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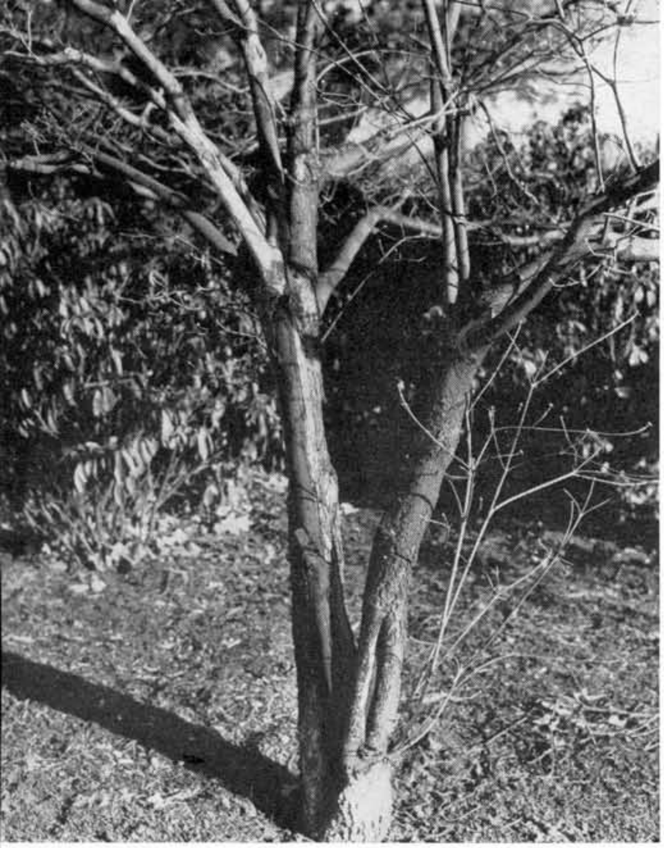
FRONTIERS of Plant Science

SPRING ISSUE

Spiral plots at the Station's Experimental Farm are used for a variety of purposes, related to plant insect and disease control. One of the newest is a study of the amounts of fungicide that are most effective and economical. See story on pages 4 and 5.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN



Damage to dogwood tree by the dogwood borer. Breaking off of bark is a symptom of advanced injury. In severe cases, the tree may be killed.

The Pests That Feed On Trees and Shrubs

by John C. Schread[1]

The modern migration from the city has meant a great increase in the number of ornamentals grown around the average dwelling. More and more people are purchasing small homes outside of city centers where there is more opportunity for landscaping and beautifying the home grounds. This trend has meant a need for more plants and better varieties to satisfy the homeowner's desire for attractive landscaping and down-to-nature escape from the accelerated tempo of modern life. The suburbanite is also encountering some new troubles with which he is not familiar. Among them are insect pests which can be a serious threat to the trees and shrubs growing in his dooryard.

Some Pests Hard To See

Many insect pests are small and inconspicuous. For the most part they are the species that obtain their food from plants by sucking the juices from the leaves, fruit or bark. Their presence may go unnoticed until extensive damage has been done. Insects of this type, although too numerous to list here, may be recognized by most anyone. For example, there are the soft and hardshelled scales, aphids, mealybugs, thrips and lace bugs. Several or more of these may be found on plants around the home.

In addition, there are the species that bite off portions of a plant and swallow them in much the same way that a cow chews grass. The Japanese beetle, weevils, canker worm, leaf miners and elm leaf beetle are a few examples.

Regardless of the classifications into which the insects fall, all are serious enemies of plants and should be dealt with as such. Their control must be pursued relentlessly as a perennial chore.

In the past, control of some of these pests has been accomplished through the use of dormant oil sprays. The possibility of plant injury by dormant oils when used on evergreens is well known. In addition, there is the risk of destroying the bloom on certain varieties. Consequently, newer insecticides are replacing the older treatments for control of insects during the growing season. The Experiment Station has conducted tests of many of these new materials and the performance of the insecticides mentioned in the following paragraphs was observed in our own experiments.

One of the most common scale insects is the oystershell scale, which attacks a variety of plants but is most often seen by the homeowner on lilac. It resembles a minute oystershell. There is one brood a year, the young of which may be killed with malathion in mid-June. Two to 3 teaspoons of an emulsion or 4 to 8 teaspoons of wettable powder in 1 gallon of water will prove satisfactory.

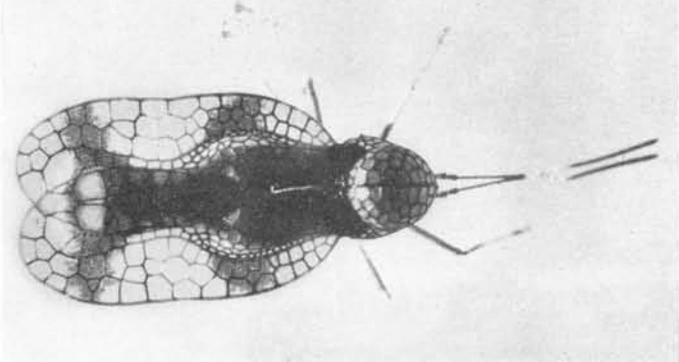
The Euonymus scale is another common species of scale insect attacking most varieties of deciduous and evergreen Euonymus. Some varieties appear to be more seriously injured than others. The female scale is flattened, pear-shaped and grayish brown in color. The male scales are white. Two broods occur each year. The young of the first brood is best controlled in early July and those of the second brood after the first of September. Malathion used as directed for control of oystershell scale will give good results.

Several additional species of scale insects, notably the one-brood Lecanium scale, may be found on yew and arborvitae. The insect is more or less hemispherical in outline and dark brown in color. The young may be effectively controlled from mid-August to early September, or in mid-spring with malathion as recommended for the control of other scales.

Leaf miners are common pests of a variety of deciduous and evergreen plants. One of the most noticeable is the birch

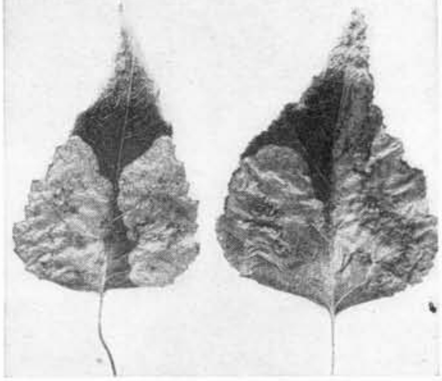
(Please turn to page 8)

[1] Mr. Schread is an entomologist.



The andromeda lace bug, one of the newest pests of ornamentals occurring in Connecticut.

Lilac infested with oystershell scale, a very common pest in the State.



The birch leaf miner causes irregular brown blotches on birch foliage. Varieties chiefly affected are the gray, white, and paper birches.

Freaks in the Corn Field

by Donald F. Jones[1]

Nearly every corn grower is familiar with bizarre types of plants that occur occasionally in his fields. These curious oddities may take the form of tiny dwarfs, pure white seedlings devoid of the green coloring that is so essential to plant life, tall plants that grow flat on the ground like a vine. Plants with striped or banded leaves, shredded or knotted leaves are also found, and some plants produce many stems in a clump exactly like a coarse grass.

None of these plants have any value whatever for grain or forage, but they are exceedingly interesting to students of heredity. They have helped greatly in understanding the principles of inheritance and have suggested practical procedures that have been immensely valuable.

Can Have Strong Offspring

The hereditary freaks just described are much less productive than normal plants and some are so weak that they cannot live beyond the seedling stage after the food stored in the seed is used up. Yet when any two of these weaklings are cross fertilized the offspring are almost always normal in every respect and are vigorous and productive. This is due to the fact that two weaklings seldom have the same weakness. What one lacks the other supplies and the reverse. This seems to be a wise provision on the part of nature, to give the offspring the best inheritance from each parent.

This pooling of hereditary resources is the basis for the phenomenon known as hybrid vigor. The importance of hybrid vigor has long been known. The mule, the sterile offspring of the horse and the donkey, has been valued since the time of Moses. The blue grey cattle of England and Scotland, which result from the crossing of a black Galloway or Angus by a white Shorthorn, have been prized in many countries. Crossbred swine, sheep and poultry are grown in increasing numbers for the market.

Hybrid corn, and many other crossbred plants, have come from an understanding of the principles of heredity involved in hybrid vigor, and are a direct outgrowth of an intensive study of these hereditary freaks of nature in both animals and plants.

Several years ago we found in our corn field at Mt. Carmel a plant with a barren cob devoid of seeds. This proved to be an inherited character. Since corn plants must have seeds to reproduce, it was, at first, impossible to produce an entire family of corn plants with barren ears, but the character could be transmitted indefinitely by crossing with normal plants. These plants devoid of seeds had normal tassels and produced normal amounts of pollen, and the seedless character was transmitted by these functional plants.

Plants with No Pollen

Other plants were known which produced only seeds and no pollen in the tassels. Such plants were functional females. Male and female plants are known to be a normal occurrence in many species growing naturally in the wild. These are called dioecious (or two house) plants. The corn plant, however, is normally monoecious (one house); that is, both the male and female parts occur on the same plant.

We were curious to see if we could make a dioecious species out of corn by combining these barren ear and tassel seed plants. By appropriate crossings and selection we finally succeeded in recombining these two characters in such a way that a dioecious type of corn did result. This is the first time such plants have been originated in experimental cultures. This family of separate male and female plants has been continued to the present time and retains its peculiar nature.

"Lazy" corn that grows along the ground like a vine is one of the many curiosities growing in Dr. Jones' unusual corn nursery. Of no value in themselves, they are of immense interest to students of heredity.

The ancestor of the modern corn plant may have been this stumpy "corn grass," shown growing alongside an up-to-date hybrid variety.

We had no thought that dioecious corn would have any practical value but much to our surprise it turned out to be immensely valuable in a way we did not foresee.

Simplified Seed Production

Barren plants without seeds were worthless from the farmer's viewpoint, since he is interested mainly in grain production. In some of our preliminary crossings leading to the production of the dioecious corn we had progenies that were all male type. That is, they all produced normal tassels and barren ears. If we could produce the opposite of this, plants with seeds but all without pollen, such plants could be used in a crossing field to produce hybrid corn without the tedious and expensive job of pulling out the tassels, as is done regularly in hybrid seed production fields. Since we had produced one type we were encouraged to look for the other. After many years of trial and failure we finally found a method of producing plants whose offspring are all sterile in the tassel and without pollen. Such plants are now widely used to produce better seed more cheaply.

Thus, freaks in the corn field lead to a new way to put science to work for agriculture.

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[1] Dr. Jones is head of the Station's Genetics Department.

To see how much residue remains on a plant after spraying, Dr. Rich examines beans which have been treated with various concentrations of Bordeaux mixture and zineb. His experiments show that a heavy application is not necessarily the most efficient.

SPRAYS

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"IF a little will work, then a lot will be better." This kind of reasoning so often decides how much fertilizer to put on the lawn, or pesticide to put on the potatoes. One of the best, or worst, examples of an overdose may be seen any Spring when hand-dusters are used in backyard gardens to dust insecticides on plants. The plants and the ground around them are white with dust. Experience has shown that a dust layer barely visible to the eye is sufficient to control leaf-eating insects. The excess dust on the plant and on the ground is completely wasted.

Pesticides are also commonly applied as sprays. An overdose of spray is not quite so obvious as a poor job of dusting, but it is just as inefficient. It is important, therefore, to know just how strong the spray liquid must be to get a good protective film on the plants without overdoing it.

Recently we completed a study to find out the relationship between the strength of spray used, and the amount of pesticide sticking to the leaf. We compared two well-known fungicides, Bordeaux mixture and a zineb formulation (Dithane Z-78). The Bordeaux was used as an example of an inorganic fungicide, while the zineb was representative of the organic fungicides. Also studied was the relation of the thickness of the dried film of fungicide to its resistance to weathering. Two crops were used: beans as an example of a plant having a hairy leaf, and celery as an example of a smooth-leaved plant.

Plants in Spirals

The plants were grown in spirally arranged plots, and sprayed with the hydraulic spray equipment especially designed for use there. The sprays were put on at a pressure of 250 pounds per square inch, and 200 gallons were applied per acre. As in commercial practice, the application of this volume of spray was more than the leaves could hold, and a portion of the spray liquid always drained off to the ground. Eight strengths of Bordeaux mixture were tested, the weakest being made up of 1 pound of copper sulfate and ½ pound of lime per 100 gallons of spray, and the strongest containing 11.2 pounds of copper sulfate and 5.6 pounds of lime per 100 gallons. Eight strengths of zineb formulation were also used, the weakest being 0.28 pounds per 100 gallons, and the strongest 3.24 pounds per 100 gallons. These strengths gave us a good series both weaker and stronger than the concentrations used commercially. The plants were sprayed once a week. The celery plots were sprayed five times, and the bean plots six times.

Sampling Methods

Leaf samples were taken just before each spray, and then again just after each spray. A single sample was taken for each strength of each material on each crop each time. Each single sample included leaves from four randomized plots which were treated identically. The total leaf area in these samples was carefully measured, after which the measured leaves were brought to our Analytical Chemistry Department for analysis. Here, W. T. Mathis accurately measured the amount of fungicide in each sample. The final data available for study represented 450 samples of leaves carefully measured and analyzed.

Once the data were assembled, the study soon disclosed that the build-up and the weathering of the deposits were very different for the two fungicides. For example, doubling the concentration of zineb in the spray fluid doubled the amount of zineb kept by the sprayed leaves. This was to be expected. As all the plants received the same volume of spray, the same volume of liquid should have remained and dried down on every plant after runoff. The deposit, then, would consist of the material contained in that volume of liquid.

Bordeaux, however, did not act in this manner. The stronger the Bordeaux applied, the less was the additional amount sticking to the leaves. For instance, doubling the strength of Bordeaux from 2-1-100 to 4-2-100 almost doubled the amount of fungicide on the plant. If, however, an 8-4-100 spray was used, only 30 per cent more fungicide stuck to the plant than when the 4-2-100 was applied. At the highest concentrations of Bordeaux, there was even less gain. This was most puzzling behavior. It suggested, however, that Bordeaux particles in the spray fluid were being held to the leaf surface by a process of adsorption.

An easy way to understand what was happening would be to imagine that the leaf is a Chinese checker-board and that the Bordeaux particles in the spray droplets are marbles. When the weak Bordeaux sprays are used, it would be the same as rolling a few marbles across the board. In this case the chances are good for all the marbles finding a hole in which to fall. Likewise, the spray droplets of weak Bordeaux would roll across the leaf, deposit their load, and fall to the ground with less material in them than when they hit the leaf. The deposit from weak Bordeaux would be built up not only by fungicide in the liquid which remained after run-off, but also by the fungicide deposited from the fluid which drained off. Using stronger and stronger Bordeaux mixture would be the same as rolling a great number of marbles across the board. The holes fill up rapidly and the chances become less and less for all of the marbles finding an empty hole in which to fall. Those which do not fall into holes on the board run to the ground. Likewise, as increasingly stronger Bordeaux mixture is used, less and less of the deposit on the leaf would come from the spray fluid which drained off.

OR PLANT DISEASES

...ongest One the Best?

by Saul Rich[1]

Actually, the Bordeaux particles in the spray droplets are not held to the leaf by falling into holes, but rather by a type of electrical attraction. In order for adsorption to take place, the leaf and the particles must have opposite electrical charges, as opposites attract. The wet leaf is known to be negatively charged. By testing the particles of Bordeaux in the laboratory, it was found that they were positively charged. It was possible then for the Bordeaux to be held to the leaf by adsorption, hence giving an explanation for our puzzle. Zineb particles proved to be negatively charged and would not be adsorbed.

Plants in the experiment were grown in spiral plots like this one, arranged especially for experimental spraying. This airplane view shows a celery spiral at the Mt. Carmel Experimental Farm.

What About Weathering?

What happened once the sprays dried on the leaf and the fungicides were attacked by rain and wind? With zineb, it was found that the thicker the deposit, the greater was the proportion of the deposit removed by weathering. The larger zineb deposits lost as much as 80 per cent, while the thinner deposits lost only 30 per cent of their original mass. The layers of dried Bordeaux weathered in exactly the opposite way. The thicker Bordeaux deposits lost only 10 per cent, while the thinner deposits lost as much as 70 per cent. The difference in weathering of these two materials is apparently related to their ability to take on water. A material whose small particles take on water is called a hydrophilic colloid, while one whose small particles do not take on water is known as a hydrophobic colloid. Hydrophilic colloids include such materials as clay, egg albumen, and jellies. When these materials dry down, for example, eggs on a dish, they are extremely hard to remove merely by washing. Laboratory tests showed that Bordeaux mixture was a hydrophilic colloid. A good example of a hydrophobic colloid would be a mixture of sand and water. Such a mixture drying on the surface of your car would form a film which would be easy to remove. Merely hosing the car would remove the sand in large gobs. Laboratory tests showed the zineb preparation to be a hydrophobic colloid. This explained the differences in weathering between the two fungicides.

How did the type of leaf influence the weathering of the two fungicides? Dried residues on bean leaves were found to be much more resistant to weathering than were the residues on celery leaves. This was caused by the many tiny hairs on the bean leaves being embedded in the flakes of dried fungicide. The action can be understood by anyone who has tried to remove chewing gum from a child's hair. Gum on a smooth surface is much easier to remove.

Practical Implications

How can this information be of use in protecting plants against disease? For one thing, it becomes obvious that the grower will gain very little by using Bordeaux mixtures much stronger than 8-4-100. This is true, of course, only when the material is applied by conventional hydraulic sprayers, and the excess fluid runs to the ground. Spray equipment which would help keep runoff to a minimum would be most effective in building up a protective residue on the plant. This is undoubtedly the reason for the success of the recent trials using low volume, concentrate sprayers. It is important, then, to use a minimum of spray fluid to cover the plants. Early in the season, when the plants are small, the spray machinery should be adjusted to use much less fluid than is used in mid-season. Spraying a small plant with one quart of spray may leave less protective material on the leaves than spraying with one pint, even though the same strength of fungicide is used.

The ability of a pesticide to be held by adsorption can be taken to mean that it will stick better to an unsprayed leaf than it will to a sprayed leaf. This is because a sprayed leaf has much of its adsorptive capacity already filled. Adsorption also offers an explanation to the phenomenon of redistribution. Redistribution is the movement of pesticide by rain from a sprayed leaf to an unsprayed leaf. One would expect any excess spray to be washed to the ground by the rain. In redistribution, adsorption could work in the following way. The rain-drop would pick off the top layers of a spray deposit as the drop rolls across the sprayed leaf. There is little tendency for the rain-drop to redeposit its load except when the drop crosses an unsprayed, and, hence, an adsorbing surface. If the drop carrying the spray material falls onto a lower, unsprayed leaf, the material is redistributed to a fresh adsorbing area even though the drop eventually falls to the ground.

Finally, the information from this study can be used in the constant search for new and better fungicides. A hydrophilic material which, in addition, was positively charged might succeed as a commercial fungicide even though it was only moderately successful for poisoning fungi in the laboratory.

[1] Dr. Rich is a plant pathologist.

From the Assistant Director

The United States is the leading industrial nation of the world today. It has reached that position by utilizing abundant natural resources, trained manpower, and Yankee ingenuity.

The contribution of agriculture to industry has been a major factor. Before the development of industry, 85 per cent of the country's labor was required to produce enough food. The development of labor-saving machinery, and the utilization of results of agricultural research have reduced the requirements for agricultural labor to 15 per cent of the nation's total manpower.

The experiment stations have had a major part in this change. Scientists have contributed new knowledge of soil fertility, new varieties of crops, and better control of pests. They have also contributed new ideas, sometimes "impractical" and even ridiculous. Thomas B. Osborne's discovery that chickens could be raised indoors by proper diet seemed of scientific value only, until it was reduced to practice. Donald Jones' pollen-sterile corn seemed useless until he introduced the character into commercial inbreds.

New ideas of this sort are needed for continuing progress in agriculture. In the past, most of the fundamental work was done in Europe. The increased emphasis on fundamental research in the United States is healthy and in time we should supply our own needs.

The United States has always had a high position in developmental research and in extension, our name for taking the results of research to practical farmers. In fact, if the interest of visitors from abroad is any criterion, our accomplishments in these fields are respected all over the world.

It is fortunate that we have the resources to increase our fundamental research, without reducing developmental work and extension. More new ideas will provide more opportunities for development and more information for extension to the farmers.

NEELY TURNER

THE TOOLS OF SCIENCE: *The Emission Spectrograph*

by W. T. Mathis[1]

The outstanding virtue of the spectrograph is its ability to show the complete metallic composition of even minute quantities of material, with relatively little time-consuming effort on the part of the operator.

While the most glamorous of its roles is the part it plays in present day criminal investigation, the spectrograph also performs admirably on many less spectacular but equally important problems as an everyday analytical tool. The modern laboratory has come to depend upon it for many analytical investigations that could not feasibly be conducted by other means.

Emission spectroscopy depends upon the phenomenon that when a material is heated to a sufficiently high temperature the atoms of which it is composed will give off measurable radiation (light) at wavelengths which are characteristic of the elements present. After appropriate channeling and diffraction, this light may be allowed to register as photographic density on a film or plate, or it may be measured directly at its pertinent wavelengths with special instruments. The latter scheme is used in direct-reading spectrometers, where the results appear on calibrated dials.

In our laboratory we use the more versatile, if somewhat more tedious, photographic procedure. Light from the burning (electrically excited) sample is optically channeled through a very narrow vertical slit to fall upon a diffraction grating. The grating consists of a strip of polished metal with a slightly concave mirror surface bearing 15,000 vertically ruled lines to the inch. It is so positioned in the instrument that the sample light reaching it is diffracted (reflected at angles related to the wavelengths present) onto a strip of photographic film covering the ultraviolet region.

Dispersed images of the slit appear on the developed film as black lines in positions relative to the characteristic wavelengths of the elements. Thus the elements present in the sample may be identified. By correlating the intensity ratios of certain of these lines with known amounts of the corresponding elements, a system of quantitative analysis is evolved.

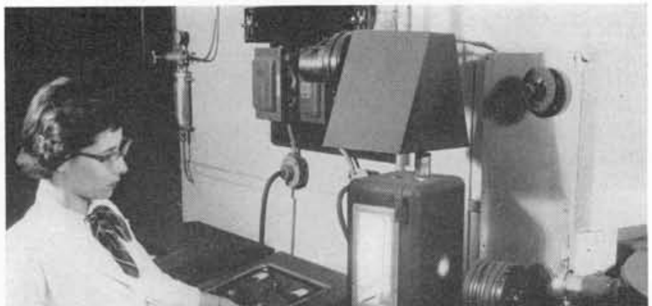
Our spectrograph is used extensively for the quantitative analysis of plant material. Eleven elements are usually determined in each sample as a matter of routine and many thousands of such determinations are run annually.

Other applications of the instrument include determination of the amounts of various spray residues on fruits, leaves and soils; analysis of soil extracts, sludges and fertilizers for major and/or minor elements; and examination of the stomach contents and organs from animals that have died under circumstances where metallic poisoning is suspected.

In criminal investigations conducted by local or state police we are frequently called upon to make comparative examinations of fragmentary and sometimes microscopic pieces of evidence in cases of burglary, arson, hit and run accidents, and other crimes. Here, the spectrograph is extremely helpful.

All in all, our spectrograph is rather a busy instrument.

[1] Mr. Mathis is an analytical chemist.



Miss Sunrae Agostini, technician in the Analytical Chemistry Department, runs an analysis on the emission spectrograph. The instrument is used in the daily routine of the laboratory to determine the metallic composition of various materials.

The Insect Resistance Problem

by Neely Turner[1]

The development of resistance to insecticides by insects has become a major problem in pest control. The first case occurred 40 years ago in Oregon, when San Jose scale on fruit trees could no longer be controlled by lime sulfur solution. A few years later in California scales on citrus trees became resistant to hydrocyanic acid gas. In many parts of the country, codling moths on apples became highly resistant to lead arsenate.

In more recent years, the number of pests showing resistance has been increasing very rapidly. Chiefly responsible for this increase is the increased use of highly effective insecticides. Houseflies and mosquitoes almost immune to DDT now occur in many parts of the world. Lice in Korea have been found resistant to DDT, and roaches in Texas to chlordane. In Connecticut, Mexican bean beetles have developed some resistance to rotenone, and mites to parathion.

Insecticides Not At Fault

However, this does not mean that there is "something wrong" with these insecticides. On the contrary, they have provided more effective pest control than was ever possible before. Before the introduction of DDT, control of houseflies, mosquitoes, and flea beetles was inadequate. Roaches were difficult to control before chlordane was developed. These are just two examples; many others could be given.

It is true, however, that the advent of these improved insecticides has made the resistance problem much more serious. Knowledge of the reasons for and mechanism of development of resistance is very scanty. However, enough is known to justify some generalizations. Substantial resistance to any highly effective insecticide may develop in any insect. Resistance may be expected to develop most rapidly if the insect population is treated with a persistent insecticide (one which remains on the plant for a long time). The larger the proportion of the insect population treated, the greater is the probability of development of resistance. Finally, some insects seem to develop resistance more rapidly than others, either because of a shorter life cycle or as a result of greater variation in the species.

How Resistance Develops

It is obvious that a thorough understanding of the way in which resistance is developed might point to the solution to the problem. This phase of the problem has been studied here for several years. Dr. Raimon L. Beard has found that the susceptibility (or resistance) of an individual is not constant. An insect easily affected by a chemical today may be much less affected by the same amount of the same chemical tomorrow. This variation explains why the more persistent insecticides may cause more rapid development of resistance. The materials remain effective for some days, the susceptibility of the individual insects is changing daily, and each one becoming susceptible to the insecticide is killed. The very few survivors are the most resistant representatives of the population, and can pass this characteristic on to the next generation. It has been well established in many laboratories that resistance to insecticides can be passed on to the offspring—that it can be inherited.

There is available enough information to make an approach to a practical solution of the problem. Resistant San Jose scale and citrus scales were controlled by switching to other insecticides. Oil sprays controlled the scale and fortunately no strains resistant to oils appeared. A change of insecticides was also tried on houseflies resistant to DDT. Unfortunately the flies soon developed resistance to the new materials, which were methoxychlor, lindane and chlordane. They also retained their resistance to DDT.

Another solution has been found by pharmacologists working on resistance of bacteria to drugs. Bacteria which develop resistance to penicillin also develop resistance to sulfa drugs. But if penicillin and a sulfa drug are used at the same time, development of resistance may be postponed for years. This is apparently true because penicillin and the sulfa drug kill bacteria in different ways.

In our laboratories we have been trying combinations of insecticides for control of resistant insects. Unfortunately the way in which the insecticides kill the insects is not known. But it is possible to select materials having different modes of action by suitable experiments. Such experiments indicated that chlordane killed insects in a different way than dieldrin, dilan or heptachlor. Dr. James B. Kring of our staff found that combinations of chlordane with each of these three materials killed potato flea beetles resistant to DDT. Use of these mixtures has provided an immediate answer for DDT-resistant flea beetles.

The use of mixtures of insecticides may not be the final answer to the problem. But it is a much better solution than switching to a second insecticide if insects become resistant to the one being used. It has been observed that insects already resistant to one insecticide generally require a much shorter period to become resistant to a second. But, if the two insecticides act differently and are combined, the period before resistance develops may be substantially lengthened. Use of the mixtures can "buy time" for studying the fundamentals and finding permanently useful answers.

[1] Mr. Turner is head of the Station's Entomology Department.

The use of insecticides is to an economic entomologist the last step to be taken only after all other methods of control have been found wanting. The classical approach to insect control has always been, first, to study the life history of the pest, with the hope of finding some way to avoid its damage. If that is unsuccessful, the second approach is to study the parasites, predators and diseases of the insect. If these offer no relief, the use of insecticides to prevent serious economic losses is considered as a third resort.

Insecticides are actually used to control only a few of the thousands of pests occurring in Connecticut. It is obvious from the study of development of resistance that use of insecticides where no serious infestation exists can actually increase the necessity of treatment in the future. Destruction of breeding places, crop rotation, use of resistant varieties and cultural methods of control need not be forgotten simply because effective insecticides are available.

Spray schedules issued by the Extension Service pool the knowledge of entomologists as to what insects are destructive enough and occur with enough regularity to require spraying every season. Insects which occur sporadically present a problem, but their abundance can usually be forecast. By making full use of all this information, it should be possible to apply insecticides only when they are needed.

Pests on Trees and Shrubs

(Continued from page 2)

leaf miner. Boxwood and holly may be seriously damaged by other species.

The birch leaf miner has several or more broods a year, the most destructive of which occur in late spring and early summer. The adult is about 1/16 inch long and black in color. Larvae developing from the eggs laid in the leaves cause the unsightly browning of the foliage. Control of the pest can be attained by spraying with malathion or lindane emulsions or wettable powders at the rate of 1 teaspoon of the former or 2 to 4 teaspoons of the latter in 1 gallon of water. Timing is essential to good control. The first treatment should be made about May 15 and the second at the end of June or early July.

The boxwood leaf miner is a one-brood insect which causes a yellowing or water-soaked puffiness of the underside of the leaves. Lindane or malathion used at about the same strength as recommended above should kill the overwintering leaf miners. Treatment should be made by May 15.

The American or Christmas holly is often seriously infested with holly leaf miner. Yellowish-brown serpentine mines occurring in the leaves are caused by the immature stages of small black flies. Control of this insect has not been easy. DDT or dieldrin applied to holly foliage during the last week in May and again after the middle of June will give good control. One to 2 teaspoons of emulsion or 2 to 4 teaspoons of wettable powder in 1 gallon of water should be sufficient.

Quite often lace bugs on andromeda, rhododendron, azalea, etc. result in off-colored foliage. The insects feed on the underside of the leaves. The species occurring on andromeda is new to this country and was seen for the first time in Connecticut in 1946. Several or more broods occur each year. The adults have lacy wings with some dark markings. They are quite active whereas the young are not. DDT sprayed on the underside of the foliage in mid-May and again about a month later will control the pests.

Borers Serious Pests

Borers, such as the dogwood and lilac borers, may kill a branch or an entire plant. Clear-winged moths lay their eggs on the bark during late spring and summer. The larvae gain access to the cambium through an injury which may have arisen in a variety of ways. Spraying the bark of the plants with DDT or dieldrin emulsion (4 to 6 teaspoons per gallon) in late May and again before July 10 and August 20 will help to control the pests.

Root feeders may also cause trouble. The roots of hemlock and taxus are sometimes seriously damaged by the larval stage of the strawberry root weevil and the black vine weevil respectively. The needles of infested plants turn yellow, die, and shed prematurely, leaving the branches bare and unsightly. Plants thus affected are a complete loss.

The white-bodied, brown-headed, grublike larvae responsible for the trouble may also be found feeding on the rootlets of rhododendron, wisteria, etc. Furthermore, as they mature they strip the bark from the large roots of all affected plants.

Control of the two species may be accomplished through the use of dieldrin, chlordane, or aldrin around the base of the plants. Treatment may be made at any time when the ground is not frozen, and should include all of the soil area under each tree.

FRONTIERS

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BULLETINS

574. Report on Food and Drug Products. 1951.
575. Control of Peach Insects.
576. Quality of Apples As Affected by Sprays.
577. Static and Dynamic Variation in the Response of an Insect to Sublethal Doses of Two Gases.
578. Scale Insects and Their Control.
579. Report on Commercial Fertilizers. 1953.
580. Significance of Sand and Gravel in the Classification, Mapping and Management of Some Coarse-Textured Soils.

CIRCULARS

185. Birch Leaf Miner Control.
186. Control of the Gypsy Moth.

Circle the Date

The Experiment Station Field Day will be held on Wednesday, August 18, at the Station's Experimental Farm in Mt. Carmel.

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