The plot on the left received a pre-emergence treatment of 2,4-D followed by two applications of the nitrogen solution plus a wetting agent and 2,4-D. These uncultivated, weed-free plots yielded 108 bushels of corn an acre. The plot on the right received two conventional cultivations. Weeds were prevalent. Corn yield was 102 bushels per acre

Herbicides with Nitrogen Solutions Biggest News in Fertilizer-Pesticide Mixtures

Successful use on corn of herbicides in combination with fertilizer nitrogen solutions is probably the biggest recent news in the field of fertilizer-pesticide mixtures. This development was reported by G. C. Klingman of North Carolina Experiment Station at the Southern Weed Control Conference. Dr. Klingman's experimental results showed good control of weeds and increased yields with applications of 2,4-D and a wetting agent in ammonium nitrate solutions. The ammonium nitrate knocked down weeds in the corn field, as well as furnishing nitrogen fertilization, and 2,4-D controlled the broadleaf weeds. Applications were side-dressed on the corn twice—six weeks and eight weeks after planting. An important advantage seen in this method is that farmers themselves can add the low-volatile 2,4-D esters to their nitrogen solution tanks just before application—at the rate $^1/_8$ pound per acre. Dr. Klingman plans to run similar tests again this season before he makes any recommendations to North Carolina farmers.

This is believed to be the first report of any research using fertilizer in combination with herbicides, most of the previous research experience having been with soil insecticides.

Meanwhile, interest in and actual use of insecticide-fertilizer combinations is growing considerably in the Southeast and Midwest. In the Southwest and California, interest is reported slow but still alive.

The fertilizer industry's opposition to mixtures seems to be dying down in the Midwest. Throughout the corn belt, all but one or two large national fertilizer manufacturers are reportedly incorporating aldrin in fertilizer for controlling rootworm and other soil insects this year. Similar trends are developing in the Southeast for corn, peanuts, and others.

In the Pacific Northwest, farmers are using combinations to control wireworms in potatoes. Potato protection in California has also used aldrin-fertilizer combinations, but development there has not been as rapid or great as some expected. Pelleted lindane formulations have also been used there.

In the Southwest, control officials have resisted the trend and this seems to have taken its toll. Southwest insecticide manufacturers have not had support from fertilizer formulators. Sources in that area say that if anything formulators are increasing their fight against the combinations. It is expected that usage will remain slight until more demand is shown by more farmers in the Southwest. The slight useage reported in that part of the country has mostly centered on pelleted aldrin and chlordan.

The fertilizer industry's objections to combinations, although weakening somewhat, are based on some important considerations. Formulators are reluctant to start using chemicals that may increase hazards to mixing plant personnel and to install additional ventilating or air-cleaning equipment. They are understandably apprehensive about potential claims for injury that customers, dealers, and other handlers may make. They are still uncertain about the big problems of chemical compatibility and decomposition during ammoniation and storage. Perhaps the biggest deterrent is reluctance to enter a field in which the products have a high degree of specificity with its problems of separate inventory, separate storage, separate labeling, and other related problems.

Demand Is the Key

Many of these objections on the part of fertilizer manufacturers can undoubtedly be swept away if sufficient demand on the part of the farmer builds up. Compatibility and mixing problems are susceptible to solving by research and experience. For instance, pelletized forms of the pesticides are a partial solution since the insecticide pellets are of the same size and density as the fertilizer granules, thus obviating the problems of mixtures settling out during storage.

Nitrogen solutions would also seem to obviate mixing problems because of their liquid nature. Also, the fact that farmers can mix pesticides in the solutions themselves would seem to relieve the formulator of legal responsibility with regard to the combination. Herbicides are not the only pesticides useable with the solutions—grain and legume growers are getting good results with mixtures of DDT in solutions of urea and ammonium nitrate. An emulsion form of DDT is mixed by the farmer in the fertilizer solution for spraying on winter wheat nurse crops seeded to sweet clover. The nitrogen is showing good results on

the wheat and the DDT shows good results on the sweet clover weevil. Farmers report that the mixture seems to have better physical application qualities than either material used separately. The weevil has become such a big problem in sweet clover that Indiana farmers cite it as one reason for turning away from sweet clover as a green manure crop. Trials are also starting with this method for oats. Further west, BHC and aldrin are being used with nitrogen solutions against the corn root worm. Research is also being done on aldrin with ammonium nitrate and free ammonia solutions.

Herbicide Development Rapidly Picking Up Speed

Organic herbicides as we now know them have an active history of only about 10 years. A great deal has been accomplished during that time. 2,4-D has been by far the best known and most widely used of the herbicides, but during the past two years several new and promising compounds have appeared. Today some of these are in active and effective use, others are only beginning to find use on the farm, and some are still in the research stage. Rapid development is under way, many of the problems are being overcome, and it seems that we can look forward to the availability of tailor-made herbicides which will more effectively control specific weeds while not harming other plants.

With the development of new tailor-made chemicals for killing weeds, it is evident that much more precision will be required in proper use. This will mean that farmers must be kept informed on the latest and best knowledge of the action of these chemicals and the techniques for applying them.

Phenoxy-Type Compounds

Of the herbicidal chemicals, the best known group is the phenoxy-type compound. This includes 2,4-D (2,4-dichlorophenoxyacetic acid), 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and MCP (2-methyl-4-chlorophenoxyacetic acid). Use of these compounds for the control of broadleaf weeds and certain other plant species has been extensive. They have been used both as post-emergence and pre-emergence sprays. As pre-emergence agents they are effective for both broadleaf weeds and grasses.

As might be expected in the early use of such compounds, there have been some difficulties. For example, some highly volatile esters of 2,4-D have been used to control weeds, but their volatility allowed them to affect the crops and cause considerable damage. New low-vapor-activity esters have been found which do not harm the crops but are as effective in their capacity to kill weeds as are the earlier agents. Also in some areas where 2,4-D was used to spray rice, there was a drift over onto cotton fields causing severe damage to the cotton. New products now are on the market which may overcome this difficulty.

Silvex (2,4,5-trichlorophenoxypropionic acid) has been made available in limited quantities only during the past year. It is a product being watched with special interest. Tests have indicated that it is equal to 2,4,5-T for the control of certain specific woody plants, especially for oak species. One of its most promising characteristics is its relatively low toxicity to cotton as compared with 2,4-D or 2,4,5-T. This may provide some relief for the disturbing problem of damage to cotton in the spraying of brush or other crops with weed killers.

Among other new compounds in the phenoxy group which show promise are 4-chlorophenoxyacetic acid, 2,5-dichlorophenoxyacetic acid, and 3,4-dichlorophenoxyacetic acid. These compounds are highly specific and as a result are expected to have special usefulness for controlling weeds in cereal crops, where legumes such as alfalfa and clover may be underseeded for later harvest. In experimental trials, 3,4-D has caused little or no injury to either Ladino clover or alfalfa. 4-Chlorophenoxyacetic acid has shown some damage to alfalfa stems but caused little or no injury to Ladino clover. It has also reduced yields of small grains under some conditions. Under identical conditions, 3,4-D caused no injury to small grains.

A new compound closely related to TCA (trichloroacetic acid) now has appeared on the scene. It is given the name dalapon. Its chemical name is 2,2-dichloropropionic acid. Recently put on the market, this new compound is more effective than TCA on many grasses and shows promise for the control of grasses and grass-type weeds in sugar beets and other row crops. Dalapon shows particular promise for use in pasture renovation. It will make possible the killing of weeds, to be followed by reseeding with a minimum of seed bed preparation, plowing, and cultivation.

Another group of compounds with the phenoxy group includes chlorinated phenoxyethyl esters. 2,4-Dichlorophenoxyethyl benzoate has been used in pre-emergence applications on soil and 2,4-dichlorophenoxyethyl sulfate has been established and its derivatives are being developed. One of these derivatives which will be in the demonstration stage this year is sodium 2,4,5-trichlorophenoxyethyl sulfate. This is an example of a tailor-made herbicide, as it will be especially suited in weed control for tomatoes. Tomatoes are particularly sensitive to most herbicides but this one can be used with relative safety.

Dinitro Compounds

Dinitro alkyl phenols and also certain chlorine substituted phenols have found extensive use as contact selective and nonselective post-emergence herbicides. Two of the more important dinitro compounds are dinitro-*o*-(sec-butyl)phenol and dinitro-*o*-cresol. They also have been used as pre-emergence sprays on weeds in a number of crops, including cotton, peanuts, and soybeans. One of the problems with the dinitro compounds has been their volatility and relatively high vapor activity. This has been particularly troublesome in their use with cotton when temperatures exceed 88° F. and the cotton is in the seedling stage. It has not been a serious handicap in other crops outside the South. A new development designed to overcome this difficulty is the use of as little as 50 pounds of lime per acre with these compounds. This reduces the volatility and, therefore, makes them safer to use. It has proved particularly valuable in their use with cotton. The lime is either applied in the spray mixture or applied separately to the soil surface immediately after the spray has been put on.

Considerable research is under way with the dinitro compounds to improve selectivity and specificity of action and to find compounds with lower vapor activity.

Carbamates

Certain carbamate compounds have found extensive use in the past few years. The best known among these are IPC (isopropyl-N-phenylcarbamate), and CIPC (isopropyl-N-(3-chlorophenyl)carbamate). Specific action and high selectivity has led to the wide use of carbamates. They have been particularly useful as post-emergence sprays for the control of germinating annual grasses in legumes and more recently have come into use as preemergence sprays for weed control in cotton, soybeans, and certain other crops.

Two new carbamates are now making their appearance as experimental herbicides. They are 2-(1-chloropropyl)-*N*-(3-chlorophenyl) carbamate, and 2-chloroethyl - *N* - (3 - chlorophenyl)carbamate. These compounds are so new as to be little known outside the research field at