## Fungicide Research Needed on Fundamental Basis

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AMERICAN AGRICULTURE is using about a half billion pounds of fungicides this year. Sulfur, lime sulfur, and copper compounds remain as the leading materials but the new organic compounds are gradually encroaching on the markets. More diseases are controlled better with less damage to the crop or hazard to the spray operator and consumer than ever before.

We have taken a conservative attitude by assuming that no more than half of plant disease loss can be controlled. However, if the time comes when we have therapeutic treatments rather than the 1950 model surface protectants, this viewpoint may be outmoded.

Today most fungicides are used as surface protective agents which must be repeated as new foliage develops and weathering proceeds. Better protection would be afforded by fungicides which would be absorbed through roots or leaves.

There is good evidence that bacterial diseases which have gone their way unhampered by chemicals for many years are going to be controlled. The bacterial blights of bean and fireblight of apple and pear have responded to treatment with streptomycin and terramycin. Now that antibiotics people have begun to open up leads, there is good reason to believe that the organic chemist may do as well or better in the synthetic field.

The great weakness in the present research program is that chemists and biologists do not know exactly how fungicides act. The only way to correct this is to study basic principles. Three types of studies are needed: the effect of chemical constitution on fungicidal action, the methods by which spores are penetrated, and the mechanism by which vital processes are destroyed.

Formulation, too, is very important and more basic knowledge is needed on the basic factors influencing the efficacy of formulations. We may be trying to exploit the most fungitoxic members of a class when what we should be doing is developing the most stable persistent molecule even though it may be somewhat less active as a fungicide.

It should be remembered that the farmer is buying protection and nothing else. It would be profitable to sacrifice 20% in toxicity, for example, if the material persisted twice as well so that the spray deposit would have to be renewed only half as often.

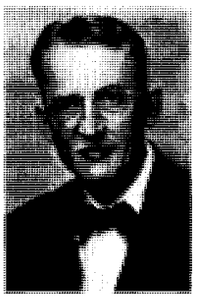
Fungicide research is coming of age. It is not easy to pick the right molecule and formulate it so that it will prevent disease establishment. It is even more difficult to write out the specifications so the new molecules can be synthesized for testing. Look at the requirements:

1. The choice of a basic nucleus which is relatively inexpensive to synthesize. This nucleus should be chemically reactive in its own right as in the quinones or else be capable of bearing reactive grouping such as the 4-nitroso group of the pyrazoles.
2. The toxophore grouping must be exposed so it will react with a vitally important cell constituent such as the enzymes.
3. The toxophore must be protected from excessive detoxification by cell secretions by proper substituents which regulate electron density, etc.
4. The group must be capable of penetrating the fungus spore. It may be necessary to add a lipoid-solubilizing group as a strategically located substituent.
5. The lipoid-solubilizing group must be selected carefully so it will not promote excessive penetration of foliage and fruit.
6. The molecule must be photostabile and otherwise persistant through all sorts of weather conditions.
7. The chemical must be formulated according to its chemical attributes so it may be deposited in an economical and enduring film.

The fundamental knowledge of how fungicides act must be obtained if the industrial research man is to be used efficiently. If such fundamentals are not available and development work continues by empirical testing, the program will eventually become unprofitable as standards of performance in fungicides increase and added expenses such as extensive toxicological research are added to the cost of development. The price of conducting such fundamental research will be paid either in an orderly, planned program or in eventual inefficiency as present methods become outmoded. It is easy to find a chemical that will inhibit spore germination in the laboratory, but it is not easy to find one that will prevent disease without injuring crops. It if were easy there would be more new fungicides on the market. There is plenty of need for them and the rewards are enticing, but industry must plan beyond its immediate future if it is to realize its potentials.

## FDA Interested in Allaying Public Fears

THE ONE MATTER of the most significant mutual interest to the National Agricultural Chemicals Association and the Food and Drug Administration appears to be whether or not there should be legislation to afford better protection to the public health through the establishment of tolerances for pesticide residues on food. We agree that pesticides are essential to the continued production of abundant food crops for the American people.



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There is every reason to believe that the need for more effective pesticides will continue to increase. The constantly changing problems of production brought about by insects and plant diseases leave no doubt that more and better pesticides are essential to our basic economy if it is to be preserved and improved.

There are many areas of agreement between us. Certainly the pesticides used most not endanger the health of consumers. The agricultural chemicals industry, we are informed, is interested in allaying such public fear of pesticide residues as unquestionably does now exist. The Food and Drug Administration is also interested in this problem. For so long as the public or any important segment of it entertains serious reservations about the safety of our food, it at the same time must question the effectiveness of our operations.

One problem which presented itself in the early consideration of legislation was the question of whether or not all chemical additives should be lumped together and dealt with in the same bill. We have become convinced that separate treatment is justified for pesticides as distinguished from other types of food additives.

Chemical additives are not subject to control under the Federal Economic Poisons Act, whereas pesticides are. Obviously the two acts should be coordinated.

One guiding principle which permeates the Food, Drug, and Cosmetic Act of 1938, and which we believe is of the utmost importance in the public interest, is that poisonous substances should not be added to our food supply, in any amounts unless the substances are necessary for production of food.

In our discussions with representatives of the pesticide industry they have expressed the view point that scientific advisory committees are an essential part of sound legislation dealing with pesti-