of information between agencies as well as some specialization by certain agencies would be highly desirable. Thus an organization with a field force working over a considerable territory would be adapted to obtaining information on a wide range of species and environmental responses. Other groups are better equipped to handle greenhouse or laboratory studies and could concentrate on the more fundamental problems including translocation, relation of chemical structure to toxicity, soil factors, etc. These recommendations are not intended to limit the research activities of any group but rather to increase these activities in the fields where a particular group is best qualified to obtain information.

The committee would like to emphasize that the present information on 2,4-D is incomplete and that much of the work is preliminary. Thus the recommendations given herein are tentative and should be considered subject to revision as our information and knowledge increases. It would be well to consult local agencies such as Farm Advisors, County Agents, Agricultural Commissioners, Experiment Station workers or Extension Services who may have definite and more specific information for local conditions.

The following is recommended as a general guide for testing 2,4-D but should not be considered as supplanting available local information.

1. Established grass lawns, turfs, grass pastures and grass seed fields - 1½ pounds 2,4-D acid or equivalent per acre in 100 to 200 gallons of water. At the seedling stage use no more than 3/4 pound 2,4-D acid or equivalent per acre.

2. For the control of young broad-leaved annual weeds in corn, barley and wheat - ½ to 3/4 pound 2,4-D acid or equivalent per acre in 100 gallons of water.

3. For the control of the listed susceptible weeds, with the expectation of some regrowth occurring in the case of creeping perennials - 1½ to 3½ pounds of 2,4-D acid or equivalent per acre in sufficient water to give coverage.

4. For the prevention of seed formation by weeds with properly timed applications of $1\frac{1}{2}$ to $3\frac{1}{2}$ pounds of 2,4-D acid or equivalent per acre in sufficient water to give coverage.

Note: Proper conditions for the application of 2,4-D as a spray are considered to exist at a time when the weeds are in a state of active, vegetative growth.

Below are given the acid equivalent factors for a number of the 2,4-D products now available. In using these factors, multiply the factor by the number of pounds of the chemical to get the acid equivalent. For example, the sodium salt has an acid equivalent factor of 0.91. One pound of sodium salt is then equivalent to 1 x 0.91 = 0.91 lbs. of 2,4-D acid. One pound of a material containing 60 per cent of the sodium salt is equivalent to .60 x 1 x 0.91 = 0.546 pounds of 2,4-D acid. These factors can only be used for weights. For liquid preparations it is necessary to know the weight per gallon. For a liquid material containing 20 per cent methyl ester and weighing 8 pounds per gallon, one gallon is equivalent to .20 x 8 x 0.94 = 1.504 pounds of 2,4-D acid.

Compound	Acid Equivalent Factor
2,4-D acid	1.00
Sodium salt	.91
Ammonium salt	.93
Triethanolamine salt	.60
Methyl ester	.94
Ethyl ester	.89
Iso-propyl ester	.84
Butyl ester	.80

It should perhaps be pointed out that these are chemical equivalent factors. Some products may be more or less active, as far as weed killing is concerned, than the chemical equivalent would indicate. However, until definite information is available, it would be best to make comparisons on chemically equivalent amounts. Likewise, two products containing the same equivalent of acid may give different results on weeds because of differences in amount or composition of wetting agents or emulsifying agents which they contain.

Susceptible	
Annual sow thistle	(Sonchus oleraceus L. & S. asper (L.) Hill)
Austrian field cress	(Roripa austriaca Spach.)
Black medick	(Medicago lupulina L.)
Blue lettuce	(Lactuca pulchella DC.)
Bull thistle	(Cirsium lanceolatum (L.) Scop.)
Burdock	(Arctium minus Benth)
Bur-reed	(Sparganium spp.)
Chicory	(Cichorium Intybus L.)
Cockle bur	(Xanthium canadense Mill.)
Common mallows	(Malva parviflora L. & M. rotundifolia L.)
Curley dock	(Rumex crispus L.)
Dandelion	(Taraxacum vulgare (Lam.) Schrank.)
False dandelion	(Hypochoeris radicata L.)
Fanweed	(Thlaspi arvense L.)
Fennel	(Foeniculum vulgare (L.) Gaertn.)

Heal-all	(Prunella vulgaris L.)
Lambs'-quarters	(Chenopodium album L.)
Lawn pennywort	(Hydrocotyle umbellata L.)
Milk thistle	(Silybum marianum Gaertn.)
Mouse-ear chickweed	(Cerastium viscosum L.)
Mustards	(Brassica spp.)
Nettles	(Urtica spp.)
Perennial dogbane	(Apocynum cannabinum L.)
Perennial ragweed	(Ambrosia psilostachya DC.)
Plantains	(Plantago spp.)
Poison hemlock	(Conium maculatum L.)
Prickly lettuce	(Lactuca scariola L.)
Prostrate pigweed	(Amaranthus blitoides Wats.)
Purslane	(Portulaca oleracea L.)
Rough pigweed	(Amaranthus retroflexus L.)
Shepherd's purse	(Capsella Bursa-pastoris (L.) Medic.)
Spiny clotbur	(Xanthium spinosum L.)
Sweetclover	(Melilotus spp.)
Tule	(Scirpus acutus Muhl.)
Tumbling pigweed	(Amaranthus graecizans L.)
Water hemlock	(Cicuta spp.)
Wild carrot	(Daucus Carota L.)
Wild morning-glory	(Convolvulus arvensis L.)
Wild radish	(Raphanus sativus L.)
Willow	(Salix spp.)
Yellow star thistle	(Centaurea solstitialis L.)

Intermediate

Common cattail	(Typha latifolia L.)
Golden rod	(Solidago spp.)
Hoary cress	(Cardaria spp.)
Knotweed	(Polygonum aviculare L.)
Oxalis (green)	(Oxalis corniculata)
Sheep sorrel	(Rumex Acetosella L.)
Spotted spurge	(Euphorbia maculata L.)
St. Johnswort	(Hypericum perforatum L.)

Resistant

Alkali mallow	(Sida hederacea (Dougl.) Torr.)
Blackberry	(Rubus spp.)
Bracken fern	(Pteris aquilina L. var. lanuginosa (Bory)Hook.)
Button willow	(Cephalanthus occidentalis L.)
Canada thistle	(Cirsium arvense Scop.)
Dog fennel	(Anthemis Cotula L.)
Horsetail	(Equisetum spp.)
Leafy spurge	(Euphorbia Esula L.)
Milkweed	(Asclepias speciosa Torr.)
Oxalis (red)	(Oxalis corniculata var. atropurpurea Planch.)
Perennial ground cherry	(Physalis spp.)
Poison oak	(Rhus diversiloba T. & G.)

Russian knapweed	(Centaurea repens L.)
Tansy ragwort	(Senecio Jacoboea L.)
Toad flax	(Linaria vulgaris Mill.)
Yarrow	(Achillea Millefolium L. var. lanulosa Piper)

Research Committee

W. A. Harvey, Chairman
R. N. Raynor
Lin E. Harris
Bruce J. Thornton
C. I. Seeley

MR. KUHN: We will now have a report from the Resolutions Committee and Mr. Morris.

MR. MORRIS: The Resolutions Committee met and did not have a great deal of help from the floor, so we had to depend a great deal upon ourselves. Following is Resolution No. 1:

WHEREAS, the weed problem is a serious menace in all sections of the United States and especially on irrigated and range lands in the Western United States, and

WHEREAS, this problem affects practically all classes of people and there is an ever growing demand for public assistance in combating weeds, and

WHEREAS, widespread interest is being shown in research methods designed to solve or minimize the weed problem, and

WHEREAS, this widespread interest and participation in weed research by State Experiment Stations, manufacturers of chemicals used in controlling weeds, and by many other agencies needing coordination of research effort and direction of eradication programs,

NOW, THEREFORE, BE IT RESOLVED, That the Western Weed Control Conference, assembled at Reno, Nevada, February 26 and 27, 1946, recommend to the Honorable Secretary of Agriculture and to the Chief of the Bureau of Plant Industry, Chemistry, Soils and Agricultural Engineering that a separate Division of Weed Research and Control be established to carry out adequately the needs of this program; and that additional regional experimental work be carried on by the government in the irrigated sections of the West on control of important noxious weeds, and that the work of the proposed new Division be closely coordinated with the work of the State Experiment Stations.

Is there any discussion?

MR. BALL: About the same resolution was passed at the meeting of the North Central Conference, at St. Paul. I believe the thought was to coordinate that action.

MR. FREED: I believe this same point came up last year at Boise and I believe a Federal man at that time pointed out that a separate division would not be advisable and that the matter would fall under the jurisdiction of the Division of Cereal Crops.

MR. BALL: The same Federal agents were at the meeting in St. Paul.

MR. THORNTON: We should make some effort to get these Resolutions to the right people, such as Congressmen, etc.

MR. BALL: Last year, I sent them out to each State official and requested each official to bring them to the attention of his Congressional Delegation.

MR. HARVEY: I think some importance should be attached to the timing of our resolutions. If the North Central Conference sent theirs in one month and some other group sent theirs in a few months later, there is not enough pressure on the Congressmen at the same time.

The first Resolution was moved for adoption and carried.

RESOLUTION NO. 2:

Be it further resolved that the Western Region of AAA incorporate into their 1947 AAA docket a practice payment for the use of 2,4-D in accordance with recommendations outlined by the Research Committee Report that was adopted by the Western Weed Control Conference.

It is further recommended that the State Technical Advisory Committee recommend that their State AAA Committee also incorporate a practice payment for the use of 2,4-D in the 1947 docket.

MR. KUHNS: Any discussion relative to the resolution including payments for the use of 2,4-D in Triple A practices?

DR. HARSTON: I suppose the Committee has given it consideration, but I am wondering if it would be possible to get it in for 1946.

MR. MORRIS: If it is advisable, I know the Committee will favor changing the dates.

MR. BURGE: I have heard at least one Triple A man today express his hope that this would not be placed on the Triple A program on the basis that only one perennial has been placed on the list.

MR. BALL: I happen to be on the State Technical Committee and was asked for definite recommendations to be included in the 1946 program. I reported that until more is known about it, I could make no recommendation.

This resolution was moved for adoption and lost at a vote of 8 to 12.

This completed the report of the Resolutions Committee.

Resolutions Committee
H. E. Morris, Chairman
R. J. Evans
C. E. Otis

MR. KUHNS: Mr. Balcom, will you give us a report on your meeting relative to Federal agents becoming members of this organization?

MR. BALCOM: At a meeting this noon we got together with Government agencies and it seems that there is no way to obtain funds from a Government organization for joining any type of conference such as this. However, it was the consensus of opinion that we would like in some way to pay for the services that we get. We would like to get into it in an official manner. We felt that if we could pay a registration fee we would certainly want to do so.

MR. KUHNS: I would like at this time to give you the personnel of the Research Committee for the coming year:

Wm. B. Fox
D. C. Tingey
C. I. Seely
H. E. Morris
Lambert Erickson
L. E. Harris
W. A. Harvey
Bruce J. Thornton
L. M. Pultz
Virgil Freed
H. R. Offord
Dayton Klingman
R. N. Raynor

MR. HARVEY: We felt, if we were going to make recommendations we would like to have at least one research man from the States involved.

MR. KUHNS: The work of the Research Committee is what the work of the entire conference will be built around for the next few years.

It seems advisable at this time to do a little work on the by-laws for the purpose of bringing them up to date and making them satisfactory for an enlarged organization.

MR. BALL: The by-laws, as first set up in Denver, were really not too complete. There was never a constitution drawn up, but rather a form of objectives and by-laws and since then we have made some changes and gone ahead without amending the by-laws as written. We are also having our seed meeting tomorrow, at which time this organization is contemplating organizing and we are trying to set up by-laws whereby these two groups will meet together annually. We have gone over with the committee the by-laws of that group and it would be in order to get these two groups closer together. The by-laws of this organization should be brought up to conform with that group.

MR. KUHNS: I have appointed Mr. Morris, of Montana, as Chairman, Dr. Harston, of Wyoming, and Mr. Thornton, of Colorado, on a committee to give consideration to this matter. One reason for selecting them is because they are from the same section of the country and also members of the Seed group.

We thought it well, if possible, to select the place for our next meeting and announce it here. We have asked Mr. Freed, Chairman of the Program Committee, to work that out.

MR. FREED: We selected Portland, Oregon, for the next meeting, about this time of year.

MR. BALL: I am also wondering if we could get some idea of the type of program we would like to have.

MR. FREED: Do a little bit less 2,4-Ding and maybe a little more hoeing. We will try to cover the field of weed control, taking up chemical work, cultural work, cropping practices,etc., and try to get a better picture of weed control. Further along that line, we had some discussion to extend the meeting to about $2\frac{1}{2}$ days in order not to crowd the meeting.

MR. KUHNS: We shall now have the report of the Nominating Committee, Mr. Burge.

MR. BURGE: Your Nominating Committee have selected the following as officers for the next year:

Mr. H. L. Morris, Chairman
Mr. V. H. Freed, Vice-Chairman
Mr. Walter S. Ball, Secretary-Treasurer

It was moved by Lin Harris, seconded and carried, that these appointments be adopted.

MR. YOST: I have enjoyed the meeting and feel that I got a great deal of good out of each of the sessions and wish to again invite each and every one of you to attend the North Central States Weed Control Conference. If any of you are interested, get in touch with Mr. A. H. Larson, Botany Department, University Farm, St. Paul, Minnesota.

MR. BALL: Dr. Crafts and I got together and sent out invitations to join our group to all of the manufacturers we could think of. If you know of anyone we forgot, please let us know. I believe this should also include the equipment people. I should also like to thank our good friend, Lee Burge, who has really helped us during the last year.

The meeting was adjourned.

Listed below are the members who took part in the panel discussions:

1. Panel discussion on 2,4-D -- Leader, W. A. Harvey
C. E. Otis
A. S. Crafts
R. N. Raynor
V. H. Freed
George Hobson
George B. Harston

2. Panel discussion on selective and contact herbicides --

Leader, A. S. Crafts
Linn Harris
W. A. Westgate
R. N. Raynor
C. E. Otis
L. M. Burge

3. Panel discussion of poison plants and their relation to the livestock industry --

Leader, Charles Fleming
M. R. Miller
Fred Kennedy
W. W. Robbins
Nic Monte
George Hobson
J. N. Grimes
V. H. Freed

WALTER S. BALL
SECRETARY-TREASURER