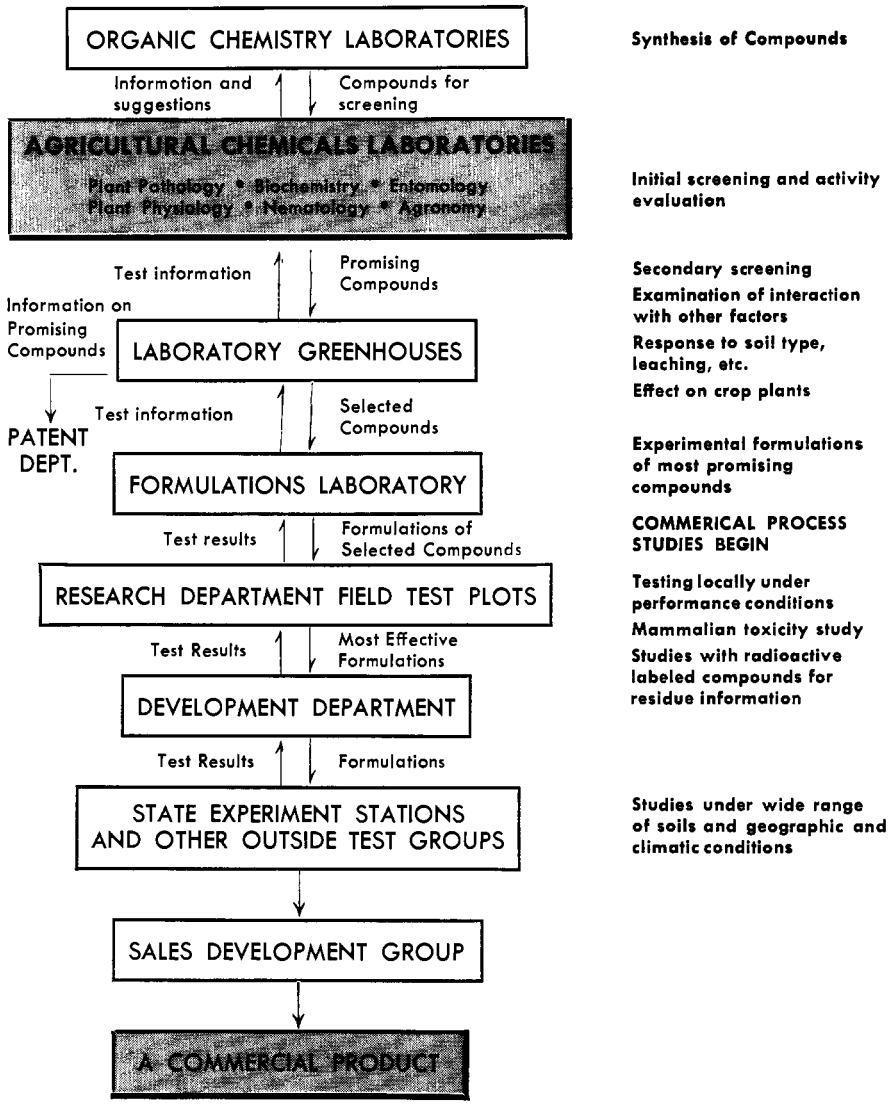
Coordinated Chemical Farm for Farm Chemicals



THE SEARCH for agricultural pest control chemicals has moved "front and center." Within the past five years several chemical manufacturers have reorganized previous or instituted new programs for developing chemicals which will make money for both the farmer and the company's stockholders. Stakes are high, but so are competition and the obstacles between the idea and the successful commercialization of a new pesticide.

Monsanto, important in the agricultural chemicals field and intending to stay there, takes into realistic consideration these facts of industrial life. Constantly on the look for something better for solving the farmer's pest problems, Monsanto has set up coordinated research laboratories and an experimental farm in the suburban St. Louis area. There, application research is being conducted in plant physiology, plant pathology, entomology, nematology, biochemistry, agronomy, and microbiology. These groups coordinate their efforts very closely with each other and with organic chemists, formulation experts, and development specialists at other Monsanto locations.

This system is getting results. Concrete evidence came to light a few months ago when the company announced three new herbicides in the commercial development stage. Furthermore, these new weed killers have highly desirable selectivity in their kill.

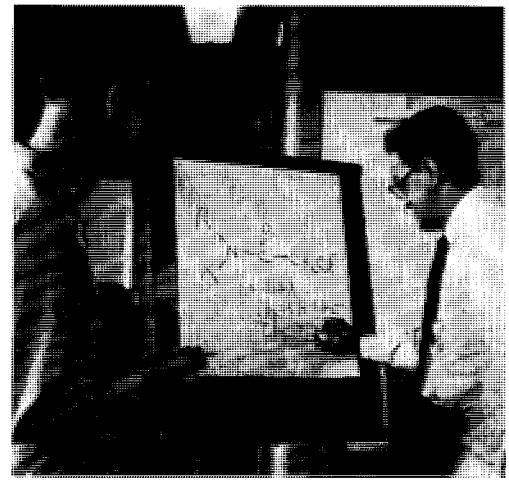
The trail started with a consultation of a biologist, interested in the type of toxic action exhibited by α-chloroacetamide, and a chemist, interested in the chemistry and the multitude of variations possible. Exploitation of *N*-substituted chloroacetamides was agreed upon as one of a number of starting chemical nuclei. Substituted chloroacetanilides similar to others reported earlier from Camp Detrick were tested first, with almost negative results. The transfer of effort to synthesis of aliphatic *N*-substituted α-chloroacetamides brought interesting results immediately.

By the end of last year, three new compounds were ready for presentation before weed control conferences as Monsanto's entires in the race for strong position in the herbicide business. α-Chloro-*N*,*N*-diallylacetamide (CDAA) and α-chloro-*N*,*N*-diethylacetamide (CDEA) had given excellent control of grasses at rates ranging from three to six pounds per acre and even lower. Not only were these pre-emergence herbicides effective against giant foxtail, wild oats, cheat grass, and crabgrass, but they also controlled certain broadleaf weeds, such as pigweed and purslane. There was no apparent stunting of crops or reduction of yields with grass-type crops such as corn, or beans, such as soybeans. A new herbicide with similar action is 2-chloroallyl diethyldithiocarbamate (CDEC).

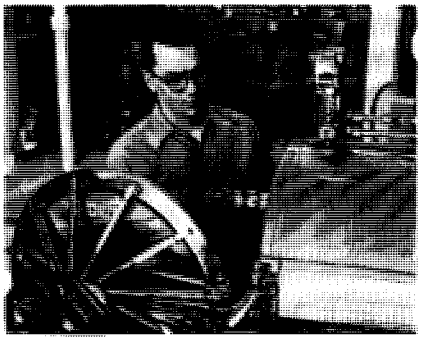
The story doesn't stop with the development of these new weed killers. Research and testing is continuing and more information is being accumulated on the relationship of herbicidal activity to chemical structure as a lead to better herbicides.

In a paper presented before the Division of Agricultural and Food Chemistry at the recent Cincinnati meeting of the American Chemical Society, P. C. Hamm and A. J. Speziale of the Monsanto group outlined some of the effects of structure on activity.

They have found that an α-chloroacetamide must carry at least one substituent on the nitrogen atom for activity. A three carbon chain is the most potent. Two alkyl groups are better than one, and again the three carbon radical is the best choice. Unsaturation gives strength—the diallyl compound is very high in activity. With branched chains, three carbons in a row still seem best, as the isobutyl ranks highest in potency with one sub-



NEMATOCIDES. Phil Santmyer, nematologist prepares for a series of tests. Screening of compounds for use against nematodes begins with microscopic observation of the living creatures in solutions or emulsions of the test chemical



PLANT CHEMOTHERAPY. Part of the program at Creve Coeur is designed to learn what chemicals are effective against fungi and bacteria on crops. Samples to be tested are put into an autoclave by Dan Roman

INSECTICIDES. An active screening program involves determination of insecticidal activity in both laboratory and greenhouse tests. Here George Ludvik reads a test on a new experimental insecticide

stituent. Disubstitution reduces weed killing power with the branched chain substituents.

Other significant observations:

Increase of the acyl moiety beyond acetyl produces inactivity.

A number of heterocyclic derivatives, such as the furfuryl, tetrahydrofurfuryl, and morpholide, show power.

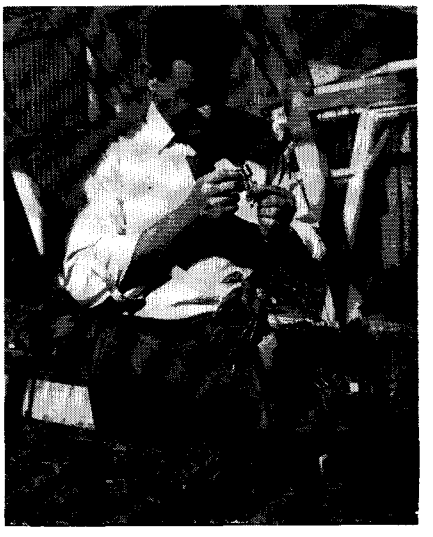
The aromatic compounds generally are weaker than aliphatic.

Di- and tri-chloro-N-substituted acetamides are inactive.

Bromine and iodine can be substituted for chlorine with only slight loss in activity. Fluorine is unsatisfactory.

Thus a coordinated program of research and testing is building up a collection of information which sharpens the focus in the search for new compounds. Monsanto's future expectations include new fungicide, insecticide, and nematocide candidates as "hired-hands" for the farmers.

BIOCHEMISTRY. Ernest Jaworski is shown examining the effects of radioactive herbicides on corn. The effects of pesticides on both pests and hosts are studied by such techniques



PLANT PATHOLOGY. The plant pathologist works in close contact with the chemical studies. This sector of work is handled by Paul Hoffman, examining here a case of bean leaf spot

FROM IDEA TO APPLICATION. Monsanto's coordinated research laboratories and experimental farm are able to carry a test compound from the original thought through the practical field test. In the laboratory (left) P. C. Hamm, plant physiologist, and John Speziale, organic chemist, discuss structure-activity relationships and, on the basis of accumulated knowledge, plan the synthesis of new compounds. Oliver De Garmo, assistant research director in the Organic Chemicals Department, is in charge of activities in the agricultural chemicals research laboratories at Creve Coeur. In the center picture he discusses field tests with John Deming (right), who heads that work. Clyde Wilson, on the tractor, applies a test formulation at Monsanto's Hazelwood farm as the final step before a product can be ready for marketing