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Impact of Resistance to Pesticides on Cotton Insect Problems in Arkansas

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The Impact of Resistance to Insecticides on Cotton Insect Problems in Arkansas

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Insecticides have been used for cotton insect control in Arkansas for 100 years. For the 1st half of this period usage was very light, only occasional applications for cotton leafworm control. Then the boll weevil entered the picture. Calcium arsenate was developed for control of this pest but usage was relatively light. 1942 was a year of heavy infestation by boll weevil and cotton leafworm, and yet only 2 million pounds of insecticides were used in Arkansas according to our best estimates. This is no more than 1/4 of an application per acre.

In 1945 DDT became available for commercial use, an event awaited with great anticipation. In 1946 a bollworm outbreak in southwestern Arkansas called for the first large scale usage of this miracle insecticide on cotton in the state.

DDT was not effective on boll weevil but other chlorinated hydrocarbons came along soon. A very heavy boll weevil outbreak extending from late 1948 through 1950 put these new insecticides to a severe test. Results were spectacular. Partly due to these new insecticides and partly to changing economic and social conditions, use of insecticides as needed became a standard production item. Over the past 20 years an average of 5 to 8 applications of insecticides has been made to about 2/3 of the cotton crop. Insect hazards are rather low in northeastern Arkansas. This results in little insecticide usage on about 1/3 of the Arkansas cotton crop.

Insect resistance to insecticides has been recognized for half a century. Mosquitoes and houseflies promptly developed resistance to DDT. Even so, it was fondly hoped that field resistance of our major cotton pests would not develop for many years, if ever.

In 1953 and 1954 cotton aphid populations appeared to be resistant to BHC in some locations. We were shortly too busy on other problems of resistance to pursue this and it has never been properly documented.

Weather conditions in 1955 were unusually favorable for boll weevil development and unfavorable for effective use of insecticides. By early August this pest was out of control throughout its normal range in the Mississippi Delta. Persistence and a break in the weather enabled farmers to bring the boll weevil under control, a truly spectacular save. In adjacent areas in Louisiana and in the South Delta of Mississippi farmers were not so fortunate. Runaway infestations persisted.

After some hasty lab tests, LSU Entomologists announced in early September, 1955 that some boll weevil populations were resistant to BHC and certain other chlorinated hydrocarbon insecticides.

Toxaphene was one of the chlorinated hydrocarbons to which the boll weevil showed resistance in 1955. As stated earlier, DDT is ineffective at normal field dosages on boll weevil. Mixtures of toxaphene and DDT proved to be effective on toxaphene-resistant boll weevils, although they were no more effective than straight toxaphene on susceptible weevils.

DDT afforded the 1st effective insecticidal control of the cotton bollworm, **Heliothis zea.** In the 40's control was spectacular with 1/2 lb/A. By the late 50's control was acceptable with 1 lb/A. This pest went out of control in the Russellville-Dardanelle area in August, 1961. Some time was bought with mixtures of chlorinated hydrocarbon insecticides and the resistance level was highly variable from one population to another.

Organophosphorous insecticides became popular in the late 50's because of their effectiveness in controlling boll weevil, aphid, and spider mites. At high dosages they came into common use for bollworm control.

Resistance to an organophosphorous insecticide, methyl parathion, interfered with bollworm control in Jackson county in 1969. This had been predicted from earlier lab work, from problems of control in Central America, and from problems with a related species, the tobacco budworm.

Carbaryl or Sevin is a carbamate insecticide, representing another chemical grouping. Like the organophosphorous insecticides it is a cholinesterase inhibitor. In a few years low-level resistance in bollworm has developed.

Several caterpillars that are sometimes pest of cotton appear to represent cases of non-target species being selected for resistance. These include tobacco budworm, cabbage looper, and beet armyworm. Spider mites are readily selected for resistance. In cotton fields in Arkansas resistance to organophosphorous insecticides has de-

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veloped, apparently another case of a non-target organism being selected for resistance.

After 25 years of heavy insecticide usage on cotton in Arkansas, several pest insects and mites have developed resistance to the 3 principal groups of insecticides and miticides: the chlorinated hydrocarbons, the organophosphorous compounds, and the carbamates.

The first reaction of the farmer to resistance is to increase the dosage and frequency of insecticide application. During the brief period that this approach is partially effective, it exaggerates the problem of environmental contamination.

Cotton is in dire straits economically. Every effort is being made to reduced the cost of production. But the resistance problem adds to the cost of production.

Cotton insects are the subject of this presentation, but the situation is similar for many of our food and feed crops. Furthermore, a pest species may develop a high level of resistance from exposure to insecticides on cotton, making it difficult to control on other crops. Examples include cabbage looper on greens crops and bollworm on soybeans.

It is neither cheap nor easy to discover new chemical groupings that will control insects and meet acceptable standards of safety and economics. Several years and millions of dollars are required to carry out the research to serve as the basis for registration. Prospects are so discouraging that at least 4 major companies have closed their primary synthesis and screening laboratories in the past 3 years.

It appears unlikely that new insecticides can be synthesized and developed rapidly enough to offset the present rate of obsolescence of insecticides through resistance. More realistic requirements on registration of new insecticides would help, but would not solve the problem. Biological insecticides (bacteria, viruses, etc.) are under more stringent registration restrictions than are chemical insecticides.

There are many exciting possibilities of insect control that do not depend upon conventional insecticides. There are only a few proven successes to date. To adequately implement these new approaches in terms of practical insect control will require many years, tremendous investments in research, and a high level of cooperation by many disciplines of the biological and physical sciences.

SUMMARY

In 25 years of heavy insecticide usage on cotton in Arkansas, resistance has become a problem with several pest insects and mites to the 3 principal groups of insecticides and miticides: the chlornated hydrocarbons, the organophosphorns compounds, and the carbamates.

Development of control measures, chemical or otherwise, is not proceeding at a sufficiently rapid pace to stay ahead of the problem posed by insect resistance to insecticides.

A Road-Kill Census of Mammals in Northeastern Arkansas

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INTRODUCTION

It is the purpose of this study to investigate species composition and numbers of mammals killed on selected highways in northeastern Arkansas. Roadside counts have been used by wildlife personnel to determine population indices for areas under study for a wide variety of game species. Hendrickson (1939) was the first to describe the roadside census as an inventory method for rabbits. Wight (1959) used roadside counts to estimate statewide rabbit population trends in Missouri. Regular predetermined highway routes were driven in an automobile at a prescribed time of day and rabbits were counted per mile. Lord (1955, 1961) used the roadside census method to count rabbits in Illinois and made comparisons of censuses taken during early morning and night. Newman (1959) reported on weather factors influencing the roadside counts of cottontail rabbits.

Ornithologists have used the roadside census technique for many years. Nice and Nice (1921) used this method to study Oklahoma bird populations as early as 1920. Since their pioneer studies, this technique has been used by a number of research workers. Kendeigh (1944) evaluated the roadside census in relation to other types of censuses used in studying birds. Dice (1938, 1952) thoroughly discussed and compared numerous census methods. Howell (1951) made detailed studies using relative conspicuousness in determining bird numbers along roadsides in Tennessee. The roadside census is used as a method of determining relative abundance and not absolute abundance. Variability of roadside cen-

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