WEED CONTROL IN THE U.S.

Northeast's Biggest Weed Problem in Forage Crops

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FORAGE CROPS are most valuable of the field crops grown in the Northeast region, and weed control in them is our biggest single problem.

A recently completed four-year survey of hay in New Jersey showed that 23% contained more than 5% weeds and 12% had more than 10% weeds. Weed content exceeding 5% lowers the hay grade and indicates lower feeding value. Add to this their effect on seedling establishment and yield of seeded species, and the weed problem can be more fully appreciated. Yields and hay quality on an estimated 2 million acres are reduced by weeds, among the most serious being mustards, ox-eye daisy, dock, plantains, horse nettle, quack grass, chickweed, Canada thistle, and cockle. Of these it appears that horse nettle is spreading rapidly.

Little progress has been made towards effective control of these weeds in legume hay with the exception of chickweed in alfalfa. Many farmers seed mixtures of legumes which complicates the use of herbicides. Chemicals already tested would be usable if either legume was seeded alone. Agronomists in the region favor use of a single best adapted legume in hay crops for a given set of conditions. In considering weed control in these crops for the future, it should also be remembered that the trend is toward extension of alfalfa to acres presently thought unfit for this crop. This shift is fostered by the availability of new alfalfa varieties with a wider range of adaptation and the availability of large quantities of alfalfa seed.

As alfalfa acres increase a reexamination will be needed of 3,4-D and 4-chlorophenoxyacetic acid which have demonstrated tolerance for this crop. The new butyric derivatives of MCP and 2,4-D show real promise as selective herbicides in alfalfa but their effectiveness against weeds has not been established.

Work at Cornell suggests that 2,4-D and related chemicals can be safely applied immediately after cutting hay with some of the weeds exposing sufficient leaf surface to absorb considerable herbicide.

The Northeast's most extensive crop is pasture, grown on 12 to 15 million acres. Productivity of all these pastures is reduced to some extent by weeds, among the most troublesome of which are woody plants, wild onion and garlic, dock, Canada thistle, horse nettle, chicory, buttercup, milkweed, plantain, dandelion, and goldenrod. There is a limited usage of weed killers in pastures although many of the problem weeds could be controlled with existing herbicides. The presence of legumes in some pastures has prevented use of 2,4-D and related chemicals but such pastures constitute only a small part of the total.

A major deterrent to wood control has been the absence of a satisfactory over-all pasture improvement program. Lime and fertilizer would unquestionably increase production on a large percentage of pastures. However, weeds prevalent in most pastures limit returns that could be expected from a balanced fertility program. With the effective, inexpensive herbicides now available, there is urgent need for information on the interrelationships of weed control and fertility on pasture production. In addition to the phenoxy compounds, work in New York indicates that amino triazole is effective in controlling milkweed, goldenrod, Canada thistle, and some brush species. Although much work remains, results to date with amino triazole and dalapon indicate that these chemicals are most promising for pasture renovation.

A third major field crop in which weeds take a considerable toll is corn. Annual weeds are by far the biggest problem but certain perennials may be more damaging in areas where they occur. Pre-emergence application offers the most satisfactory control for annual weeds since this is the only way to prevent competition from the weeds completely. Use of less soluble formulations has improved weed control during wet weather and provided safety for the crop. Failures with pre-emergence treatments today are due most frequently to dry weather immediately following application. It appears that poor weed control with 2,4-D under dry conditions is partly due to loss of the chemical before it has a chance to act. Introduction of more persistent chemicals, such as trichlorobenzoic acid, CMU, and 2,4-D acetamide, is a step towards better control under dry conditions. During 1955, it was observed that weeds which emerged during dry weather in plots treated with these chemicals were often seriously retarded following rain. Certain broad-leaved weeds including pigweed and lamb's-quarters which emerged in plots treated with trichlorobenzoic acid actually died following rain. An additional possibility for improving control during dry weather now being investigated at New Jersey, is to mix the herbicide

Clean potatoes with no cultivation where dinitro was applied before emergence

Mustard in oats is a big Northeast problem in legumes which are underseeded

Inhibition of chickweed and prevention of flowering by CIPC in lower area

with the surface layer of soil so as to be effective against any weed seeds having sufficient moisture for germination.

There is increasing evidence that combinations warrant consideration for pre-emergence control. With 2,4-D and others the practice has been to recommend sufficient chemical to control annual grasses and broad-leaved species. It would seem logical to mix chemicals using each at rates sufficient to control only the more susceptible species thus improving control and minimizing crop damage. Combinations of trichlorobenzoic acid and 2-chloroallyl diethyldithiocarbamate showed promise in New Jersey plots last summer.

Results with amino triazole, dalapon, or maleic hydrazide applied before plowing show that these chemicals can be used to control quack grass in corn. This technique deserves consideration with other perennial weeds including Canada thistle, horse nettle, and nut grass in corn and other crops. Another problem in corn is that of weeds which come in after the last cultivation. Work in Massachusetts during 1955 showed excellent control of grasses and no injury to corn when dalapon was applied as a directed spray beneath the corn foliage.

Nut grass, *Cyperus esculentis*, appears to be increasing rapidly in the region and the potato crop is one most seriously threatened at present. Although not yet serious, it may be found in a predominance of potato fields (constituting possibly 125,000 acres) in seaboard states south of Maine. Without effective control it is only a matter of time before the weed becomes serious. During the last two years workers in Rhode Island obtained effective nut grass control with a combination of dalapon and phenyl mercuric acetate applied after emergence—a rather costly treatment, but warranting further study. Another control opportunity may be treatment of the crop preceding potatoes or treatment just prior to harvesting where potatoes will follow potatoes.

Annual grasses which come in after the last cultivation are a problem in most potatoes in the region. Control has been erratic with chemicals applied at the time of the last cultivation partly because of the long period during which the chemical must remain active. Dalapon applied after emergence has controlled grasses at rates which did not reduce yields. Results in New Jersey suggest that 0.25 pound of 2,4-D may be added to dalapon if broad-leaved weeds are present. Further information is needed concerning the dalapon's effect on potato quality.

Ready Market in Vegetables

Vegetables are an important industry in the Northeast, which produces one-fifth of the country's annual crop. Annual weeds are the most pressing problem in these crops and are frequently more severe than in field crops because of heavier applications of fertilizer, preparation of a fine seedbed, and use of irrigation. The culture of many vegetables requires hand weeding. Use of mechanical harvesters makes weed control even more necessary. It should be kept in mind also that the average value of vegetables in the Northeast amounts to about $250 per acre which is approximately eight times the average acre value of field crops. These facts add up to a ready market in vegetables for satisfactory herbicides.

Present Chemicals Often Expensive

Chemicals are presently being used in many of these crops but most are not completely satisfactory, and treatment is often expensive. Pre-emergence treatments are of greatest interest, but they are also the most difficult since many of the vegetables are shallow planted. Danielson's work in Virginia shows that granulated herbicides can be applied to soil for pre-emergence control in seeded crops or in transplants with little danger of absorption through crop foliage. Directed sprays also deserve consideration in upright-growing crops.

Limited information indicates the derivatives of α-chloroacetamides and dithiocarbamic acid may be used as selective pre-emergence treatments in sweet corn, lima beans, snap beans, onions, beets, and tomatoes. An area in New York reported good results with them on muck-grown onions where most other herbicides have not been satisfactory. Scattered reports of work with 2-chloro-4,6-bis (diethylamino)-S-triazine indicate that it holds promise for use in peas, beans, and sweet corn.

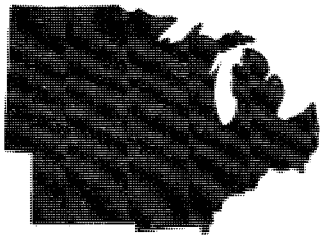
Use of dual operations to reduce cost of the weed control also warrants evaluation. Some large vegetable growers are already applying herbicides at planting time, but they might also apply them effectively while cultivating or side-dressing.

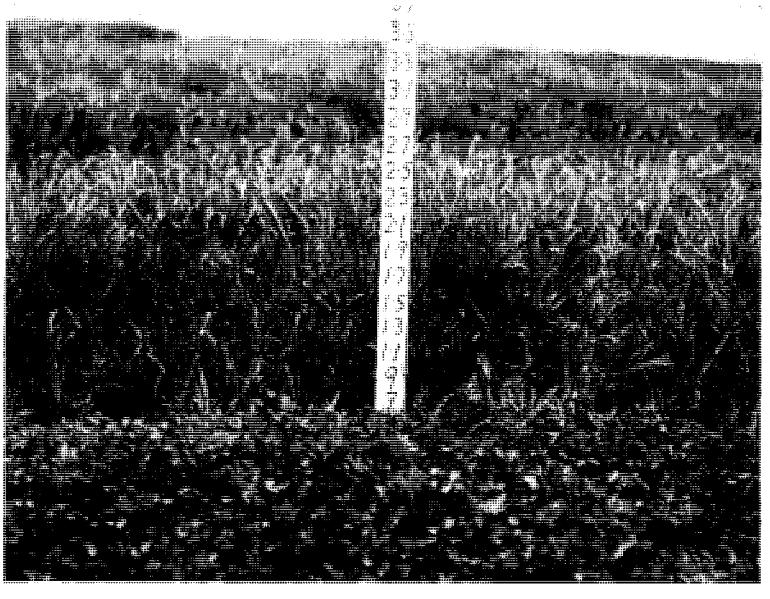
The cranberry industry in the North-

east, actually more valuable than that of any other small fruit, had a total production in 1953 of about $12 million. There are a large number of perennial herbaceous and brush species of weeds in cranberries. Chemicals have been used for sometime but their cost has been high, application of older chemicals has been inconvenient, and results have not been completely satisfactory. Some hand weeding is used on many bogs, but the cost is nearly prohibitive although the acre value of the crop is sufficient to justify considerable expenditure for a satisfactory herbicide. Among the new herbicides tested, amino triazole shows particular promise for selective control.

Chemicals warrant consideration for renovating two- or three-year-old strawberry beds. Weed infestation is frequently the reason for abandoning beds. It costs approximately $150 per acre to establish a new bed which suggests the amount growers might expend for renovation treatments. Of course, effective all-year control would minimize the need for renovation but this is not being satisfactorily accomplished. With an increasing proportion of strawberries being irrigated, pre-emergence treatment in conjunction with irrigation deserves study.

The floral and nursery stock industry has an estimated value of $150 million in the Northeastern region, roughly twice the value of potatoes and equal to the value of vegetables and fruits. Weedings costs are frequently higher in these than in any other crops, but relatively little is being done with herbicides for them. It would seem that much could be done with existing herbicides since granular formulations and directed sprays suggested for trial in vegetables are equally applicable in these crops.





Fall application of the amine salt of dinitro-o-sec-butylphenol has been used effectively to control weeds in the foreground of this field of alfalfa. Weeds in background include chickweed and bachelor's button

North Central States Battling Deep-Rooted Weeds

B. H. GRIGSBY, Michigan State University, East Lansing

IN ALL CROP and weed areas of the North Central region substantial advances have been made since the advent of 2,4-D and related compounds. Other types of herbicides likewise have solved certain problems. However, many weed problems, especially in the case of deep-rooted perennials, are just as serious now as they were 10 years ago.

The thistles illustrate the course of development as well as any other group of weeds. Canada thistle, sow thistle, and bull thistle are present in nearly all parts of the North Central region. Bull thistle can be eliminated from pastures, turf, and other uncultivated areas with 2,4-D. Perennial sow thistle is no longer a serious problem in any crop because it can be destroyed in small grains. By slight shifts in rotations a badly infested field can be cleaned in two years; then one can go to any crop without undue concern. This has been of great help in growing beans, sugar beets, peppermint, etc. Now, in the last two years, real progress has been made in control of Canada thistle, a serious problem which did not respond to 2,4-D. Amino triazole promises to eliminate all the common thistles as any real menace.

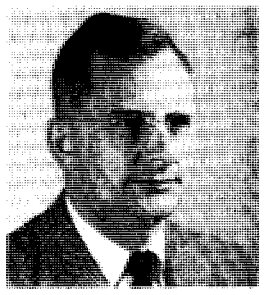
Field bindweed, long a major problem in drier parts of the North Central region, can be controlled seasonally and in some crops with 2,4-D. But eradication is no more feasible now than it was when only soil sterilizing chemicals were available. Here we have an example of only partial success, and the need for much more work.

Leafy spurge and toadflax are much less common in the area than bindweed, but control aspects are essentially the same.

Use of 2,4-D in conjunction with appropriate crop rotation and tillage practices can eliminate Russian knapweed and hoary cress in a reasonably short time.

Satisfactory methods for control of the perennial grasses, Bermuda and quack grass, have been developed, but they are subject to limitations of climate and cropping practices. Quack grass is important only in the more northerly areas, and where a fairly humid climate prevails. It often limits establishing forest tree seedlings, and is the weed most hated by home gardeners and small truck-crop farmers. Dalapon, TCA, and MH are the

W. B. Ennis



W. A. Harvey

R. J. Aldrich

These weed specialists, including B. H. Grigsby, were participants in a symposium, under the chairmanship of M. W. Parker of USDA, before the Weed Society of America in New York in January. This AG AND FOOD feature is a condensation of their papers.

chief herbicides now used on quack grass.

Bermuda grass occurs only in the southern part of the region and is seldom a serious pest.

Johnson grass is a problem across the southern edge. Reinfestation by seeds brought in by winter or spring floods has made chemical control difficult in some cases. Destruction of top growth and exhaustion of rhizomes can be obtained by a combination of chemical treatments. However, with corn, tillage will not destroy Johnson grass seedlings in the row and they soon develop into a serious infestation.

Field Crops

Control of annual weeds in small grains with 2,4-D has become almost a universal practice in the region. Spraying is done after harvest when legumes are seeded with the grain crop, and (in eastern areas) to control ragweed.

Broad-leaved annual weeds in corn are universal in both field and sweet corn. Pre-emergence or at-emergence sprays of 2,4-D or DNBP are in general usage. Foxtail and other annual grasses do not respond to current chemical treatment. Only the recently developed urea and acetamid herbicides seem to control them.

Dalapon, TCA, and MCP are used fairly successfully against red root pigweed, lamb's-quarters, and foxtail in flax—an important crop in Minnesota, the Dakotas, and Canada. No adequate chemical control has been developed for wild oats—probably the most serious weed in these areas, not only in flax, but in some other crops.

Control of annual weeds in soybeans is important in Ohio, Indiana, Illinois, Iowa, and Michigan. Presently, only pre-emergence applications of DNBP, CIPC, and NP are used, and the acreage sprayed is relatively small. One of the major problems is the heavy growth of large species such as butter-print, lamb's quarters and pigweed. They may affect combine operations and delay harvesting—thereby preventing sowing wheat at the proper time in some areas. Considerable research is needed to develop a satisfactory preharvest spray program. In some fields, 25 to 30 percent of the harvest product is weed seeds and entails a substantial loss to the grower.

Weed control in beets has lagged behind other phases of beet production, an industry whose goal of complete mechanization is almost reached, except for early weed control. In the drier parts of the beet area, preplanting treatment with the carbamates has been successful in controlling wild oats. Foxtail generally is controlled by pre-emergence application of TCA.

Broad leaved species, more serious weeds in the eastern portion, cannot be controlled chemically. Lack of selectivity of chemicals between beets and lamb's-quarters is one of the main difficulties. Endothal while promising for post-emergence use, has no effect on the Chenopodium group.

Horticultural Crops

North Central area weed problems in horticultural crops are not essentially different from those elsewhere. In small fruits, the chief weeds, chickweed and grasses, can be controlled reasonably satisfactorily with 2,4-D or substitution products such as SES, as well as DNBP, and Dalapon. Some of the newer chemicals show promise, but no acceptable control has been devised for wild garlic, a minor problem in fruits.

Pre-emergence use of CIPC is common practice with onions, which have the most serious weed problem among the vegetables. However, late germinating species, such as purslane, still are difficult. More use of mechanical harvesting has meant a considerable preharvest weed problem. Suitable chemicals are available, but crop residues are a problem.

Crab grass, chickweed, and a few species not killed by 2,4-D, are the problems in turf. No satisfactory control of crab grass has been developed.

Brush control problems in the North Central area range from the complex ones of Oklahoma to the relatively simple northern ones, chiefly right-of-way maintenance. In some areas pastures and range brush control is important, but control is easy. While usually of limited occurrence, thornapple and ash, cannot be controlled at present.

Fundamental studies on the effects of herbicides on the physiological activities of plants has been limited in the North Central area. This field should receive the same kind of intensive study that was given to the practical use of 2,4-D, when it first became available. Basic studies on germination and dormancy of seeds of several weeds and grasses not responding to current control methods have been instituted at four state experiment stations. Two states are studying bud dormancy in certain perennial weeds. All of these weed seed projects are supported by federal funds for the NC-10 Regional Technical Committee. Additional basic work awaits more funds.

Increasing interest in wild life and recreational facilities is bringing some pressure for work in aquatic weed control. Infestations in natural lakes, impounded waters, and drainage ditches are serious in Michigan, Minnesota, Wisconsin, and Indiana. Current recommendations for lake weed control are limited to copper sulfate for algae and sodium arsenite for submerged weeds. The latter is potentially hazardous. A coordinated research program is needed greatly.

Brush and cattail, the most common weed problems along drainage ditches, can be destroyed by Dalapon and 2,4-D brush killers.

Little Attention to Public Health Benefits

Public health aspects of weed control, especially with respect to pollen and hay fever, have received almost no attention in the North Central area. Poison ivy control in park and resort areas generally is practiced.

At least 40% of the agricultural land in the North Central area, as well as a large share of recreational and other public lands could profitably be sprayed. Sprayed acreage is now estimated to be less than 10% of cropped lands. Limiting factor is not lack of methods, but public education. Far too few farmers and public agencies are familiar with benefits and limitations of existing methods. Those workers charged with translating available information into action are making progress, but their number is simply too small for the gigantic task before them.

Weed control on ditch banks is essential to clean fields. These are soil sterilant test plots

West's Most Serious Weed Loss in Irrigated Crops

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THE WEST and its agricultural areas embrace a variety of environments—from almost no rain in desert regions to over 100 inches along the northern Pacific Coast; temperatures from subalpine to subtropical; soils of many types. It is within this framework that we must approach western weed problems. Field data under all possible variables are never available, and we must often extrapolate on the basis of whatever information is available.

Looking first at non-irrigated cropland, we find about two thirds of total western cropland is not irrigated. Principal crop is grain—wheat, barley, oats—with dry peas, green canning peas, alfalfa for both hay and seed, flax, and numerous seed crops among other major ones.

2,4-D is the standard weedicide in grains. Cruciferous weeds are no longer a problem, but a few broadleaved annuals such as Russian thistle occasionally require special treatment. An increasing problem is wild oats, and several experiment stations are approaching oat control with both cultural and chemical techniques.

Wild oats and volunteer grain are often major pests in dry peas, with IPC being the most satisfactory chemical. Dodder plagues all alfalfa in the West, and general contact sprays and chloro-IPC have been most promising. Flax has been weeded with 2,4-D, MCP, and IPC, depending on the problem, but the margin of safety is not great and care needs be exercised.

Throughout the region, bindweed, white top, and Russian knapweed occur, and control with inorganic soil sterilants has long been common. Current interest trends toward the newer organics, both as soil sterilants and as systemic sprays.

Weed Problems Most Pressing on Irrigated Crops

About 20 million acres of western cropland are irrigated. Here are the high-value crops, and it is on these that the most pressing weed problems arise. Cotton, for instance, is one of the major crops and one on which we have perhaps more "weed" information than on any other single crop. Grass and weed problems in cotton are those common to the region. Pre-emergence treatments are not generally useful, partly because of lack of rain at planting time, partly because major weed problems develop later. Annual grasses after lay-by have been the principal problem. Early practice was to control these by cultivation and flaming, and the latter is increasing in popularity.

There is considerable interest in lay-by residual treatment, however. Most promising chemicals to date are dalapon, Alanap, and CMU (latter subject to limited recommendation because of extended residual life). Among perennial weeds, morning glory is a difficult problem because of potential damage to cotton—2,4-D spot treatments must be made extremely carefully. Amino triazole shows promise for perennial white horse nettle, and spot treatment is less damaging to surrounding cotton.

Alfalfa grown for hay has long been a major crop on western irrigated lands, and more recently alfalfa and clover grown from seed have likewise become important. Among alfalfa problems are annual weeds affecting establishment of stand and quality of the first cutting. Also problems are dodder and perennial grasses, particularly quack and Bermuda grasses. Annual weeds are controlled with dinitro selectives on seedling stands and with general contact sprays during winter or early spring on established stands. IPC has been used for grass control in alfalfa and in clover. Dalapon is being investigated for annual grass control while alfalfa is dormant and between cuttings. Perennial grasses are usually controlled by a season of dry tillage or by spot treatments with oils or dalapon.

Weed control in other field crops is generally not well worked out. Shielded spraying of 2,4-D for bindweed is used in beans and in row alfalfa grown for seed, and extension of shielded spraying to other row crops appears likely.

Weed in Vegetable Crops Acute

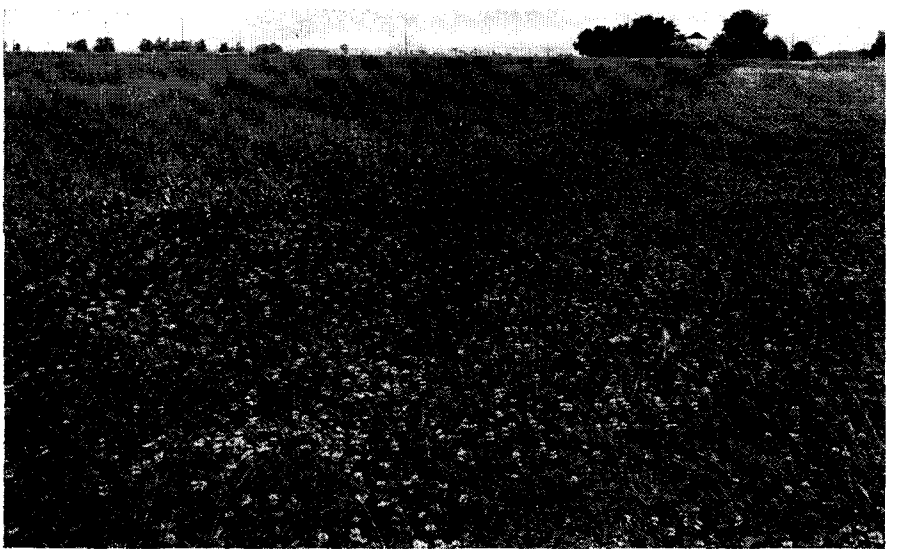
Weed problems in vegetables are often acute, and hand weeding is common practice. Chemical control has been developed for only a few, and the field is wide open for better ones. Lettuce, for instance, is the major vegetable crop, but there is no chemical weed control on a commercial scale. The same is true for tomatoes. Carrots are almost all sprayed with a light oil for weed control, and some celery is similarly treated in the plant bed or immediately after transplant.

Cantaloupes had no chemical weed control prior to limited use of Alanap, just now becoming commercial practice. There is some treatment of asparagus with CMU, and onions are treated with dinitro selectives and some potassium cyanate. A limited amount of chloro-IPC has been used on dry onions, and CMU is now registered for this use.

Fruits and nuts contribute a major share of the dollar income to agriculture in the West, but they are not major consumers of herbicides. Non-cultivation in citrus with oil sprays is common, and CMU is now being used for the same purpose. Deciduous orchards may be spot treated with 2,4-D for bindweed control, and dalapon is currently sparking interest for perennial grass control. Use of dalapon in grapes for control of Johnson grass and Bermuda grass is developing rapidly.

California farm adviser Milt Miller in a beautiful field of weed-free ladino clover

Ladino clover strip for seed production has been treated with 2,4-D to remove chicory, which is almost solid in the field on the upper left



Some of the most troublesome weed problems occur on the 400 million acres of range land. Here, land value is low, and chemical treatment must be cheap if it is to reach large-scale use. Among brushes, big sagebrush is perhaps the most widespread, while mesquite in the Southwest is a major problem. These and other major brush species can be controlled with 2,4-D, 2,4,5-T, and their propionic derivatives, but cost has limited the area treated. The market potential, of course, is tremendous.

Poisonous plants take their toll every year, but control work is limited by low land value and widely scattered infestations. Halogeton has received great notoriety in the past few years, and it is currently receiving adequate research. Klamath weed is of major importance in Idaho, Washington, Oregon, and California. Biological control with insects has proved successful and is the first important application of this method to weeds in the U. S. It may point the way to biological control investigations on other widespread weeds.

Southern Cotton's Most Troublesome Weeds Are Annual Grasses

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Pre-emergence treatment of cotton in bottom photograph with CIPC has proved quite effective in controlling weeds and maintaining clean rows

Weedy species in the South occur with widely differing growth characteristics, ranging from those inhabiting the semiarid areas of western Texas and Oklahoma to those in the subtropical areas of lower Florida. Because of the wide range in species and variations in the soils and rainfall, a multiplicity of problems are presented the weed control research men in developing suitable weed control programs with broad adaptation. Moreover, great diversities in acreages devoted to a given crop between farms imposes limitations on research directed toward developing equipment and methods suitable for both large and small production units.

The number of man years devoted to research on chemical weed control by Federal and State workers in the 13 Southern states has grown from approximately 3 to 5 in 1946 to about 40 to 44 in 1955. Some success has been attained in developing procedures for using chemicals to control weeds in cotton, sugar cane, rice, and other small grains and for controlling brush on rangelands, and weeds in tobacco plant beds. This success is being reflected in farmer use of the practices. Herbicides are being used on a more limited basis in peanuts, corn, pastures, and certain horticultural crops.

Annual weeds, notably crabgrass, are the ones that present most serious problems in cotton although Johnson grass, perennial vines, and other species are also important on large acreages. Late-season annual grasses are particularly troublesome in irrigated cotton as well as in much of the cotton in the humid Southeast. Since 1952 the total cotton treated with pre-emergence herbicides has ranged between 180,000 and 250,000 acres and post-emergence oils on about half this acreage. Ultimately, herbicides could possibly be used to good advantage on as much as 10 to 12 million acres of the cotton grown in the U. S. For usage to increase to this extent at a rapid rate the following are needed:

Lower costs of treatments with current herbicides.

Better selective post-emergence chemical agents which are capable of killing weeds when need for weed control actually exists and stand of cotton is ensured.

Improved and simplified application equipment with greater versatility, lower cost, and suitability for small production units.

Practical methods for controlling perennial weeds such as Johnson grass, nutgrass, the deep-rooted vines, and others not controlled by present herbicides so that no hoeing will be required in chemically treated fields.

Development of more satisfactory materials and methods for controlling annual morning-glory, *Echinochloa crusgalli*, *Amaranthus* spp., and other annual weeds that present late-season problems and lower lint quality and yields in irrigated, as well as in rain-grown, cotton.

Development of chemicals and techniques that perform satisfactorily in spite of variations in soils and weather.

Improved educational programs designed to train farmers in proper use of herbicides.

Weeds increase production costs and lower yields on most of the approximately 20 million acres of corn grown in the South. Crabgrass, barnyard grass, Johnson grass, and other grasses present early season problems; the more important broad leaf weeds are cocklebur, morning-glory, ragweed, lamb's quarters, and smartweed. The post-emergence use of 2,4-D to control these latter weeds is increasing. Pre-emergence herbicides have been largely inconsistent in controlling early-season weeds and this coupled with relatively high cost of treatment and comparatively low cash returns per acre have impeded large-scale use. If low-cost materials were available for controlling mid- and late-season broad leaf weeds without a drift hazard to

cotton they would likely be used broadly if for no other reason than just to improve mechanical picker efficiency.

Weeds Serious in Soybean Harvesting

Probably a fourth to a third of the approximately 4 million acres of soybeans grown in the South become infested with weeds that present serious harvesting problems. Particularly troublesome are morning-glory-cocklebur, coffee-weed, and pigweed. Also important are crabgrass, Johnson grass, and other annual grasses. Only small acreages of soybeans have been treated with pre-emergence herbicides. Suitable post-emergence materials for control of late-season weeds that cause harvesting difficulties would find ready use on those fields infested with such weeds.

It has been estimated that a third or more of the total pre-harvest manhours required to produce peanuts are devoted to hand hoeing of weeds. Principal weeds are crabgrass, Florida pusley, carpet weed, pigweed, nut grass and others. Although about 50,000 acres of peanuts were treated with pre-emergence herbicides in 1955 the potential acreage for usage of a completely satisfactory chemical would be in the order of 1 to 1.5 million acres. The search should continue for more efficient and selective herbicides for peanuts.

Both broad leaf and grassy weeds present serious problems in much of the approximately 2 million acres of rice grown. The phenoxy type herbicides are being used rather routinely on rice where broadleaf weeds present problems and drift damage to cotton can be minimized. Grassy weeds are becoming of increasing importance and more research effort is being directed toward use of herbicides to control such species as barnyard grass (*Echinochloa crusgalli* (L.) Beauv.), *Brachiaria* spp., *Cyperus* spp. and red rice but satisfactory controls have not been developed. The need is urgent for developing application techniques to minimize drift problems in the use of 2,4-D and other phenoxy compounds when treating such broad leaf weeds as coffee weed (*Sesbania macrocarpa*), Mexican weed (*Caperonia palustris*) and curly indigo (*Aeschynomene virginica* L.).

Wild onion, curly dock, volunteer vetch, corn cockle, field mustard, Shepherd's purse, and others present problems in the approximately 22 million acres of oats, wheat, and rye grown in the Southern region. Considerable acreage in the Piedmont is treated with 2,4-D and increasing acreages are being treated in the deep South. There is an excellent potential for increased use in these crops. The needs are for safer and more economical materials, particularly as regards underseeded legumes.

A number of weeds cause damage to sugar cane but the most noteworthy and serious pest is Johnson grass. Since sugar cane is grown 3 years before complete tillage and replanting the establishment of Johnson grass is favored. Out of the total of approximately 300,000 acres of sugar cane grown, Johnson grass, *Ipomoea* spp., alligator weed, (*Alternantheria philoxeroides*), *Brachiaria* spp., Pellitory weed (*Parietaria numularia* Small.) and other weeds either present serious problems or threaten to develop problems on a majority of the total acreage. Excellent progress has been made in developing chemical weed control procedures for controlling Johnson grass and broadleaf weeds in this crop and increasing usage of herbicides is expected. Vigorous research should continue to make improvements over current materials and techniques.

Weeds are serious problems in virtually all of the 3 million acres devoted to commercial vegetable crops in the 13 Southern states as well as in all home gardens. The more important weeds are crabgrass, nutgrass (*Cyperus rotundus* L.) Bermuda grass, chickweed (*Stellaria* and *Cerastium* spp.), henbit (*Lamium amplexicaule*), *Euphorbia* spp., *Amaranthus* spp., purslane (*Portulaca oleraceae* L.), annual bluegrass (*Poa annua* L.). Herbicides are being used in the Norfolk area of Virginia and in Florida but the total acreage treated is still relatively small. The hand labor requirement for weeding is costly and suitable herbicides for mitigating some of the problems are needed with urgency.

Weeds Now Limiting on Pastures, Forage

Weeds limit the productiveness of pastures and forage crops on virtually all farms, even though proved practices of fertilization, recommended species and management are followed.

Establishment of pure stands of desirable pasture and forage species is difficult if not almost impossible. Fall seeded legumes and grasses become infested with henbit, chickweed, annual bluegrass, little barley, Shepherd's purse and other weeds. The commercial employment of herbicides to alleviate some of these problems is low but the potential is great for safe and efficient compounds. Effort should be intensified to find satisfactory weed control materials and procedures to aid in proper establishment of pastures and forage crops.

Maintenance of weed-free improved and permanent pastures is also a critical problem throughout the South. Species such as bitterweed and wild onion and garlic cause severe losses to dairymen each year because of the off-flavors they impart to milk. Numerous other weeds including rag weed, stickweed, hawkweed, chicory, *Plantago* spp., curly dock, croton, yarrow, sumpweed, yucca, palmetto, *Rosa* spp., horse nettle, ironweed, various thistles (Canada, Bull, Sow, Star, and others), wild carrot, and tall dog fennel lower tremendously the productiveness and quality of pastures. Within the last three years there has been increased usage of 2,4-D to control weeds in permanent pastures.

Notwithstanding, intensive research is needed to provide better and safer herbicides to aid in solving specific weed problems as well as studies directed toward equipment development to minimize drift of current phenoxy compounds. A stronger educational program is also needed to help promote wider uses of proven herbicidal techniques. A material as versatile as 2,4-D but without the serious drift hazard to cotton and injury to some legumes, would find wide usage in the Cotton Belt for maintaining permanent pastures free of broad leaf weeds. Weed control research in this field shows bright promise of yielding tremendous returns to the farmers of the Southern region.

Another area of potential usage of herbicides is for the control of weeds when renovating run down pastures by sod seeding or other techniques. Research should be intensified along these lines.

Woody Species Critical

The removal and control of woody species such as the various oak species, mesquite, persimmon, cedar and numerous miscellaneous species on the range lands of the South remains a most critical problem. Approximately 2 million acres of the 30 million acres of mesquite in Texas and about 250,000 acres of the 27 million acres of oak infested range lands in Texas and Oklahoma have been treated within the past few years. Although excellent progress is being made, improvements are needed to provide higher root kills and more economical procedures than are offered by current materials and methods.

Aquatic weeds are increasingly presenting problems in drainage canals, farm ponds, and lakes of the South. The demand is great for chemical agents to alleviate the numerous problems but satisfactory recommendations are largely lacking. There is dire need for increased research on aquatics.