HISTORY OF THE WEED PROGRAM IN THE DEPARTMENT OF AGRONOMY[1]

by Lowell W. Rasmussen[2]

In The Beginning

Weeds have plagued crop and livestock production since the beginning of plant culture and livestock husbandry. For many years weeds were controlled by crop rotation, clean cultivation, inter-row cultivation, hand weeding and hoeing or pulling. Other methods included mowing or hand cutting, grazing and burning top growth to prevent seeding. The devastation caused by weeds was more subtle than infestations of insects or diseases and, consequently, the call to science for help in control did not arise until the early part of the twentieth century.

Instruction program: The farm crops section of the department recognized the need to provide help in combating the threat of weeds in cropland. As a first step, a two-credit lecture course was offered to students in the Fall of 1915. This was described as a study of noxious weeds with reference to control and eradication. The course dealt with methods of weed propagation, distribution, life cycles and effects on field crops with the eradication of weeds as the stated goal. Students were required to have a background in botany before enrolling in the course.

This course was included in the farm crops curriculum through a succession of years with Professor E. G. Schafer providing the leadership. He was assisted at times by instructors R. L. Buchanan, E. D. Alvord, A. Floyd Heck and A. L. Hafenrichter.

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In 1925 the format of the course was changed to one hour of lecture and two hours of laboratory work per week. Apparently low enrollment resulted in the course being offered only on alternate years beginning in 1939-1940.

During the mid 1940's increased emphasis was placed on weed plant identification, ecology and control while eradication was de-emphasized.

Research: The thirty-fourth annual report of the Agricultural Experiment Station, 1924, stated "The weed problem is one of the most difficult with which farmers in eastern Washington and also in western Washington have had to contend. The wild morning glory, perhaps the most serious pest in the state has taken possession of over ten thousand acres in one county in eastern Washington". Canada thistle, sow thistle and blue flowering lettuce were declared to be serious pests and difficult to control. The report also pointed out that satisfactory control methods were unknown.

Very little research work had been done by 1924 and it was recognized that it could not be done until someone in the Farm Corps Department could devote sufficient time to weed research. Prelimiary field plot experimentation was begun in 1925 as a part time activity by Professor Schafer. He sought practical methods of eradicating perennial weeds by tillage methods and chemical applications. In 1926, Schafer set up an experiment in a bindweed (morning glory) infested area to determine the effectiveness of clean cultivation and chemical application treatments as control methods. The cultivation consisted of 40 to 45 cultivations, cutting the plants at a depth of 3 to 5 inches underground throughout the growing season. His brief report did not specify the chemicals used in the trials.

In 1927, Mr. O. C. Lee joined the crops staff to work with Professor Schafer. Lee noted the rapid spread of bindweed throughout cultivated fields and he intensified research on clean cultivation, cropping, pasturing and

chemical applications. He used sodium chloride, sodium chlorate, arsenicals, carbon bisulfide and sulfuric acid. By 1928, he concluded sodium chlorate was the most effective chemical herbicide and expanded his studies to the control of Canada thistle. He noted the danger of sodium chlorate use in 1929 and sought ways to minimize the fire hazard of this compound.

A. L. Hafenrichter of the crops staff joined the weed research effort as did J. R. Nellor of the Division of Chemistry. With their input the research was expanded to determine more precisely the quantity of chemicals needed for effective control of bindweed and Canada thistle. Field plot studies were set up in other parts of the State in response to increasing demands for effective control measures and methods.

During the early 1930's, sodium chlorate dominated as the most effective herbicide but, in addition to its causing a fire hazard, it caused clay deflocculation and sterilization at the required effectve application rate of 300 pounds per acre.

J. R. Nellor cooperated in the research only a couple of years but Schafer and Hafenrichter continued the studies, focusing on the use of sodium chlorate and its problems through 1933.

Early in 1932, Professor Schafer wrote a letter to several county agricultural agents throughout the State asking each for information on the effects of chemical weed control treatments. He received and summarized replies from fifteen agents. Sodium chlorate and atlacide (calcium chlorate) were reported to be generally satisfactory for the control of Canada thistle and bindweed.

C. I. Seely was appointed assistant in agronomy, June 15, 1934, to work on the weed research program. A year later, however, he was named acting superintendent of the Adams Branch Experiment Station in Lind, Washington. He

continued studies on the use of sodium chlorate on bindweed and further warned of the fire hazard caused when this chemical was combined with organic matter. He also found that the toxic effects of this herbicide persisted in the soil for two to three years.

By this time, in the western most part of the state around Long Beach, cranberry growers were losing the battle to weeds. D. J. Crowley, Superintendent of the Cranberry-Blueberry station, initiated experiments to determine the possibility of finding an effective chemical herbicide to use in and around the bogs. Sodium chlorate, atlacide, arsenicals and petroleum oils were tried. In addition, he tested the use of copper sulfate, sodium arsenite and sulfuric acid. No encouraging early success was reported from these studies.

In 1936, the agronomy weed program began a cooperative program with the United States Department of Agriculture Bureau of Plant Industry and the Idaho Experiment Station. The field research included further studies on mechanical tillage and crop rotations, specifically as they affected the root food reserves of perennial weeds.

In 1938, William A. Harvey was appointed assistant in farm crops, for weed control research. He worked with the ongoing studies in eastern Washington. A year later he initiated a cooperative program with the Indian Irrigation Service and farmers in the Yakima Valley.

The team of Schafer, Seely and Harvey continued the cultural and chemical weed control studies in the Palouse and Yakima farming area. In addition to studies on Canada thistle and bindweed, they worked on Russian knapweed, white top and blue flowering lettuce. They reported in 1938, that a combination of cultivation, cropping and chemicals was most effective. They found that clean cultivation at 8 to 12 day intervals effectively reduced the root reserves of

perennial weeds.

Harvey's research in the irrigated fields of the Yakima Valley included clean cultivation, cropping and chemical herbicides. He also tried a method of impounding water at a depth of 3 to 4 inches on areas of Russian knapweed and of white top for periods of three months in late summer and fall with encouraging results. He did some plant propagation studies on white top which revealed that seedling plants, eight weeks old, could reproduce vegetatively when the tops were removed.

The onset of the war in the early 1940's, brought about a change in the weed research program. Sodium chlorate and calcium chlorate became scarce and then unavailable. Two new compounds ammonium sulfamate and sulfamic acid became available. Then in 1944, 2,4-dichlorophenoxyacetic acid compounds began to be offered as herbicides.

Harvey and Seely continued the research they had underway and focused attention on root reserves and the reproduction of perennial weeds. In 1943, an enlarged cooperative research effort was begun on a bindweed-infested farm at Genesee, Idaho, with Seely as principal in charge. Harvey spent most of his time in the summers with the research in the irrigated Yakima Valley. He made a survey of aquatic plants causing hindrance to the flow of water in canals and reported that the problems were becoming serious.

The possibilities of selectively killing weeds among crops and other desirable plants began to appear worthy of research. Other new and potentially selective herbicidal chemicals that emerged were Sinox (4,6-dinitro-o-cresol, sodium salt) and D-D (a mixture of dichloropropane and dichloropropylene).

Selective weed control by the use of herbicides created a vision with broad possibilities and brought researchers outside the Agronomy Department

into the studies. As noted earlier, research had begun in the cranberry bogs. Horticulturists, C. L. Vincent, L. R. Bryant and F. L. Overley saw possibilities for solving weed problems in vegetable fields and orchards. Zinc sulfate showed promise for weed control in cranberry bogs. At the Tree Fruit Experiment Station, Wenatchee, ammonium sulfamate appeared effective in orchards for the control of poison oak, bindweed, Canada thistle, milkweed and Russian knapweed.

Other studies showed Sinox to be useful in grass seedings and in lawns. Diesel oil, stove oil, and kerosene showed effectiveness for killing young weeds in carrot fields.

W. A. Harvey resigned in February 1945, and was replaced by W. B. Fox the following September. While new field trials aimed at learning the possible uses of 2,4-D in agronomic and horticultural crops, some attention by Schafer and Fox was directed towards the problem of Klamath weeds on range lands. A series of plots of chemical and cultural treatment to control Klamath weed were set out in Marble Valley in Stevens County.

Post World War II Programs

The tempo of weed control activities began picking up dramatically as farmers eagerly sought effective means of controlling weeds in crop fields. Chemical firms, freed from war production activities, turned to civilian goods and the herbicide potential looked good. Compounds such as the various salt, amine, and ester forms of 2,4-D showed considerable usefulness as selective herbicides. Consequently, pressure and demands for reliable information grew dramatically for scientists to provide the parameters of use for each new herbicide. In Washington, as in every other state, research had to be initiated to test herbicidal effectiveness, selectivity characteristics, plant reactions, persistence and movement in soil. Concern soon arose over the

potential hazardous effects of the new herbicides. The weed plant species and their crop or ecological associations were recognized as factors influencing weed control and crop yield. Micro-environments such as soil types, moisture levels, topography influenced control activity. Consequently, research results on herbicidal use could not be extrapolated very far beyond the site of the research. This led to the need for research directed at specific weeds in specific crops or in specific environments. Washington, with a vast array of crops and environments, demanded weed research in at least three major areas, eastern non-irrigated, central irrigated, and western humid environments.

Campus Headquarters: In July 1947, Lowell W. Rasmussen began service as assistant agronomist leading the research and teaching of weed science. There existed an urgent need for field research and for physiological studies on plant mechanism response as well as to identify and understand herbicidal action. At that time there was no laboratory in the Crops Section of the Agronomy Department in which physiological and chemical studies could be done. A small room in Wilson hall became available and, after about a year and a half, it was remodeled and equipped for this phase of research and for use by students who began to pursue advanced degrees with principal research in the speciality of weed science.

The field research in eastern Washington focused on selective control of annual weeds in wheat fields and on the action of new herbicides on the control of the perennial weeds, Canada thistle and bindweed. The primary attention was on the use of 2,4-D in its various forms as this was the herbicide vigorously being pushed by commercial interests and eagerly sought by farmers as the hoped for "easy cure" for their weed problems.

Field research was confronted with difficult problems of measuring and

quantifying the effects of herbicides on weeds and crops. Consequently, considerable effort was devoted to studies of experimental designs, plot sizes and plot sampling techniques to measure the effects of herbicidal treatments on the weed infestation and the crop yield.

The outflow of new chemical herbicides accompanied by claims for various uses kept the pressure on for research to determine their real usefulness, if any, for weed problems and to identify their limitations. A critical need became evident for a herbicide which would effectively and selectively remove grass weeds from crop fields.

Opportunity arose in 1949, to investigate the possibility of biological control of Klamath weed. James Holloway, a U.S.D.A. scientist in charge of a biological control project in California reported that Chrysolina beetles fed on Klamath weed plants exclusively. Rasmussen was able to get two small lots of these beetles from Holloway to see if they might survive the winter in Washington. These beetles were released in Klamath weed patches north of Spokane, one at Chatteroy and another at Addy. The beetles survived and reproduced and in late 1950, arrangements were made to get several lots of beetles from California in the spring of 1951. Releases were made at three locations in western Washington and four locations in eastern Washington. H. S. Telford of the Entomology Department cooperated in these releases and subsequent studies of the beetles. In a way they were too effective. They reduced the Klamath plants so completely that the beetles died for lack of food.

Coordination and Dissemination

The rapid growth of the weed research programs throughout the country brought out the need to coordinate activities and to share research techniques, results and problems. A program of regional research set up by

the Experiment Station Section of U.S.D.A. and the regional associations of state experiment station directors afforded an opportunity for cooperative weed research and the coordination of planning. Washington state scientists joined in the first regional project and continued this effort. The coordination aspect of these regional projects proved to be the outstanding feature.

Another mechanism of coordination and dissemination of information was a fledgling Western Weed Control Conference. This body which met annually brought together industry representatives, research scientists, regulatory representatives, commercial applicators and any other interested persons to report on problems, new herbicides, research in progress and tentative results of control activities.

Early in the 1950's a Washington State Weed Association was organized in response to needs envisioned by researchers, state and county weed control authorities, commercial company representatives and leading farmers. This group sponsored annual meetings for the exchange of information on weed control materials and methods.

Herbicide Problems: The effectiveness of 2,4-D herbicides in controlling annual weeds in wheat fields led to widespread use. Innovative methods of application were used with varying degrees of success but occasionally causing unforseen damage beyond the treated area. In the Palouse farming area, pea fields intermingled with wheat fields; in south central Washington, grape vineyards are near dryland wheat fields; and in irrigated areas, many crops sensitive to 2,4-D herbicides occur near grain fields.

Large field application of herbicides required equipment for timely application at the proper time. Such equipment had to be developed. Some emerged as modifications of orchard sprayers for insect control and often

continued the use of high pressure to fog the herbicide spray but making it highly mobile in wind movements. Some equipment applied the herbicides as a dust formulation which also was readily carried afar in the wind. Consequently, nearby fields, farmsteads, orchards, and towns where herbicids sensitive plants grew showed varying degrees of 2,4-D damage. Disputes and law suits ensued. Extension specialists and weed researchers joined forces to provide schools, conferences and consultation for applicators and growers to teach methods of application to minimize or avoid such damage.

Annually, during the early years of 2,4-D herbicide use, 1948-1956, conferences were alternated between Yakima and Wenatchee at which aerial applicator operators met with entomologists and weed scientists to consider problems and their solutions in the aerial application of pesticides.

Aerial spraying of 2,4-D/2,4,5-T to defoliate vegetation in Vietnam jungles worsened the public image of these generally useful herbicides. As used in that situation, the damage was serious, but that use amounted to application of quantities far in excess of that needed for control of weeds. As a consequence, weed scientists, entomologists and their extension specialist associates have faced a continuing challenge to develop means and methods of minimizing damage. A result has been the development of control methods utilizing combinations of cultural and chemical methods. These have reduced the demand for, and the reliance upon, chemical pesticides.

The growing use of herbicides for selective weed control in crops led to concern for residues in food and feed crops. In 1954, the Federal Food, Drug and Cosmetic Act was amended to establish residue tolerance for pesticides on food, feed and fiber crops. At Washington State University the Agricultural Chemistry department began a program of pesticide residue testing. In 1962, Richard Maxwell became assistant agricultural chemistry scientist for pesticide regulations and to provide information to scientists on residue

tolerances and registration requirements. These safety regulations slowed down the outflow of new pesticides as each one had to be shown effective for each intended use; and residue levels had to be at or below specified legal levels. Much additional research had to be done by herbicide manufacturers, federal and university scientists to obtain reliable data upon which tolerances could be based to furnish guidelines for use of each pesticide in the desired environmental situation. Agricultural chemistry became a vital participant in the whole pesticide use arena.

Continuing Research: Lowell Rasmussen transferred from the weed program in 1956, to become Assistant Director of Research at the Agricultural Research Center.

In the fall of that year, Thomas J. Muzik, an experienced weed scientist at the Puerto Rico Research Station accepted the position in charge of the weed program at the campus. He continued research on selective weed control in crops and on rangeland in eastern Washington. His field research shifted towards the control of downy brome grass in wheat fields and on semi-arid rangelands. Wild oats in pea and wheat fields continued to be a difficult problem and demanded some research attention as new selective herbicides became available.

The physiological action of various herbicides and their persistence and movement in plants and in the soil were studied. These studies provided opportunities for graduate student theses research which characterized the program directed by Muzik.

In the mid 1970's, the U.S.D.A., A.R.S. program in soil, water and land management cooperative with W.S.U. was expanded to investigate the feasibility of reduced tillage. As a result more research on methods of controlling weeds was required. A.R.S. scientists Larry Morrow, Frank Young and David Gealy

were added to the faculty. Their research was directed toward the control of grass weeds, namely downy brome, wild oats, goatgrass, and rye. Morrow resigned to accept a position with a commercial firm. To fill the vacancy, Alex Ogg was transferred to Pullman from the Prosser station faculty.

In the late 1970's, Dr. Muzik took leave from the W.S.U. weed program to accept foreign service work. Dr. Ralph Whitesides was named assistant agronomist for the weed program in September 1981. Inasmuch as the A.R.S. weed research was focused on weed problems under limited tillage operations, he chose to focus attention on problems of broadleaf weeds in crops under conventional tillage. Research time was divided about equally between herbicide screening studies in wheat, barley, peas and lentil crops and field bindweed biological and control investigations. In addition, some attention was given to weed control problems and vegetation management on industrial land sites.

The new herbicides of the 1980's, became those that were effective at application amounts in the order of a few ounces per acre. These presented problems of proper application and spray mixtures to achieve desired vegetation management. This in turn appears to be the proper goal of the future in contrast to the early weed control goal of eradication and even the later one of control.

Rangeland weeds: With the overall recognition of the damage being done by weeds in cropland, concern spread to weed infestations on rangelands in the mid 1950's. Klamath weed infestations had been given some attention, but now Dalmation toadflax and several species of knapweeds began to cause alarm. Halogeton, a weed of the dryland range spread rapidly throughout the Great Basin and created calls for early eradication.

In response to ranch owners' and public servants' requests for research on range weed control, Charles Robocker, USDA weed scientist was transferred from Reno, Nevada, to Pullman in May 1957.

He started research field studies on herbicide use and the ecology of Dalmation toadfax and Medusa-head rye grass. Subsequently, Robocker shifted attention to the control of downy brome grass on range and in crested wheat grass fields. Some research was directed to perennial sweet pea, Bracken fern, camelthorn, and swainsonia. Considerable research focused on the various knapweeds and yellow star thistle which became aggressive rangeland weed threats.

Research at the Irrigation Experiment Station:

The Irrigation Research Center became headquarters in 1939 for W. A. Harvey's weed research in cooperation with the Indian Irrigation Service and farmers in the Yakima Valley.

Early in 1947, Washington State University, working cooperatively with the U.S. Department of Agriculture, responded to public demand to establish a full time research position at the center. V. F. Bruns was transferred from a U.S.D.A. Research station in Kansas to head the research on weed control in and around irrigation systems. His focus was on the use of chemical and mechanical methods to control submersed and emergent plants in irrigation canals. Aromatic solvents were tested and some proved adequately effective for use. Canal company managers adopted these control methods and a close working relationship developed between researchers and the managers.

At the request of the Bureau of Reclamation and canal company officials anticipating the creation of the equalizing reservoir from which irrigation water would be distributed to the land, Bruns and Rasmussen designed an experiment to determine (a) whether weed seeds would remain viable in fresh water and (b) whether such seeds might be a source of weed infestation when deposited in fields. The findings were affirmative and weed seed traps were constructed and installed by the canal companies in many of the latteral

distribution ditches.

The magnitude of weed problems in the irrigated farming area signaled the need for another weed scientist at Prosser. The U.S.D.A. Crops Section agreed to provide this help and Jean H. Dawson was assigned to do research on weed problems in crop fields. He concentrated research on the problems of dodder in alfalfa seed fields. Later he worked on annual weed problems in horticultural and agronomic crops with the objective of finding safe, effective herbicides to remove the weeds economically.

Richard D. Comes became the third U.S.D.A. weed scientist to join the team. His principal assignment was to work on the problem of weeds along the canal banks.

Alex Ogg began work with the team as a research technician, then later returned to graduate school and, upon completion, returned as a plant physiologist in 1969.

Vic Bruns' health began to fail in the late 1960's and by 1975 he retired.

Northwest Research Center

In the early 1950's, requests arose in northwest Washington for weed research on problems peculiar to that area. Dwight V. Peabody, having earned a Master of Science degree with a major in weed science at Washington State University was employed July 1, 1951, on grant funds provided by the agricultural interests of northwest Washington. Subsequently, state funds were obtained by W.S.U. enabling Peabody's transfer to a permanent position. His full time research position in 1966, was changed to 3/4 research and 1/4 extension as a better reflection of the nature of his work.

The diverse crops and cropping systems of western Washington created many demands for weed control information. Peabody did field plot research aimed

at gaining answers to questions of herbicide effectiveness, safety, selectivity and methods of timing and application. He studied weed control problems in vegetable crops, strawberry fields, bulb crop fields, grass seed fields, pastures and forage crops and established conifer plantings. His field research provided many answers for growers and herbicide marketeers. He made effective use of his field plots for demonstrations in extension type education sessions.

Peabody retired December 31, 1982, but was then re-employed on a 40 per cent basis until June 30, 1985. At that time the regular position was filled by the employment of Stott Howard.

Education Programs

Resident Instruction: While classroom instruction was an important aspect of the weed program dating back to 1915, it nearly became over-shadowed by the urgent demands for research in the immediate post war years. However, the general concern for weed problems created an interest among students which resulted in expansion of the weed courses.

The beginning course in weed identification and control was enlarged from a two-hour credit course to three credit hours to permit adequate attention to the use of the new selective herbicides. An upper division course dealing with principles of weed control was added in 1949. This was a two-hour credit course that treated in depth physiological and ecological factors associated with chemical and cultural methods. It also introduced students to methods of conducting weed research.

These course offerings, and the mounting new information on weed control being generated, pointed up the need for a new textbook. Dr. Muzik devoted his research and teaching experience toward preparation of a manuscript of a text for classroom use and for general reference. In 1970, his book, "Weed

Biology and Control" was published by McGraw Hill Book Company.

The course curriculum offerings and the closely associated research activities attracted graduate students to elect weed science as a specialty for advanced degrees in Agronomy. Alvin Overland was the first agronomy major to complete work for the M.S. degree with emphasis in weed science. He was followed by Dwight Peabody and by the mid 1950's, nine advanced degrees had been earned in weed science. This pursuit of degrees has continued, providing weed scientists for positions in universities, state, federal, and county programs and in the chemical industry serving agriculture with weed control materials.

Extension: The urgent demands of farmers, orchardists, vegetable growers, turfgrass managers and others for weed control information made evident the need for a state extension specialist position. The College of Agriculture created this position in 1951 and Henry Wolfe was employed. He developed extension education programs to assist the county agricultural agents throughout the state with answers for farmers and others on weed problems and the proper use of herbicides. He worked cooperatively with the research personnel in preparing bulletins and circulars as a means of getting information to the public.

Early in 1958, Wolfe was transferred to a regional supervisory position in extension and Ben Roche was named to succeed him as weed specialist. At this time attention was focusing on the importance of the ecological aspects of weeds. Roche gave impetus to this movement as he built extension education programs on weed-crop relationships and weed-range plant associations. Effort was focused on management as a suppliment to herbicides. Roche continued the principal extension programs of assisting county agents in understanding control measures and in helping them with demonstrations and in meetings with

farmers and ranchers. He provided leadership in setting up a program for the control of yellow star thistle, a serious weed infesting rangelands of eastern Washington.

Another element of herbicide use that demanded much attention was the passage of laws governing the effectiveness and the toxicity levels of herbicides applied on food and feed crops. Education programs for the public had to be prepared and presented, bringing together research information on herbicide effectiveness, time and quantity of application, residue persistence and toxicity to animals and people. Meetings with research scientists, herbicide manufacturers' representatives, state and federal regulatory officers and herbicide users required much time and effort to work out satisfactory programs for the safe use of herbicides.

Roche also devoted time to educating and advising various county weed control officials on the control of weeds along roadways and on other non-crop areas under county management.

In 1966, Roche resigned to pursue graduate study which led eventually to his becoming a member of the W.S.U. Forestry and Range Management faculty as a range ecologist.

Dean Swan succeeded Roche as extension weed specialist for the state, but the nature of the work soon led to a change in the position to 3/4 time extension and 1/4 time research. Swan made extensive use of both research and demonstration plots located in many counties to teach the safe effective use of herbicides to county agents, farmers and other interested persons.

Swan devoted much time to preparing and presenting teaching packages for the preparation of commercial applicator personnel for licensing under state law.

Swan's time was needed mostly in eastern Washington, while Peabody was

able to provide extension education to western Washington. In mid 1970's Robert Parker was added to the faculty at the Irrigated Agriculture and Extension Center at Prosser to provide extension help throughout the central irrigated portion of the state.

Epilogue

In the seventy years, 1915-1985, the problem of weed control has shifted from tedious, hand and mechanical labor to the use of scientifically and specifically designed herbicides. The concept of weed control likewise has changed dramatically. Sixty years ago, in the early days of chemicals with which to kill weeds, the goal was eradication. The very nature of weed plants soon proved such a concept to be fallacious.

The application of science to solving problems of weed control arose among agronomists and horticulturist involved in plant production type studies. Professor E. G. Schafer of the farm crops faculty began teaching a course in weeds and subsequently initiated field plot research on methods of control. The science of weed control was non-existent so the early research came from plant scientists who were confronted with weed problems. After World War II, students began preparing specifically for careers in weed research. In the 1950's, Washington State University, like a few other graduate schools began turning out graduate students with advanced degrees in weed science.

The very early experimentation on weed control was directed toward killing field infestations of aggressive, perennial weeds, primarily wild morning glory (bindweed) and Canada thistle. Smaller patch infestations were considered for possible control by chemical treatment while large field areas could only be treated by clean cultivation. The early weed control chemicals were highly toxic to all plant life and had to be used in such large amounts

that the soil became sterile for plant life of all kinds over periods of one to several years.

Only within the last forty years have physiologically active chemicals been applied in small quantities for weed control. These chemicals exhibited differential action among species of plants, opening the way for selective weed control.

The quantities of chemical needed to kill weeds has been reduced from 300 to 500 pounds of sodium chlorate per acre to one half up to one pound of 2,4-D, and currently as low as an ounce of some new potential herbicides.

Another trend of the past forty years has been the search for biological methods of weed control. This has involved selectively feeding insects as well as management methods to give desired plants a competitive edge over the weeds. These non-chemical methods supplimented by judicious use of properly designed low volume herbicidal applications increasingly will become the means of controlling weeds. Eradication is not a goal, nor can it be.

Significant awareness has arisen concerning the impacts of long range potential hazards of pesticides on human beings and the biosphere at large. As a result, provisions have been made for strict tolerance limits of pesticides and the licensing of use and applications to minimize potential damage in the environment.

The present progam at W.S.U. is moving forward under the leadership of scientists in agronomy cooperating with scientists in horticulture, biological chemistry, entomology and ecology. The emphasis is on safe, effective use of various methods for controlling weeds.

The instructional program serves students who wish to pursue careers in weed science as well as students in other areas of study who desire some awareness of the weed problems and their solutions. The course in principles

of weed science now attracts 70 or more students each fall semester. An advanced course, Herbicide Development and Application, serves an average of 12 graduate students. Through cooperative course offerings with the University of Idaho program, students at each institution have access to three courses covering the various aspects of weed science.

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