**Pest Control Review**

Entomology Biological Control Nematology Weed Control Plant Pathology Vertebrate Zoology

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXTENSION SERVICE

**September-December 1964**

**WEED CONTROL**

**Ioxynil - A New Weed Killer for Use in Cereal Grains**

Chester L. Foy and William Harvey

**Introduction**

For many years, various formulations of 2,4-D have been recommended and used effectively for the control of most annual broadleaved weeds in cereal grains. However, the present recommendations have two important limitations as follows: (1) for certain "difficult-to-wet" species in the genera Amsinckia, Hemizonia, Grenalia, for example, control with 2,4-D is often not satisfactory; (2) for reasons of crop safety, treatment with 2,4-D should normally be delayed until the grain is well established and tillered. Therefore, new herbicides are continually being sought which will provide improved control of "difficult-to-kill" species and/or permit earlier treatment without loss of selectivity.

**Ioxynil - A New Herbicide**

Ioxynil, a new contact post-emergence herbicide, has shown considerable promise for selective use in small grains. In tests thus far it has controlled a number of broadleaved weeds, including fiddleneck (Amsinckia sp.) and Tartary buckwheat, which are not easily killed by currently available herbicides (1).

The herbicide may be regarded as either a substituted cyanophenol or a hydroxybenzonitrile as shown by the chemical structure.

\[ \text{CN} \]

\[ \begin{array}{c}
\text{I} \\
\text{I}
\end{array} \]

\[ \text{OH} \]

2,6-diodo-4-cyanophenol or 3,5-diodo-4-hydroxybenzonitrile

Ioxynil (formerly ACP 62-70, then ACP 62-177, then Bentrol)

Ioxynil is the proposed new common name for 3,5-diodo-4-hydroxybenzonitrile in this country.

In 1961, a few grams of an oil soluble amine formulation of the compound (ACP 62-70) were made available by Amchem Products, Inc., for limited testing. The compound was later formulated and tested (one full season only) as a 50% wettable powder under the code designation, ACP 62-177 or ACP 62-177A (the latter denoting an air milled powder). In general, the above formulations have performed similarly.
During the coming season, the water soluble lithium salt formulation, under the proprietary name of Certrol, is scheduled for extensive testing in California and elsewhere.

General Herbicidal Properties of Ioxynil

Early experiments indicate that Ioxynil is most effective on newly germinated weeds before they are 4 or 5 inches high. Crop tolerance also appears to depend upon stage of growth. The relative tolerance or susceptibility of several crops has been described (1).

Ioxynil apparently acts primarily if not entirely as a contact toxicant, thus thorough plant coverage is important to insure good kill. Though a relatively fast-acting herbicide, Ioxynil activity does not appear to be typically that of a desiccant. Plants often wilt and dry up after a matter of two or three days in the greenhouse; however, faster contact (localized) action has been observed under field conditions. High temperatures at the time of application and immediately following appear to increase the activity of bentrol on both weeds and crops (1). The herbicide is almost completely ineffective when applied to the soil (4).

Field Studies in Small Grains

(1) A preliminary field study in 1962 (2) comparing several postemergence herbicides on oats grown for hay indicated that Ioxynil (then ACP 62-70) warranted more extensive testing. The herbicides were applied in replicated plots when oats were 4-6" tall and tillered; fiddleneck was 2-3" (6-10 leaf stage), and knotweed had 3-6 leaves.

The results showed a high degree of crop tolerance yet striking reduction in fiddleneck and knotweed competition.

(2) In 1963, foliar applications of 1/4, 1/2 and 1 lb/A of Ioxynil (ACP 62-177 and 62-177A) were compared with the standard 2,4-D amine (3/4 lb/A) and several other experimental treatments (not included in this report).

Six replicated experiments were conducted at three locations on fiddleneck infested barley in progressive stages of crop and weed maturity. One test was abandoned because of a sparse Amaelincia population and a heavy infestation of annual grasses in the barley. The results of the five other experiments are summarized in Table 1, (from 3).

Some contact injury and yellowing of the barley was observed following all applications; however, these symptoms were quickly outgrown. Ioxynil was generally less damaging to the crop yet provided more weed control than the standard application of 2,4-D which caused only moderate twisting of fiddleneck plants. Older portions of fiddleneck foliage sprayed with Ioxynil exhibited varying degrees of acute contact toxicity; non-necrotic portions of treated foliage became darker green after treatment, but otherwise showed little or no visible toxicity symptoms. The plants ceased growth and finally collapsed or later became understoried by the overgrowth of the barley before collapsing.

Most effective weed control was apparently obtained by applying Ioxynil when most of the fiddleneck had emerged but was still small (cotyledon stage to 5 inches tall). Fortunately, crop tolerance also tended to be greatest with the early applications. It is possible, of course, that on less productive soil or under less favorable growing conditions, patterns of competition might differ sufficiently to alter the above conclusions. Most extensive field testing of the new (lithium salt) formulation of Ioxynil is justified.

Recent work at Davis indicates that volatility would not appear to pose a significant problem under normal field conditions. Radio-tracer work suggested poor translocation in barley and fiddleneck.
Table 1. Effects of loxynil and 2,4-D amine on Amsinckia sp. and barley treated at several stages of development. (Data are averages of four replicates in each experiment).

(1) Barley 3-4 leaves - Amsinckia Cotyledon stage

<table>
<thead>
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<th>Chemical</th>
<th>Rate</th>
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<th>Yield</th>
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(2) Barley 4-5 leaves - Amsinckia 1 to 1 1/2" tall

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(3) Barley 5-8 leaves - Amsinckia 1 to 4 inches tall

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(4) Barley 6-8 inches (tillered) - Amsinckia 4-5 inches tall

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(5) Barley 14 inches (tillered) - Amsinckia 15 inches tall

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Preliminary studies indicate oxynil may be a potent inhibitor of respiration similar to a related compound dichlorobenil (casoron).

Additional information is needed on the herbicidal performance over a broad spectrum of weed and crop species. Work in grain should be concentrated on weeds now resistant to 2,4-D, MCPA, etc. and to earlier than normal application dates when selectivity with standard chemicals is reduced. More information is needed to determine the influence of air versus ground application, treatment volumes (or concentration), stage of growth of weed and crop, formulation, temperature, and other environmental factors.

The results this spring look promising except where applications are made too late, i.e., when the weeds are large.

LITERATURE CITED


SHAMAZINE RECEIVES FEDERAL CLEARANCE

A. H. Lange

August 17, 1964, we received notification from the Pesticide Regulations Division of the United States Department of Agriculture that simazine is now registered for use at 4 pounds per acre in the following orchard crops: avocados, sweet cherries, olives, peaches, pears, plums, and walnuts. It is also registered for use in almonds but at 3.2 pounds active per acre. Simazine was previously registered on apples, pears, and sour cherries, citrus and Macadamia nuts.

Geoxy Chemical Company's new label for simazine does not include sweet cherries, peaches, or plums. They recommend applying 2 1/2 to 5 pounds of simazine 80 W/A (2.4 on active basis) in late fall or early spring for apples, pears, avocados, Macadamia, olives, and walnuts. Simazine is recommended at 2-4 pounds of the 80 WP per acre in almonds. They add the additional warnings:

Do not apply to trees growing in sandy soil.
Do not apply while nuts are on the ground.
Make only one application per crop cycle.
Injury has been noted on Mission variety in certain areas.
(Note: This is Geoxy's label NOT a University of California recommendation)
WEED CONTROL
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\[
\begin{align*}
\text{IOXYNIL} & \rightarrow 2,6\text{-diiodo-4-cyanophenol} \\
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\end{align*}
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(2) Barley 4-5 leaves - Amsinckia 1 to 1 1/2" tall

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(3) Barley 5-8 leaves - Amsinckia 1 to 4 inches tall

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(4) Barley 6-8 inches (tillered) - Amsinckia 4-5 inches tall

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(5) Barley 14 inches (tillered) - Amsinckia 15 inches tall

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</table>
Preliminary studies indicate oxynil may be a potent inhibitor of respiration similar to a related compound dichlorobenil (casoron).

Additional information is needed on the herbicidal performance over a broad spectrum of weed and crop species. Work in grain should be concentrated on weeds now resistant to 2,4-D, MCPA, etc. and to earlier than normal application dates when selectivity with standard chemicals is reduced. More information is needed to determine the influence of air versus ground application, treatment volumes (or concentration), stage of growth of weed and crop, formulation, temperature, and other environmental factors.

The results this spring look promising except where applications are made too late, i.e., when the weeds are large.

LITERATURE CITED


SIMAZINE RECEIVES FEDERAL CLEARANCE
A. H. Lange

August 17, 1964, we received notification from the Pesticide Regulations Division of the United States Department of Agriculture that simazine is now registered for use at 4 pounds per acre in the following orchard crops: avocados, sweet cherries, olives, peaches, pears, plums, and walnuts. It is also registered for use in almonds but at 3.2 pounds active per acre. Simazine was previously registered on apples, pears, and sour cherries, citrus and Macadamia nuts.

Geoxy Chemical Company's new label for simazine does not include sweet cherries, peaches, or plums. They recommend applying 2 1/2 to 5 pounds of simazine 80 W/A (2-4 on active basis) in late fall or early spring for apples, pears, avocados, Macadamia, olives, and walnuts. Simazine is recommended at 2-4 pounds of the 80 W per acre in almonds. They add the additional warnings:

Do not apply to trees growing in sandy soil.
Do not apply while nuts are on the ground.
Make only one application per crop cycle.
Injury has been noted on Mission variety in certain areas.

(NOTE: This is Geigy's label NOT a University of California recommendation)
EUROPEAN CANKER OF APPLE

H. J. O'Reilly

This fungus disease was first reported in California counties. Since 1955 the disease has been increasingly troublesome, particularly in Sonoma County.

Identification of European Canker

The disease appears first as small, sunken dead areas which are centered around leaf scars. These lesions later enlarge, girdling and killing the twigs. Cankers on the branches form around twigs which have become infected. These cankers are particularly destructive since they kill the branch or weaken it so that it may break during windy weather.

The outer bark flakes off older infections after the first year and typical callus tissue folds are revealed. In larger limbs cankers expand for two or more years and may girdle the branch or stop expanding. Minute round, red fungus bodies often occur on the surface or in the cracks of older cankers.

Disease Development in the Apple Tree

The causal fungus (Nectria galligena) is active in the late fall and early and late spring. New cankers seen in the spring are a result of fungus activity in the fall. Apparently the fungus can enter the shoot through the leaf scar for a two-four-week period while the leaves are dropping in the fall. While the fungus is also known to enter through mechanical wounds during the California winter rainy season, it does not occur through pruning wounds. Why it does not do so is not understood.

The causal fungus lives from one year to the next in old cankers and produces two spore types. Following the first autumn rains, spores produced in the cankers become active and produce many additional spores, capable of invading the twigs through the leaf scars or bark injuries (but not pruning cuts). Rain water acts as a medium of moving the spores about and also provides the necessary moisture of their germination and invasion.

It is believed that apple twigs at temperatures of 50-60° F. must remain wet for at least 6 hours to permit the time necessary for spores to germinate and invade through the leaf scars. Neither shorter periods of moisture, nor dry weather conditions permit germination and invasion. When a twig becomes infected it is no longer dependent upon external moisture conditions and infection and disease development continue uninterrupted particularly during periods of mild temperatures. Under such conditions new cankers or lesions may be seen a few weeks after infection. This process is slowed down during the colder winter period, but continues in the spring.

Susceptibility of Apple Varieties to European Canker

The Delicious variety of apple and its red sports are highly susceptible to European canker. Next in susceptibility are Gravenstein and Rome Beauty. The Golden Delicious and Johnathan varieties are less susceptible under California conditions (Anjou and Bosc pear varieties are the most susceptible pears but the disease is less severe in pear trees).

Can European Canker be Controlled?

Recent work in Sonoma County by Dr. Wilson (UCD), as well as survey work by Dr. Nichols, Bureau of Plant Pathology, Sacramento, have not yet come up with a reliable control method. Protective sprays of Bordeaux, as recommended in England, during the leaf fall period to protect the leaf scars have not been successful here. Probably this is because there is such a gradual dropping of leaves over a period of several weeks, thus a protective spray will not protect all of these scars because of this gradual leaf-dropping process. If the spray
is delayed until all the leaves have dropped probably many of the leaf scars have already become infected.

Removal of diseased branches is advisable as it is in existing cankers that the fungus survives. Research is continuing on other control methods but at the present time removal of existing cankers appears to be the only solution.

GENERAL SUBJECTS

REPORT ON OREGON STATE HORTICULTURAL
SOCIETY MEETING, November 18-20, 1964


Oregon-California Extension Conference

On Wednesday morning, November 18, California Extension personnel met with Oregon Extension Director, Mr. Gene Lear and various specialists and county agents. Mr. Lear outlined the budget cut which Oregon Extension experienced a year ago. This involved a total reduction of 650,000 and necessitated elimination of certain Extension positions. Home Economics and 4-H work were cut more severely than was agriculture.

Extension participation in "applied research" was discussed at length, the Oregon agents being interested in how this aspect of Extension was handled in California. Apparently Oregon agents do less applied research but are becoming interested in expanding this field of extension.

In the afternoon two major reports were given on pear marketing problems. James Kihare, Manager Hood River Apple Growers' Association, and Mr. Robert Collins of Walnut Grove, California, Mr. Kihare indicated that there would be more Bartletts produced on the Pacific coast between now and 1970 than the market would require if present consumption trends continue. Mr. Collins agreed that unless Bartlett production is injured by some new calamity, such as pear decline, a price disturbing surplus is almost certain. He said that the California Canning Pear Association, of which he is President, is making strenuous efforts to discourage new pear plantings. Collins recommended to the northwest Bartlett growers that they consider the possible values of a Federal marketing order to regulate quality of fresh Bartletts. A relatively small surplus tonnage could have disastrous effects on price, he said.

Chemical Sex Sterilants

Insect control by chemical sex sterilants was discussed by B. A. Butt, Yakima USDA Entomologist, in a paper presented by D. O. Hathaway. Reduction in insect population will be in direct relation to the number of sterile males released, he said. Thus Chemo sterilants would eliminate the expense and problems relating to rearing large numbers of sterile insects in captivity. Presently, scientists are attracting the insects in the field to the Chemo sterilants by mixing the chemicals with attractants which cause the insect to come to the attractant to be sterilized and then leave. In reviewing advantages of a sterile male program over chemical control, Butt noted that eradication or control low-populations could be achieved more effectively than by chemical control. This technique does not injure beneficial insects and mites, leaves no harmful residues and may be cheaper.
Concentrate orchard spraying was discussed by Iain MacSwan, Oregon Extension Plant Pathology Specialist, pointing out that it was just as effective as dilute spraying, but cheaper. In applying 60-100 gallons of spray per acre instead of 350-1,000 gallons, concentrate spray machines use 70-90% less water per acre and result in 25% or more reduction in the amount of pesticide per acre. Some concentrate machines are more maneuverable and result in less soil compaction. As there is little run off from the trees less pesticides go directly into the orchard soils. Concentrate spraying gave as good results on brown rot blossom blight control in Oregon cherries in 1958 as did high volume sprays. The results were often superior to those used with fungicide dusts on this disease. Similar results were found in results of concentrate spraying versus high volume spraying in apple scab and walnut blight tests. Concentrate spraying has been steadily gaining in grower acceptance over the past few years. It is now being widely used in the Willamette Valley and the Rogue River Valley. These smaller machines are easier to use in new apple orchards planted closely or dwarfing or semi-dwarfing rootstocks.

"The Fuss about Residues"

Dr. Leon Terriere, OSU biochemist, said that techniques for discovering pesticide residues are now a million more times effective than they were 20 years ago. He said that the current public interest in pesticides and their concern over residues is largely due to the discovering of new techniques by the chemists. New equipment such as the gas chromatograph which hadn’t been invented 20 years ago now enables the chemist to locate pesticides at levels so low that they are almost beyond comprehension. The extreme sensitivity of the instruments has made it necessary for these scientists to invent a whole new vocabulary. A few years ago biochemists were investigating chemicals in terms of milligrams; now they talk about nanograms, and pico grams or billionths of a gram.

Pesticide residues can be found in places where they were never suspected before. However, the actual amount of pesticides that find their way into the human diet has not increased. The evolution of analytical techniques is entirely natural although it has focused public attention on pesticide use. The chemists search for more effective pesticides to insure an abundant food supply. This has brought with it vast improvement in analytical techniques, and the chemist of today is probably 25 times more efficient than he was 20 years ago.

The current public concern over pesticide uses is not really unique, Terriere pointed out. He referred to the codling moth problem which occurred in the late 1920’s and early 1930’s in Oregon. At the time the growing resistance of the codling moth to the only available control material, lead arsenate, made necessary the use of more and more arsenical compounds on fruit trees; this prompted a great deal of public concern. At that time more effective fruit-cleaning techniques probably saved the fruit industry.

Oregon Sweet Cherry Industry

Oregon sweet cherry plantings have expanded to the point that the capacity for producing more than the market can take is more than likely, according to R. L. Stebbins, OSU Extension Horticulturist. New plantings have expanded from 551,000 trees in 1954 to 788,000 to date. Improved cultural practices are also increasing yields. New irrigation water in The Dalles areas, Wasco County, is substantially increasing tonnage. Growers are now planting more marketable pollinating varieties, such as Corum and Sam. Growers are now top working trees on mazzard 5-12-1 rootstock to prevent bacterial canker and some have planted trees with Montmorency sour cherry trunks and converted them to sweet cherries to get a tree that bears sooner and that is somewhat smaller in size for easier picking. Trees are now
planted close together, particularly where new irrigation is available. Pruning is producing larger size fruit which is picked easier.

Leaf Analysis Survey of Prunes

In another paper, Stebbins discussed the nutrition of the Italian prune orchards stating that they could be doubled or even tripled in production if growers were to follow a good fertilization program. He based his statements on Oregon State University nitrogen and boron fertilizer plots on prunes in the Willamette Valley and a leaf analysis survey of 185 orchards in the Willamette Valley. The survey showed 75% of the orchards deficient in nitrogen, 65% deficient in boron, 17% deficient in potassium, and 2% in magnesium. Analysis of the leaf samples taken from the orchards was made at Michigan State University.

Research conducted by Dr. O. C. Compton, Horticulturist, OSU, has shown that with the application of 1/2 pound agricultural borax and 1 1/2 pounds actual nitrogen per tree it is possible to increase prune yields from 2 to 9 tons per acre. In 1964 orchards where nitrogen and boron had been applied showed as much as a four-fold increase in yield with the production going from a low of 50 lbs. per tree up to 200 lbs. When nitrogen was used alone and boron deficiency existed, nitrogen applications reduced yields compared to unfertilized trees.

Cherry Picking

A new cherry pickle packing process pioneered by OSU was discussed by Drs. Sather of the Food Science and Technology Department. The process makes it possible to pickle burlap cherries in the barrel, thus eliminating several steps in the process of pickling sweet cherries. OSU scientists are also evaluating results of nitrogen freezing on cherries as these may retain their texture and flavor better than conventionally frozen cherries. Other products in the process of development at OSU include banana flavored cherries, peach flavored cherries (for peach ice cream) and dehydrated cherries for use in breakfast cereals, puddings and other convenience foods.

Soil Fumigation

Dr. Stephen Wilhelm, UCB, told Oregon vegetable and small fruit growers about the California soil fumigation program, saying that fumigation has changed the direction of the breeding program and cultural practices of California strawberry industry. Growers are now planting strawberries year after year on land of high fertility that had been given up as infested beyond use. Growers in parts of the state have gone to handling strawberries as an annual or biennial crop, taking advantage of the first and second year of vigor, production, and quality.

Verticillium wilt, in particular, is widespread throughout California soils because it attacks widely grown crops: potatoes, tomatoes, cotton and various flowers and weeds. Once land is invested with Verticillium it remains infested for many years and long rotations with nonsusceptible crops have not controlled it. Before fumigation growers grew strawberries for the normal 3-6 year period and then moved to new land. This meant expensive land leveling, drilling wells and building irrigation systems. In addition Wilhelm said that there was no assurance that soil-borne diseases were not already in the new land and new land is scarce in California today. A mixture of methyl bromide and chloropicrin gave a fumigant that controls Verticillium and other root attacking fungi, including Rhizoctonia and Pythium, which also attack strawberries. The combination gives excellent weed control and control nematodes without leaving injurious residues in the soil. Land, during fumigation, is kept covered with a tarp for 48 hours. Wilhelm said that the proportions of chloropicrin or methyl bromide are adjusted to the fumigation job to be done, whether the main problem is weeds or wilt. He reported California farmers are fumigating 2500 to 3,000 acres of
strawberry land each year, 500 acres of early market pole tomatoes, 600-700 acres of tomato seedling nurseries, 15 acres of deciduous fruit nurseries, and 350 acres of ornamentals. The principal commercial operator doing the work is using 4,000 miles of 13 foot polyethylene sheeting per year.

Development of one-year cropping of strawberries, Wilhelm said, was an unforeseen outcome of the UC plant pathologists fumigation work. Breeders have been able to forget root diseases and concentrate on a plant bearing heavily the first year. Some growers have replanted annually eight times on the same land. In reality many so-called worn out soils have really been nonproductive because of the soil pathogens they contain.

A new cherry disease occurred in Oregon in 1962. Now known as cherry rosette and known to be caused by a virus, the disease can be masked (but not controlled) by an application of boron. This is a new intriguing possibility in virus disease control according to John A. Hillbreath, Plant Pathologist, OSU. At blossom time infected trees have small unopened green buds which open late but soon drop, leaving a ring of persistent green bud scales. New leaves on affected trees are now delayed in expansion and appear to form a rosette or cluster of small leaves, due to the slow elongation of the terminal growth. Badly diseased branches have a mixture of normal leaves, long narrow leaves, and short, cupped leaves.

The ability to "live with" the disease resulted from a grower observation that when he had applied a solution containing borax soap into the root system the trees recovered. The disease which is spread alarmingly in the Willamette Valley and also in certain areas along the Columbia River near Hood River and The Dalles is being actively studied by plant nutritionists and plant pathologists. Entomologists have investigated the possibility of an insect vector. K.G. Swenson, OSU Entomologist, showed that six of the seven aphid species tested could transmit the disease, thus pointing to the probability of a virus. Aphid species included the green peach aphid, and the black cherry aphid. Boron sprays have given the best control, particularly trees receiving three sprays of 2 lb. of Solubor (20% actual boron per 100 gallons of water applied at monthly intervals during the summer. A mechanism whereby boron masks the disease symptoms will receive intensive study.

Senator Morse on Agricultural Policy

The keynote speaker at the meeting was U. S. Senator Wayne Morse, whose address was entitled "Government Policies Which are Injuring Oregon Agriculture." He pointed out that the U. S. had already made one major retreat on the farm front, when it agreed in trade talks with the European economic community to commence with industrial goods and let farm goods go for the time being. Countries in the European economic community (EEC) are important customers of U. S. agriculture. Of the total 3.5 billion worth of goods exported annually to the common market, one billion is agricultural products. The EEC is this country's largest single cash market for farm products.

Although this interest in European outlets for farm products has been recognized by administration spokesmen, especially during consideration of the 1962 trade expansion act, a serious reversal of what was believed to be a firm position was made a few days ago when the U. S. took it upon itself to help bail out the common market of its own conflict over farm policy.

This came with an agreement to start negotiations with industrial goods, after first refusing to begin any negotiations under lists for farm had been published by both sides, according to Senator Morse.

The failure of the common market nations to agree on unified prices for their own agricultural commodities has been a stumbling block to the Kennedy round of negotiations with conflict between France and Germany on grain price levels.
France with her typical use of extreme threats to gain a bargaining point has threatened to disrupt the EEC completely unless Germany accepts the French offer on grain price levels.

Morse emphasized that France is not trying to do the U. S. and American agricultural supporters any favors in this matter. France envisions herself as the bread basket of the common market. By driving out marginal German producers she hopes to expand her own lower cost farm production. But in every action and in every official pronouncement on almost every issue — economic, political, and military — France has made clear she wants the U. S. excluded from Western Europe and that includes our fruit, our grain, our beef, our culture, our nuclear force, and our leadership.

Morse charged that U. S. leadership responds to this with the same technique we used for 20 years in Western Europe.

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W. A. Harvey
Weed Control Specialist