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Science serves your farm and home.

A. H. VanLandingham

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AGRICULTURAL EXPERIMENT STATION

WEST VIRGINIA UNIVERSITY

JANUARY 1962

BULLETIN 467

PART I

Science

SERVES YOUR FARM AND HOME

ANNUAL REPORT OF A. H. VANLANDINGHAM, DIRECTOR, WEST VIRGINIA UNIVERSITY AGRICULTURAL EXPERIMENT STATION FOR THE PERIOD 1960-61

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Science

AGRICULTURAL EXPERIMENT STATION
WEST VIRGINIA UNIVERSITY

on our cover

The apparatus pictured on the cover is a 3-unit fermentor used by the Department of Plant Pathology, Bacteriology, and Entomology for culturing bacteria and fungi. By the use of this fermentor, a large number of cells can be produced under rigidly controlled conditions of aeration, agitation, and temperature. Each fermentor jar contains about 2 gallons of medium. The contents may be sampled at any time so that the fermentation can be followed hour by hour. The apparatus has been used to study the yield of polysaccharides produced by bacteria. The Department has been working on this problem for a number of years. The apparatus has been used to culture fungi which produce growth factors for certain parasitic fungi.

The next use of the fermentor will be to study the decomposition of sewage under acid conditions such as that found in our rivers when they are contaminated by acid mine waters. Our rivers that receive acid mine waters are so acidic that growth of bacteria is greatly reduced. Biological purification of water depends upon the growth of microorganisms which destroy organic materials such as sewage. Microorganisms are Nature's garbage men. They convert offensive and useless organic compounds into carbon dioxide, water, and ammonia.

The funds for the purchase of this fermentor were given the Department by the Claude Worthington Benedum Foundation.

PART I

Annual Report of the AGRICULTURAL EXPERIMENT STATION

West Virginia University
Morgantown, W. Va.
Director

A. H. VanLandingham

Editor JOHN LUCHOK
Associate Editor STANLEY J. NELS
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SCIENCE SERVES YOUR FARM AND HOME will be sent free to any resident of West Virginia in response to a written request to the Director, Agricultural Experiment Station, West Virginia University, Morgantown, West Virginia.

on the

calendar . . .

FEBRUARY—

22-23—Annual Meeting, West Virginia Horticultural Society, Martinsburg.

MARCH—

2—Meeting of West Virginia Sawmill Operators Association, Jackson's Mill.

new publications

Bulletins

- 456. W. F. Porter, W. W. Armentrout, Mary K. Conrad, Robert Dimit, Gale Lyon, C. E. Swank, and Gale Ueland. Food Buying, Knowledge—Concerns—Practices, An Evaluation of the Marketing Information for Consumers Program in the Wheeling-Steubenville Area. May 1961.
- 457. K. D. McIntosh. Marketing Practices and Procedures of Northeastern Livestock Producers. June 1961.
- 458. Collins Veatch. Spring Oat Variety Trials in West Virginia, 1952-1960. June 1961.
- 459. Annual Report of A. H. VanLandingham, Director. Science Serves Your Farm and Home. June 1961.
- 460. E. S. Elliott and R. E. Baldwin. Control Hemlock Canker. June 1961.
- 461. W. H. Reid, W. W. Christensen, A. W. Goodspeed, and N. D. Jackson. Primary Wood Industries of West Virginia. June 1961.
- 462. R. W. Pease. Consumer Purchases and Preferences in Landscaping. June 1961.
- 463. E. B. Collins, H. F. Ross, and V. Flesher. The Automation of Burley Tobacco Barn Ventilating Doors. June 1961.

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MASTITIS--

It's costing our dairymen over \$300 million a year!

by
R. G. Mitchell, Assistant Dairy Scientist
and
W. D. Schultze, Assistant Bacteriologist¹

MASTITIS is one of the most costly disease problems confronting the American dairyman. It occurs in about one cow out of four and it is estimated that it is costing the dairymen over \$300 million a year.

Mastitis is defined as any inflammation of the mammary system. The degree of severity ranges from abnormal milk to death of the infected animal. An infection may be acute, having a short but severe course which may lead to the loss of one or more quarters or even death. An infection may also be chronic, flaring up at intervals, resulting in the eventual loss of part of or the entire quarter.

A number of different types of bacteria are known to cause mastitis. The most common are *Staph. aureus*, *E. coli*, and *Strep. agalactiae*. Contrary to popular belief, *Staph. aureus* is the bacterial agent most commonly found in cases of mastitis. Not only is mastitis harmful to the cow, but it is also harmful to humans, since milk from a mastitis cow can be one means of spreading the dangerous *Staph.* to humans.

Several Carriers of Bacteria

The bacteria capable of causing mastitis can reach the udder in many ways. They can be carried from an infected cow by the hands of a milker or the teat cups of a milking machine. They may be present in contaminated bedding, stall floors, and manure, especially if milk is discarded onto the bedding or in

the gutter. Still, the bacteria must get into the udder in order to cause infection. The unbroken skin is an effective barrier, and it appears that bacteria also have great difficulty in working their way up through the teat opening. Open cuts, especially those opening into the teat or udder cistern, and even a mashed teat, greatly increase the chances of infection. If a cow receives an injury to the teats or udder, it may be impossible to keep her free of mastitis and she may well lose her value in the milking herd.

It is important to remember that disease-causing bacteria may be present in a human or an animal without causing any difficulty. If the body's resistance is sufficiently high, the bacteria may be defeated and eventually killed. Stress and strain can lower a cow's resistance to disease. As the dairy industry has grown, it has become more concentrated. Herds have become larger, and cattle housing has not been increased sufficiently on many farms. Cows have been crowded together in inadequate quarters where they have been exposed to drafts and conditions that may cause udder injuries. They have been bred and fed for high production. In many cases this has led to large, pendulous and overworked udders. These conditions make it easier for infections to take over. Since the disease-producing bacteria are always present, and since improper housing and other mismanagement practices increase the chance of infection, it is no wonder that mastitis is a serious problem.

MASTITIS—Left—normal quarter with pliable secretory tissue. Right—hard quarter resulting from infection; scar tissue has replaced secretory tissue.

Milking Program

Improper milking practices have contributed greatly to the mastitis problem. If you are not now using a managed milking program, we submit the following for your consideration:

➤ Wash the udder and teats with a warm antiseptic solution one to two minutes before putting on the milking machine.

➤ Use a strip cup to test milk from each quarter. Do not pour the milk on the floor or in the gutter.

➤ The udder should always be milked out completely. This is important not only in a healthy quarter but also in an infected one. Milk left in the udder allows bacteria to multiply. Proper machine or hand-stripping will allow the milker to detect swelling or hardness even before abnormal milk shows in the strip cup.

➤ Milking should be rapid and gentle and the machine should be removed as soon as the udder is empty. Milking causes wear and tear in the udder even when properly done. If the machine is left on too long, it causes extra irritation due to excessive rubbing of the internal tissues. This may give the bacteria that are present a chance to take over.

➤ Rinse the teat cups after milking each cow by dipping them into

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¹Resigned March 31, 1961.

VIRUS DISEASES --

A Hazard to Sour Cherry Production in West Virginia

by

Robert E. Adams, Associate Plant Pathologist

FIGURE 1. Sour Cherry tree (with Rosette) in a commercial planting. Notice the extensive killing of branches, limbs,

THE fruit industry contributes greatly to the economy of the regions where soils and climate are favorable for fruit culture. Any threat to continued fruit production is and should be of vital concern, not only to the fruit growers of these regions, but also to those engaged in enterprises that depend directly upon the level of the general economy.

Ringspot, Sour Cherry Yellows, and Rosette are three virus diseases that threaten to destroy the sour cherry industry in West Virginia. We have studied the behavior of diseased trees in the orchard and their distribution in order to evaluate the importance of these diseases. We also have tried to find the means of natural spread so that control measures could be devised. In order to combat these diseases

successfully one must understand how they behave in nature.

Variation in Damage

In general, the severity of a virus disease depends upon the susceptibility of the individual to attack by the particular virus causing the trouble. This variation is shown by the sour cherry tree and its several diseases.

The West Virginia University Agricultural Experiment Station has been studying the virus diseases of cherry trees in cooperation with the other states of the Northeast Region, principally Pennsylvania and New York. The purpose of this article is to describe the common virus diseases of sour cherry and to report on the progress of our research. To those of us studying these diseases it is obvious that con-

trol must be found if we are to continue to grow sour cherries.

THE DISEASES

Ringspot

The initial symptoms of this disease occur early in the growing season. Newly diseased trees bloom several days later than adjacent healthy or "recovered" trees. Close examination of the newly unfolding leaves affected by this disease reveals that their surface is covered with numerous depressions in the form of arcs and rings. As the leaves enlarge, the tissues in the centers of these arcs and rings may die, turn brown, and drop from the leaf. This gives the leaves a shot-hole or shredded appearance. But under West Virginia conditions affected leaves frequently show little or no shredding and may be retained, exhibiting only the pattern of depressed arcs and rings throughout the growing season. Only the first few leaves produced will show typical symptoms, while those produced later in the season are only slightly affected. In some cases the young terminal growth may be killed back for a short distance. Newly diseased trees may blossom normally (because the blossom buds are formed the preceding year), but the majority of the blossoms may die, resulting in a much-reduced yield. This reduction in yield may be carried over into the second year in some cases, but it is more common for the tree to show little evidence of the disease in the year following the initial or shock stage. Affected trees never recover completely, although they show no

FIGURE 2. Distorted leaves and dead branches as they appear on a diseased Sour Cherry tree in the orchard.

FIGURE 3. Sour Cherry terminals showing extreme rosetting, dwarfed leaves produced in advanced stages of disease.

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A new approach to the STUDY OF PARASITISM

by
H. L. Barnett, Mycologist

PROBLEMS dealing with the nature of parasitism have interested the plant pathologist and other scientists for many years. A thorough understanding of the parasites and their activities on the host plants is essential to a logical approach to the control of many plant diseases.

Research workers at the West Virginia University Agricultural Experiment Station have been studying various phases of parasitism by fungi and bacteria for a number of years. Emphasis is now being placed on a study of fungi that are parasitic on other fungi. The use of these specialized parasites represents a new approach to a better understanding of the complex mechanisms of the host-parasite relationship. We are attempting in this work to learn more about principles of parasitism that may be applied equally well to parasites that attack and destroy our crop plants. Fungus parasites are being used in these studies because they grow rapidly and they can be cultured in a minimum of space and equipment. The nutrition and environment can be accurately controlled.

Work Reported Earlier

In the first of a series of articles on parasitism (see *Science Serves Your Farm*, Fall-Winter, 1956-57) the results of some preliminary work on fungus parasites were reported.

Parasites, in general, fall into two types, depending on how they affect the host. The *balanced parasite* obtains its food from the living host without killing it. This is a live-and-let-live situation and the parasite may stop growing if the host dies. The *destructive parasite*, on the other hand, usually kills all or a part of the host and obtains its food from the dead tissues. Up to the present, only some of the balanced parasites have been studied, but it is planned to include the destructive parasites in later studies.

Nutrition of Host Affects Growth of Parasite

Since the balanced parasite absorbs food directly from living cells of the host, it seems probable that

the nutrition of the host would affect the growth of the parasite. This hypothesis was tested on five species and was found to be generally true, but variations did occur with different parasites and different hosts. For example, species of the parasite of *Piptocephalis* made better growth when their hosts received greater amounts of nitrogen and relatively low amounts of carbohydrates. On the other hand, nitrogen starvation increased the resistance of the hosts. By the daily addition of sugar to cultures of the host and parasite it was possible to delay the growth of the parasite indefinitely. This probably means that the available nitrogen was used by the host for its growth, leaving insufficient available nitrogen for the growth and other activities of the parasite.

In a similar way some crop plants, such as wheat, are more susceptible to rust and some other pathogens when they have been heavily fertilized with high-nitrogen fertilizer.

It must be pointed out that host nutrition is only one factor that affects resistance of plants to pathogens. It is known that some plants are resistant because they possess specific resistance genes, but it is not clear how most of these genes act.

What Makes a Fungus a Parasite?

But there still remains the question "what makes a fungus a parasite?" What ability does the parasite have or lack that is different from the non-parasitic fungus? One of the simplest explanations is that the parasite may lack the ability to synthesize a required nutrient and must obtain it from its host. Such a nutrient might be specific and be produced by only one variety of the host species, or it could be of widespread origin.

Among the fungus parasites studied at the University, two were found to require for their growth either their living hosts or an extract from the killed mycelium. One of these parasites, *Calcarisporium parasiticum*, is known only from West Virginia. A study of how this fungus parasitizes other fungi was re-

ported in West Virginia University Agricultural Experiment Station Bulletin 420T, 1958.

More recently, the second parasitic fungus, *Gonatomotrys simplex*, was found attacking different host fungi but requiring the same nutrient for its growth. This substance can be obtained from many higher fungi, but apparently is not produced by lower fungi. It has been partially purified and found to be heat stable. Only minute quantities, less than one part per million, are required for fair growth of these two parasites.

Better Understanding Is Our Goal

This substance has been tested on many additional non-parasitic fungi, but it did not stimulate the growth of any of them. It is possible that other parasitic fungi of the balanced type may be found to require this or similar nutrients from their hosts.

It is concluded that this nutrient required by the two parasites is a growth factor, similar to a vitamin. However, at the present time it is not known whether this growth factor is required by any animal or higher plant.

While these studies do not furnish with practical methods of controlling plant diseases, they should lead to a better understanding of the host-parasite relationship, of the conditions that affect this relationship in plants, and thus to a better understanding of the basic principles of parasitism.

MANUSCRIPTS IN PRINT

The Station editors are working on several manuscripts at the present time. Some of these are—

From Brush to Plantation—An Economic and Silvicultural Study.

Using Flail Forage Harvesters.

Acorn Production and Damage.

Performance of Double Cross Dent Corn Hybrids in West Virginia, 1958-1960.

The Effects of Antibiotics on Vibrio Fetus and the Metabolism of Bovine Spermatozoa.

WILDLIFE MANAGEMENT RESEARCH on the University Forest

by
Robert Leo Smith, Assistant Forester

A ONE-ACRE clearing planted to birdsfoot trefoil in the spring of 1959. This legume furnishes early spring and late fall and winter food for deer and an abundance of insects and "greens" for turkey and grouse. The exclosures shown are used to determine amount of early spring grazing by deer.

WHEN most of that part of Coopers Rock State Forest lying north of Route 73 was leased by the West Virginia University Division of Forestry last year, many sportsmen throughout the state believed this would mean the end of hunting on the greater part of Coopers Rock. Such fears were unfounded. Not only does the Uni-

versity Forest still remain a favorite hunting ground for many sportsmen in the State, but it also provides the Division of Forestry its first real opportunity to investigate wildlife problems of the Appalachian hardwood region.

One important phase of wildlife research on the Forest is designed to find more effective ways to im-

prove wildlife habitat. Most of this habitat improvement work and evaluation is done in close cooperation with the Game Division of the West Virginia Conservation Commission. All game food plots and clearings developed by the Game Division are being retained and improved. New small clearings on poorer timber growing sites are

MOST of the West Virginia University Forest supports a dense stand of pole-size timber. Such forests offer little food for game. As a result the deer herd will decrease unless more browse can be provided.

IMPROVEMENT cuttings stimulate browse production. Additional light admitted by the opened forest canopy will encourage the growth of sprouts and understory plants. The wolf tree, girdled, will serve as a den for squirrels.

LEFT—Preparation of an opening on the University Forest to be planted to birds-foot trefoil. The legume was planted without a cover crop on this area; an excellent catch resulted. **RIGHT**—Students in a laboratory class in Farm Woods Management learn techniques of planting trees and shrubs. At the same time they improve wildlife food and cover. Here students are planting autumn olive.

being planned. Since the University Forest was acquired, 3,000 conifer trees and 1,000 shrubs have been planted to improve existing clearings. Two species of conifers, red pine and Norway spruce, are being planted yearly in part of each clearing to provide winter cover. Red pine furnishes winter cover for deer; spruce is best for grouse. The remainder of each clearing is planted to autumn olive (*Elaeagnus umbellata*) and to ladino clover or birds-foot trefoil (*Lotus corniculatus*). During the past year eight new plots were seeded to legumes. Grain plots, containing buckwheat, millet, sorghum and soybeans, are being planted each spring. Three food patches, totaling 1½ acres, have been planted on the Forest. To date the Division of Forestry and the Conservation Commission have jointly supplied labor, materials, and equipment for this work.

Birdsfoot Trefoil Promising

Outstanding among the habitat improvement studies is the work with birdsfoot trefoil. Although this legume is best adapted to more northern regions and is rarely planted in West Virginia, it appears exceptionally promising on the University Forest as a forage plant for forest clearings. At present four stands of European strain birdsfoot trefoil have been established on the University Forest. Two of these areas are an acre each; two others are smaller. In addition, three more experimental plots, including one of narrow-leaf trefoil (*Lotus tenuifolius*), are located on Coopers Rock State Forest. The first plantings were made in May 1959. An additional experimental fall planting was made in August 1959, but because of a very dry fall a poor catch

resulted. These plots were disked, harrowed, and reseeded in the spring of 1960. Spring plantings in both 1959 and 1960 became established quickly and produced some seed the first fall. The 1959 plantings were grazed heavily by deer during the fall and in the spring of 1960. The trefoil was planted with no grass associate. Except for the first planting, which was made in wheat, the trefoil was established without a cover crop.

From these plantings and others to be established, we hope to obtain data on the utilization of trefoil by game, to determine its adaptability as a forage for forest clearings in West Virginia, and to arrive at management practices applicable to maintaining the stand indefinitely in wildlife plantings.

Improvement Cuttings

Extensive forest management experimental areas on the forest afford an opportunity to observe the effects of forest management practices on wildlife. Most of the University Forest is made up of pole-size timber, typical of much forest land in West Virginia. The canopy is closed, shutting out the sunlight from the forest floor; the limbs are high above the ground, and undergrowth is scarce. Improvement cuttings in such forests not only free better trees for rapid growth but also open up the canopy, allowing sunlight to reach the forest floor. This stimulates the growth of both sprouts and shrubs. Observations are made on these thinnings to determine the amount and utilization of deer browse under different silvicultural systems.

Beginning in 1959, the Division of Forestry (in cooperation with the Conservation Commission) assumed the operation of game-aging stations for the entire Coopers Rock State Forest. Aging stations are run on the opening day of squirrel season, during the turkey season, and during the hunter's-choice deer season. These stations are operated to obtain needed information on the ups and downs of game populations on the forest and the age and sex ratios of game taken. It is necessary to have this information in order to determine specific management practices.

Other Studies

Small mammals of the forest—the mice, shrews and chipmunks—also are studied in the wildlife research program. Included are

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PRODUCTIVITY of headwater streams like this one is being investigated on the West Virginia University Forest.

Effects of Feeding Antibiotics to Dairy Cows

by

R. A. Ackerman, Assistant Dairy Scientist
and

G. A. McLaren, Biochemist

IN November 1957, the Federal Food and Drug Administration approved the feeding of aureomycin (chlortetracycline) to milking dairy cows at the daily rate of 0.1 mg. per pound of body weight. Manufacturers of the product have carried on extremely extensive advertising campaigns claiming that the feeding of the product at this level would reduce the incidence of foot rot, respiratory diseases, bacterial scours, and certain other sub-clinical and infectious diseases. They also reported field trials which indicated that an increase in milk production might be expected if the chlortetracycline-containing material is fed.

Your West Virginia University Department of Dairy Science, recognizing that the evidence regarding the value of the product was not conclusive and that the material was being offered for sale and widely advertised in the State, undertook a research project in an effort to determine whether we should encourage our dairymen to use it.

18-Month Trial

The trial was conducted over a period of 18 months. During this time most of the animals in the study were in production for the greater portion of two lactations. Sixteen cows were paired as to their real milk-producing ability, and one of each pair was placed in a treated group and fed 0.1 mg. chlortetracycline per day for the entire period. The other animal of each pair was used as a control and received no antibiotic. Other feeding and management practices were the same for both groups of animals. At the end of the first year, several of the animals had to be replaced due to our culling practices, but the others went through the entire period without change.

Daily milk weights were kept on all animals. The per cent butterfat, as determined by the D.H.I.A. tester, was used to figure the butterfat production. Over the entire period, the control group produced an average of 2.1 more pounds fat than the treated group, all records converted to 2x, M.E., 305-day basis. This, of course, is of no statistical significance, but it certainly shows that

under our conditions the use of the antibiotic did not increase production.

During the first seven months of the first year, individual milk samples from each cow was inoculated with a cheese starter culture and the increase in acidity was measured at intervals to determine if there was any inhibition of bacterial growth. None was indicated, and it is apparent that feeding the antibiotic at this level would not be a detrimental factor in cheese-making.

Health Data Recorded

Health data were kept for the entire period. Although the herd has had few cases of foot rot during the past several years, two cases developed during the trial. Both of these were in the group receiving the chlortetracycline. Therefore, we can say that the treatment was of no value in preventing this ailment.

The treatment group had two cases of scours compared with one for the control. The control group had somewhat more mastitis, but this was due to two animals that had had the trouble several times. Overall, the feeding of the material did not in any way appear to improve any health aspects, nor did it seem to affect it adversely. Breeding and conception data were not significantly different.

Digestibility Trials

Digestibility trials were conducted each year and although the treated group showed slightly poorer digestibility for most of the feed nutrients, only the crude fiber digestibility was reduced to such an extent that it was significant at the 8 per cent level of probability.

The result of this trial clearly indicates that under our conditions of feeding and management the feeding of chlortetracycline at the level approved by the Federal Food and Drug Administration was of no benefit to the animal in milk production or health. A number of other research stations have also been running trials with the feeding of antibiotics and, in general, their results confirm our findings.

Editor's Note: This report covered in more detail in West Virginia University Agricultural Experiment Station Current Report 32, *The Effect of Continuous Low Level Feeding of Aureomycin on Dairy Cows*, dated January 1962. Copies of this report are available at county Cooperative Extension Service offices and at the Experiment Station in Morgantown.

PUBLICATIONS

(Continued from Page 2)

Current Reports

29. K. C. Elliott. Multi-Purpose Wagon. March 1961.
30. O. E. Schubert. A Plastic and Wood Cold Frame—Practical, Inexpensive, Easy to Build. June 1961.
31. J. H. Brown and E. H. Tryon. Shaping Norway Spruce for Christmas Trees. October 1961.
32. C. E. Polan, G. A. McLaren, A. H. Rakes, R. S. Dunbar, Jr., H. O. Henderson. The Effect of Continuous Low Level Feeding of Aureomycin on Dairy Cows.

Scientific Articles

598. O. M. Neal and S. L. Emsweller. Observations on Frost Injury to Lilies. *Yearbook, North American Lily Society*, 1959, No. 12:11-14.
599. D. C. Shelton and N. O. Olson. Control of Infectious Synovitis. 7. Comparison of Tetracycline Antibiotics. *Poultry Science*, Vol. 38, No. 6:1309-1315, November 1959.
600. G. A. McLaren, G. C. Anderson, J. A. Welch, C. D. Campbell, G. S. Smith. Diethylstilbestrol and Length of Preliminary Period in the Utilization of Crude Biuret and Urea by Lambs. I. Digestion and Nitrogen Retention. *Journal of Animal Science*, Vol 18, No 4:1319-1326, November 1959.
601. F. S. Chu. Carotenoid Found in Accionspores of *Kenkelin nitens* (Schw. Arthur. *Proceedings, West Virginia Academy of Science*, Vol. 31, pp. 33-35, 1959.
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RESTRICTED FEED MANAGEMENT OF FLOCK REPLACEMENTS

by

Homer Patrick, Poultry Scientist

RESTRICTED feed management refers to feeding programs that limit the required nutrient uptake. In this type of management the replacement stock is fed enough feed to produce about 85 per cent normal growth (about a 75 per cent nutrient uptake based on that required for full growth rate).

Restricted feeding of flock replacements during the period following the development of the New Hampshire broiler strain of chickens and the high-energy ration has become more important and has been given greater consideration each year.

Many strains of chickens when first fed develop sexually before their body capacity for egg functions is fully developed. Restricted feeding programs generally retard sexual maturity about four weeks. If this type of program is adopted, the producer should keep that fact in mind when he desires that his pullets come to egg production at the same time they did when fed on a full nutrient program in previous years.

Number of Programs

A number of restricted feeding programs can be used. Each has certain advantages as well as limitations. The success of a restricted feeding program may depend on a number of factors. Good judgment and careful observations of the birds are necessary. Birds which do not get enough feed are hungry, nervous, and they may become cannibalistic and also develop litter or feather-eating habits. Good judgment and careful daily observations also are essential because each operator must work out his own feeding schedule since temperature, strain of birds, management (range, or confinement or confinement on pens), and type of ration exert any influence on the program. The failure of birds to receive enough feed to satisfy their needs may render them more susceptible to mild infections. The following restricted feeding programs are being used:

1. A conventional growing feed fed at an 85 per cent level.
2. A high-energy feed fed at a 70-75 per cent level.
3. High fiber ration—full feed.
4. A conventional growing feed plus light oats (full feed).
5. Medium fiber — low-density mash (full feed).
6. The length of day shortened to reduce feed uptake.

Conventional Feed

>Conventional feed which contains 6 to 8 per cent fiber and fed in the mash or pellet form at a level of 85 per cent normal uptake will reduce growth as measured by weight and sexual maturity; however, normal skeletal development will be produced. The 85 per cent program allows the bird to keep busy most of the time, and the fiber keeps the intestinal tract filled. This reduces the nervous condition common with starved birds. This program does not produce uniform birds because the more aggressive birds will prevent the others from getting their share of the feed.

High-Energy Feed

>The high-energy feed, fed at the 70 to 75 per cent level, will produce replacement stock at a low cost; however, it requires careful supervision because of feather pulling, cannibalism, and nervousness. The birds do not receive enough fiber from the feed to keep the digestive system full. This makes them nervous and cannibalistic. This program, as with program 1, does not produce uniform birds.

Restricted Feeding

>The restricted feeding program using the high-fiber ration contains 15 to 18 per cent fiber. This ration is low in energy and protein and the birds will attempt to eat enough to fulfill their energy needs. By so doing, they will keep occupied, keep a full intestinal tract, be less cannibalistic, and less feather pulling

will occur; therefore, this program requires less supervision. However, the cost of feed to produce a laying bird is about 50 per cent more than when the feed uptake is limited by use of mechanical means. This program produces uniform birds.

Conventional Feed With Oats

>The oldest feeding program for growing stock is to feed a conventional 6 to 8 per cent fiber ration plus free access to light oats. This method does not restrict the growth as much as some programs; however, when oats and mash are fed on a 50-50 basis, the program is easy to manage, the birds are easy to handle, and they develop uniformly. This program takes advantage of local oats, which in turn produces a choice laying bird at a low cost.

Low-Density Feed

>The restricted program using the medium fiber (10 to 12 per cent), low-density mash consists of a mash ration containing bulky materials such as coarse ground oat hulls and a course high fiber alfalfa along with wheat bran. It is difficult for the birds to eat enough of the bulky ration (low-density) to satisfy their needs before they become tired. This program produces a uniform bird at a reasonable cost and involves minimum supervision. This feed can use local light oats, cheap alfalfa (high fiber), and perhaps other local high fiber feedstuffs which make possible a low-cost feed.

Length of Day Important

>The length of day can serve as a means of obtaining limited feed uptake. Birds can adjust themselves to near darkness. If a short light day is provided, the birds will tend to stop eating and retire. Any of the above rations can be used in this program. The birds can hunt the feed in the dark, however, they will not be nervous, nor cannibalistic, and will develop uniformly. This program involves a gradual increase in light period as the birds reach maturity, hence greater supervision is required. The program also requires a windowless house, which in turn requires complete mechanization and confinement.

Evidence strongly supports some form of restricted feeding of flock replacement pullets. The method used will depend upon equipment, housing, breed, and personnel available to the grower.

SOUR CHERRY

(Continued from Page 4)

symptoms and may grow as vigorously as healthy trees. Once having contracted ringspot, sour cherry trees then, and only then, are subject to severe injury by another virus disease, Sour Cherry Yellows.

Sour Cherry Yellows

This is an insidious disease. The first year that a bearing tree is infected the disease causes but little reduction in yield. In subsequent years there is a progressive, cumulative reduction in yield until after a few years diseased trees produce only one-half the volume of fruit produced by healthy trees. The fruit that is produced is large and of high quality. The leaves tend to be larger than normal and deeper green. Terminal growth appears to be vigorous. These factors lend a general appearance of lush vigorous growth of a tree with noticeably larger fruit. However, lateral buds on diseased trees fail to develop into fruiting spurs. Translated into practical terms, this means that a diseased tree loses much of its bearing surface and this is reflected directly in reduced yield.

The main diagnostic foliage symptom of this disease is produced only sporadically in West Virginia. In June, following a cool blossom season, there may be one or more waves of yellow leaves that drop to the ground. The affected leaves show islands of green tissue scattered over the yellow background of the leaf blade, presenting a characteristic mottled pattern. It is this symptom that gives the disease its name. All of our older plantings are affected with Sour Cherry Yellows.

Rosette

The importance of this disease in commercial orchards in the United States was first recognized in West Virginia, in 1956. Later in the same growing season, it was found to be widespread and important in the sour cherry plantings in Pennsylvania and New York. Today the catastrophic results of Rosette infections in our younger orchards and the speed with which it spreads once it becomes established in an orchard threatens the very existence of the declining, but at one time profitable, sour cherry industry.

The severity of this problem can best be illustrated by presenting the

case history of the first orchard in which the disease was found. In 1956, when this orchard was eight years old, it was making vigorous growth and promised to be one of the best sour cherry orchards in West Virginia, except that 29 per cent of the trees showed symptoms of Rosette. In 1957, 37 per cent of the trees had the disease, in 1958, 65 per cent, and in 1959 all of the 2,871 trees had become diseased and were removed. In a period of eleven years this large, thrifty young planting was completely destroyed by this virus disease, with most of the damage being done in the last three years. The enormity of this loss is clear to any orchardist who has invested the money, time, and effort necessary to grow an orchard to producing age.

Symptoms of Rosette

In West Virginia the most striking symptom of Rosette is dieback (Figure 1). The extent of killing may vary from one dead terminal to complete death of the tree. It is common to find one-quarter to one-half of the tree dead, with the remainder normal in appearance except for a transition zone of malformed leaves and rosetted terminal growth arising between the dead and normal portions of the tree (Figure 2). Many vigorous shoots are produced immediately below the killed portions of the tree. Leaves on these shoots may be dwarfed and malformed (Figure 3), but in some cases they may appear normal. Rosetting of much of the new terminal growth is pronounced. Diseased portions of the tree appear in sharp contrast to normal portions and the dividing line between diseased and normal is narrow.

In general, leaves showing symptoms are smaller than normal leaves, cupped, and in many instances much narrower. Leaf margins tend to be irregular and many leaves are severely distorted. The upper and lower surfaces of affected leaves are rough, apparently resulting from an overgrowth or irregularity of the veins.

The foliage produced on diseased trees or diseased portions of trees is abnormally light green during the early part of the growing season. This symptom is easily seen from a distance and readily serves to attract attention to diseased trees. Later in the growing season, this color difference is not great and is

difficult to see. Diseased trees may blossom, but under West Virginia conditions these blossoms die when they reach the balloon stage of development, resulting in a total loss of yield on diseased trees. All these symptoms are most pronounced during the spring and early summer and they become less evident as the growing season progresses unless, of course, the tree dies. Rosette has been found in every young cherry planting in the State that has been visited in the course of these studies.

CONTROL SUGGESTIONS

Virus diseases are, in the main responsible for the discouraging outlook for the continued production of sour cherries in West Virginia. On the other hand, it means that the grower who will take the time to learn about these diseases and their control has the opportunity to produce a desirable fruit that will likely be in short supply in the not too distant future. Research workers at the State Agricultural Experiment Stations in the Northeastern, North Central, and Western Regions have joined in regional and inter-regional projects to attack this problem. This combined effort has led to the discovery and release to the nursery trade of virus free clones of sour cherry. This offers a degree of control in that fewer diseased trees are presently being offered for sale as planting stock. Thus, there is less likelihood of planting diseased stock and establishing these diseases in the new planting. New planting should not be made near older established cherry orchards or wild cherry trees. Young trees should not be planted in old orchards as replacements for trees that have died. These will become diseased almost immediately, will serve as reservoirs of the virus diseases, and will probably never yield a profitable crop. This isolation is doubly important because the vector of vectors of the diseases are still unknown despite the intensive search for them. As soon as they are known it is likely that effective control measures can be formulated. For the present, if one purchases certified virus free stock and the planting site is well isolated from other cherry trees, there is every reason to expect that a profitable orchard can be grown. Those who plan to plant new sour cherry orchards should recognize the hazards caused by these diseases and seek advice from their

the agricultural experiment station before proceeding.

WILDLIFE MANAGEMENT

(Continued from Page 7)

udies to determine the cause of population fluctuations and the influence of ground cover on the distribution of small mammals. Acorn consumption by small mammals is receiving close attention to determine how this influences both gray squirrel and deer food supply, as well as oak reproduction. This year laboratory study on the effects of pesticides, particularly systemic poisons, and rodenticides on small mammal populations, will begin. This will have an important bearing on the relation of pesticides to wildlife and on the development of methods for controlling small rodent populations in areas where new forest and wildlife cover plantings are being destroyed by small mammals.

Arnold Benson of the University Department of Biology is starting a study on the University Forest of the productivity of headwater streams. The objective of this study is to determine the role of various stream organisms in energy exchange and the rate at which food materials are transferred downstream from headwater sources. The results may aid in the understanding and management of trout waters.

As the years pass, West Virginia sportsmen can look to the University Forest not only as a better place in which to hunt but also as a source of new knowledge which can be used to improve hunting and fishing throughout West Virginia.

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MASTITIS--

(Continued from Page 3)

MASTITIS, encouraged by small stalls and other poor management practices.

an antiseptic solution and then rinse in warm water.

>Check the vacuum level and pulsator ratio regularly and adjust according to the manufacturer's instructions.

>Discard worn out inflations.

>After milking rinse all parts in cold water and then wash thoroughly. Soak the inflations in lye solution as recommended by the manufacturer.

Approximately 15 years ago preparations of penicillin and other antibiotics first became available for the treatment of mastitis. Since they are relatively inexpensive and easy to introduce into the udder they have become very popular. All too often they are used improperly by the dairymen who fail to consult a veterinarian. Despite the value of antibiotics, they have not solved all our mastitis problems and have definitely created new problems.

Take Care with Antibiotics

It is anticipated that an antibiotic infused into the udder will eliminate the infecting bacteria. Actually, in a badly swollen udder the antibiotic may not penetrate sufficiently to contact most of the bacteria. Also, all bacteria are not sensitive to the same antibiotics. For this reason, we now use mixtures of several antibiotics. *Staph. aureus* presents a particular problem because it can often become highly resistant to the antibiotics used. In addition, antibiotics are often misused and al-

though they kill the weak bacteria, they allow the more serious ones (such as coliforms) to take over. As milk is secreted after udder infusion the antibiotic is carried with it in decreasing amounts over a period of approximately 72 hours. It is illegal for the dairyman to sell this milk. The first complaints came from cheesemakers who experienced difficulties with milk containing traces of penicillin. We now have a still more serious objection to milk contaminated with antibiotics. A few of the people who receive penicillin in the treatment of an infection become allergic to it. Exposure again to penicillin can be dangerous for them. There are now a few cases on record in which such people have been harmed by small amounts of penicillin in fluid milk and dairy products.

Good Management Vital

Even if treatment is successful, the benefits are only temporary. The udder injury or the poor management practices that allowed infection to enter before will likely lead to a reinfection, followed by the need for more antibiotic treatment. An easy squirt-tube treatment can never take the place of good management to prevent infection. Antibiotic treatment has its place in the fight against mastitis. It can clear up an infected quarter before serious and permanent damage to the tissue can result. It must, however, be used with a veterinarian's advice, and as only one part of a program that includes the testing of cattle brought into the herd, sanitation to prevent the spread of infection, and good management practices to prevent udder injury and maintain the animals in a healthy and disease-resistant condition.

Experiment Underway

In the winter of 1958-59, a mastitis research and control program was initiated in the West Virginia University dairy herd. We are investigating the mastitis problem from both the management standpoint and the laboratory study of infectious organisms. Detailed management and health records are now beginning to tell us something about the causes of and cures for mastitis.

Approximately 80 per cent of all cases of mastitis in the W.V.U. dairy herd have definitely been diagnosed as caused by *Staph. aureus*. However, this "bug" is not killed by the same antibiotics in all cases. In

other words, some strains of *Staph. aureus* have built up resistance to some of the more common antibiotics. We are now studying this phase in more detail. On the basis of preliminary management studies the stanchions in the main milking barn were numbered in September, 1960 to see if any relationship existed between the incidence of mastitis and the location of the infected animal in any specific part of the barn. It became apparent in a short time that the incidence of mastitis in five animals stanchioned close to a ventilating fan was alarming. During the same period there were no cases among the other 65 animals in the barn. The fan was turned off, the cases cleared up, and these five animals have had no udder inflammation since. In further checking the drafts, indications are that the incidence of mastitis is higher in sections of the barn where drafts are more pronounced. These and other management factors are being studied, together with the bacteriological approach, in an attempt to provide more definite information on mastitis control.

Much remains to be learned about mastitis. However, by utilizing the presently available information as to sound management practice, proper milking procedure, and correct and supervised treatment we should be able to do a good job of controlling mastitis.

TOBACCO BULLETIN AVAILABLE . . .

Director A. H. VanLandingham reports that a new bulletin, entitled *Tobacco Production and Marketing in West Virginia*, has just been released by the Station.

Authors of the new publication Bulletin 465, are W. W. Armentrout and Homer C. Evans, Station Agricultural Economists. The authors point out that tobacco is grown and harvested in 35 counties in West Virginia. In 1954, the most recent year for which State figures are available, 3,352 farmers produced tobacco on 2,837 acres. The marketed crop in that year was 4,116,143 pounds.

Copies of this and other Station publications may be obtained from county Cooperative Extension Service offices or by writing to the Station in Morgantown.

Science

SERVES YOUR FARM AND HOME

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AGRICULTURAL EXPERIMENT STATION

WEST VIRGINIA UNIVERSITY

PRIL 1962

ULLETIN 467, PART 2

Science

SERVES YOUR FARM AND HOME

ANNUAL REPORT OF A. H. VANLANDINGHAM, DIRECTOR, WEST VIRGINIA UNIVERSITY AGRICULTURAL EXPERIMENT STATION FOR THE PERIOD 1960-61

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Science

AGRICULTURAL EXPERIMENT STATION
WEST VIRGINIA UNIVERSITY

on our cover

Fifty years ago Plant Pathology was recognized as a Department in the West Virginia Agricultural Experiment Station. On April 23-25 this department celebrated the 50th anniversary of this occasion by holding open house and acting as host to the Potomac Division of the American Phytopathological Society at their annual meetings.

Plant pathology research has undergone many changes within this period. The principal diseases investigated during the early years included cedar-apple rust and chestnut blight. Some of the projects now receiving major attention are late blight of potato and tomato (upper right: Dr. M. E. Gallegly examining plants in the greenhouse where he is breeding for resistance to the disease), diseases of forage crops (lower left: Dr. E. S. Elliott looking for rust on blue grass being selected for resistance), and diseases of forest and shade trees (upper left: leaf diseases being examined by graduate students Raymond Amos, Terry Davis and Wayne Harnish), including the destructive oak wilt disease (lower right: method of control by girdling to the heartwood).

PART 2

Annual Report of the
AGRICULTURAL EXPERIMENT
STATION

West Virginia University
Morgantown, W. Va.

Director

A. H. VanLandingham

Editor JOHN LUCHOK

Associate Editor STANLEY J. NELS

Photographer DAVID R. CREEL

SCIENCE SERVES YOUR FARM AND HOME will be sent free to any resident of West Virginia in response to a written request to the Director, Agricultural Experiment Station, West Virginia University, Morgantown, West Virginia.

on the

calendar . . .

MAY—

5-6—West Virginia Home Economics Association Annual Meeting, Jackson's Mill.
27-June 3—Soil Stewardship Week.
28-June 2—Volunteers 4-H Leaders Conference, Jackson's Mill.

JUNE—

4—Commencement, West Virginia University, Morgantown.

new publications

Bulletins

464. Leonard Sizer, County Study Data Book, Measures of Social Change in West Virginia, August 1961.
465. W. W. Armentrout, H. C. Evans, Tobacco Production and Marketing in West Virginia, January 1962.
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Tent Caterpillars

they have been with us since at least 1646!

Tent of the eastern tent caterpillar

by

Herbert M. Kulman, Assistant Entomologist

THE tent caterpillars are comprised of a group of closely related species of moths belonging to the genus *Malacosma*. There are many species, but only two occur in the eastern United States—the forest tent caterpillar, *M. disstria*, and the eastern or apple tree tent caterpillar, *M. americanum*.

The forest tent caterpillar frequently occurs in large numbers and defoliates hundreds of acres of forest trees. It feeds on most hardwoods that commonly occur in the forest. Its defoliating activity does not kill trees, but trees that undergo heavy defoliations suffer a reduction in growth and often a dying back of small branches. Foresters and conservation-minded people in general are concerned about the damage caused by this insect, but the general public is probably only vaguely aware of its activities since they seldom come in contact with the caterpillar and its damage. Unlike the name implies, the forest tent caterpillar does not make a tent like the better-known eastern tent caterpillar.

The eastern tent caterpillar is a very common pest of black cherry, chokeberry, fire cherry, hawthorn, and apple. Many other trees and shrubs have been reported to be infested on a few occasions. The eastern tent caterpillar is more of a nuisance because of its migrating habits just prior to pupation than as a pest of valuable trees. Although it may cause damage to the various wild cherries, few people are concerned since these are usually considered to be weed trees. Black cherry when growing as a forest tree is a valuable source of furniture wood in some areas, but the eastern tent caterpillar is not known to be a serious pest of these trees. The eastern tent caterpillar never becomes a pest of properly-managed orchards because of the extensive use of insecticides.

Life Cycle

Both species of tent caterpillars overwinter as groups of 100 to 350 eggs in a compact mass surrounding

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EGG, larval, adult, and pupal stages of the tent caterpillars. The larva and adult on the right are of the eastern tent caterpillar and the ones on the left are of the forest tent caterpillar.

IRIS LEAF SPOT

by

Edward S. Elliott,

Associate Plant Pathologist

DISEASE spots in various stages of development on bearded iris leaves. Spots vary considerably in size.

THE most widespread disease of bearded iris in West Virginia is the leaf spot caused by the fungus *Didymellina macrospora* Kleb. Certain other diseases of iris, particularly iris soft rot, are very destructive, but none is so widespread as iris leaf spot. It may appear that the small leaf spot would not cause much damage to the plant, but when such plants are compared with disease-free plants, one finds the disease does cause premature death of the foliage and a reduced rhizome growth. Such plants are less vigorous with the approach of winter weather and are more subject to injury. The fungus is found not only on bearded iris but on several other species of iris including the bulbous types.

The spots may vary considerably in size (see photograph). They begin as green, water-soaked areas which soon become brown and dry. Usually a ring of darker brown cells surrounds the lighter colored, dry centers. Occasionally one can see a black, velvety mass of fungus spores on the surface of the dried spot.

Spores Spread

The spores of the fungus may be splashed by rain or carried by air currents from the point where they were produced to other locations on the leaf, or to other leaves. There the spore germinates and, if weather conditions remain favorable, the

fungus penetrates into the leaf and grows, utilizing the contents of the plant cells as food. Within a few days a spot outlines the area in the iris leaf tissue that has been invaded by the fungus.

Sometimes hundreds of the spots may occur on a single leaf and cause rapid death of the entire leaf. This premature death of the leaves prevents the normal growth of rhizomes. This results in a plant of lower quality the following season. Although the disease may cause the death of entire plants, the usual damage results in unthrifty plants.

The fungus lives through the winter on the dead leaves that it had invaded the previous season. As warm weather develops in the spring, masses of spores are produced on the old infected areas. These start the disease again as they are easily wind blown or splashed to the new foliage.

If one could remove all of the dead infected leaves, the disease might be eliminated from a planting, but this is not practical. Even with a thorough removal of dead leaf material, some fragments harboring the fungus will remain to perpetuate the disease. But thorough removal and destruction of the old leaves is valuable as a control measure because it removes a major part of the fungus material and reduces the severity of the disease.

If the grower wishes to obtain the maximum control of this leaf spot it is also necessary to protect the plants with suitable fungicides during the growing season. A limited testing program carried out during the 1960 season* indicated that some commonly available material will control this disease effectively.

Three organic fungicides, Zineb (75 WP), Maneb (70 WP), and Phaltan (50 WP) were compared in this test. The first two were used at the rate of 1 level tablespoon of the wettable powder per gallon of water; Phaltan was used at 1½ level tablespoons per gallon. Since iris leaves are waxy, it was necessary to add a spreader to the spray mixture. The spreader Triton B-1956 was added at the rate of 1 milliliter (20 drops) per 1 gallon of water; at this rate, the spray material readily wet the waxy leaves.

Replicated plots, each composed of mixed bearded iris varieties were sprayed with the materials on May 16 and again on May 27. An additional spray treatment was planned but was not applied because of the lack of rainfall following the second application. The effectiveness of these materials was determined on June 29 by counting the number of

(Continued on Page 7)

*The author wishes to express to Dr. Claude J. Davis appreciation for the use of his iris plantings in Morgantown as a site for this test and to Mr. Charles M. Howard for assistance.

Developing Superior Strains of Chickens

by

H. M. Hyre, Associate Poultry Scientist

THE poultry breeder must give his attention to many traits in poultry in developing a superior strain of birds. Factors to be selected for include egg size, egg shape, interior egg quality, shell quality, hatchability, viability, and body conformation. Although these traits are all important and must be selected for, perhaps the ones that need first priority in a breeding program are number of eggs produced and rate of growth.

Growth rate is of most importance in meat production, and while number of eggs must be considered in a breeding program for both eggs and meat, most progress has been made in egg production when egg number was the principal concern.

Great progress has been made in poultry meat and egg production. It is not uncommon for broiler growers to attain an average weight per bird of 3.5 pounds in nine weeks, and some of the best records in annual egg production are as high as 70 per cent. These are excellent records compared to those of 20 years ago. However, the poultry breeder must not take all the credit or this progress. The nutritional specialists have done an excellent job in formulating rations that bring out all the genetic potentials in the chicken so far as egg number and growth rate are concerned.

Selecting for Egg Production

In this discussion, let us primarily consider selective breeding for egg production, and we will mention a few of the breeding systems used to lay in developing our egg production stock. Most breeders have used the closed flock system. This means the selection was done within their own flock and no stock was used from the outside. This is considered by some as a type of line breeding. Many of our top egg production strains have been produced in this manner. These are called purebreds and would also be a pure strain. A strain is a line of chickens developed by an individual or an organization. Some poultry breeders have more than one strain of birds.

Production of incrossbreds is another system of breeding. These are chicks that are produced by crossing

highly inbred lines. Another type of crossing involves two different strains. In this case, two entirely unrelated strains of the same breed are crossed to produce egg production chicks. This is known as a strain cross. Still another type of crossing is the crossing of two different breeds, and chicks produced by such a cross are known as crossbreds. Some of these systems of crossing may give better results than others. In general, crosses usually increase vigor and egg production as well as other desirable traits.

Table 1 shows the results of some of the poultry breeding work being conducted at the West Virginia University Agricultural Experiment Station. The per cent of egg production from a pure line of New Hampshires and a pure line of White Leghorns is listed along with the per cent production of the progeny of these two pure lines. It may be noted that while the New Hampshires laid at a rate of about 53 per cent and the Leghorns about 60 per cent, the progeny from this cross produced eggs at a rate of better than 66 per cent. This is 10 per cent higher than the Leghorn line which laid at the highest rate of the two pure lines used in the cross. This would indicate that egg production may be increased by crossing two breeds.

Crosses Produce Well

Table 1 also gives the results of crossing the New Hampshire line with a Rhode Island Red line. For

two consecutive years this cross produced at a rate of 70 per cent. At the time these records were made, information on production of the Rhode Island Reds under the same environmental conditions as the New Hampshires was not available. This strain of Reds in other environments, however, shows a production record of about 65 per cent. Here again the cross progeny out-produced both of the purebred parents.

Table 2 presents egg production records on two pure lines of Single Comb White Leghorns and their strain cross progeny. While one of the pure lines has relatively low production, and the other relatively high production, the progeny of these two strains produced eggs at a rate equal to the high line.

These records indicate that egg production is apt to be increased by crossing two breeds or two strains of the same breed. Approximately 65 per cent of the chicks that are hatched today are some type of cross.

TABLE 2.
PER CENT EGG PRODUCTION ON A HEN-DAY BASIS OF THE PUREBRED PARENTS AND THE STRAIN CROSS PROGENY

YEAR	PUREBRED PARENTS WHITE LEGHORNS	
	STRAIN A	STRAIN B
1959-60	55.2	73.2
YEAR	STRAIN CROSS PROGENY STRAIN A X STRAIN B	
	72.5	

PUBLICATIONS

(Continued from Page 2)

34. Collins Veatch, Oscar E. Schubert, and K. L. Carvell. Weed Control—1962-1963 Suggestions. April 1962.

Scientific Articles

648. M. D. Welch, Collins Veatch. Some Effects of Herbicides and Season on the Rhizomes of Quackgrass. *Weeds*, Vol. 10, No. 1:15-17, January 1962.
649. P. G. Caltrider. Growth and Sporulation of *Guignardia bidwellii*. *Phytopathology*, Vol. 51, No. 12:860-863, December 1961.
652. W. G. Martin, Homer Patrick. Radio-nuclide Mineral Studies: 4. Studies on the Metabolism of Ca^{45} by the Chick. *Poultry Science*, Vol. 41, No. 1:213-216, January 1962.
655. H. A. Wilson. Rhizosphere Bacteria of Some Strip-Mine Vegetation. *Proceedings, West Virginia Academy of Science*. Vol. 33, pp. 15-20, 1961.

TABLE 1.
PER CENT EGG PRODUCTION ON A HEN-DAY BASIS OF THE PUREBRED PARENTS AND THE CROSSBRED PROGENY

YEAR	PUREBRED PARENTS	
	NEW HAMPSHIRE	WHITE LEGHORN
54-55	53.1	61.4
55-56	53.8	57.8
56-57	57.1	61.4
58-59	50.6	
59-60	54.5	
YEAR	CROSSBRED PROGENY	
	W.L. X N.H.	R.I.R. X N.H.
54-55	66.5	
55-56	65.8	
56-57	67.6	
58-59		70.2
59-60		70.8

FIGURE 1. Rutgers tomato plant severely defoliated by late blight.

FIGURE 2. Late blight rot of fruit on severely diseased Rutgers

LATE BLIGHT—

most serious disease of tomato in West Virginia

by

M. E. Gallegly, Plant Pathologist
and

J. R. Shumaker, Assistant in Horticulture

LATE blight is the most serious disease of tomato in West Virginia. The disease is caused by a microscopic fungus (*Phytophthora infestans*) that attacks leaves, stems, and fruits of tomato plants (Figures 1 and 2), and often may completely destroy the crop. The cool, moist conditions prevalent in the mountainous, western part of West Virginia are particularly favorable for development of the disease.

Spray trials have shown that the disease can be effectively controlled by fungicides such as zineb, maneb, fixed copper, and bordeaux mixture when late blight is mild during relatively warm and dry seasons. However, when the growing season is cool and wet and the disease becomes very severe, the best spray programs may fail to give good control of the fruit-rot phase of the disease. In 1950, the fruit from plants thoroughly sprayed at weekly intervals with zineb and fixed copper fungicides showed 30 per cent rot.

Following the 1950 epidemic, a project was set up by the West Virginia University Agricultural Experiment Station to search for resistance to tomato late blight and, if found, to incorporate this resistance in a commercial variety.

Wild Tomatoes Show Resistance

After testing more than 900 different wild and cultivated tomatoes from various parts of the world, resistance was found in several wild tomatoes having small, cherry-size fruit. Figure 3 shows the resistance of four collections of wild tomatoes in comparison with the susceptible Rutgers variety when inoculated with race 0 of the tomato late-blight fungus. Immediately these resistant cherry tomatoes were crossed with large-fruited varieties as the first step in transferring the resistance to commercial type plants.

As breeding work progressed, it became evident that resistance was controlled by a single factor (dominant gene-pair), which gave com-

plete resistance to the race of late blight then present in the field. Hopes were high that a tomato variety with this type of resistance could be developed for West Virginia growers within a few years.

These high hopes were short-lived for it was soon found that the late-blight fungus had developed a new race, later named race 1, which would attack varieties with the single resistance factor. In 1957, race 1 was introduced into West Virginia on southern grown tomato plants and completely killed breeding selections in experimental plots having only single-gene resistance.

However, all is not lost in efforts to develop a late blight resistant tomato variety. Early in the breeding work a second type of resistance was found due to multiple factors. The degree of resistance in a plant having this type will depend upon the number of factors present. The second type of resistance is not only effective against race 0 of late blight but also against race 1. As shown in Figure 4, cherry tomatoes 36-1 and 106, which have the single-factor resistance and little to no multiple-factor resistance, were completely killed when inoculated with race 1. However, cherry tomatoes 907W and 700 were only slightly affected.

Although the second type of resistance is equally effective against both races of the fungus, it does not give complete immunity. Plants may show a slight amount of disease on the foliage and fruit. In 1957, when plants with only the

single-factor resistance were killed by late blight, plants with high levels of the multiple-factor resistance showed comparatively little disease. Plants of the latter type showed the most resistance again in 1958-61.

A number of breeding selections having both the single-factor and multiple-factor resistance along with fair to good horticultural characters were first made in 1957. Additional crosses and selections have been made each year. These selections will be examined more closely for horticultural qualities in 1962 or possible release of a new variety.

A commercial variety with the multiple-factor resistance may not give complete freedom from late blight during severe epidemics but neither does a regular spray program with a good fungicide. However, excellent control should be obtained if both resistance and a fungicide is used. The present goal of the tomato breeding work by the West Virginia University Agricultural Experiment Station is to develop a commercially acceptable tomato variety with a high degree of multiple-factor resistance to serve in partnership with a fungicidal program for the control of tomato late blight. In addition, resistances to *Fusarium* and *Verticillium* wilts have been incorporated in the breeding program along with factors for high color, uniform ripening, and crack resistance. Of primary importance is a home garden and fresh market variety and secondarily a canning and processing variety.

FIGURE 3. Rutgers are susceptible, whereas wild tomato collections 106, 36-1, 907W, and 700 are resistant to isolate M-7 of race 0 of the late blight fungus.

FIGURE 4. Rutgers, 106 and 36-1 plants are susceptible to isolate F-3 of race 1, whereas 907W and 700 were only slightly affected by race 1; 106 and 36-1 plants carry a single-factor type of resistance; 907W and 700 carry a multiple-factor type.

IRIS

(Continued from Page 4)

disease spots on twenty leaves from each plot.

There was approximately four times as many leaf spots on the unsprayed iris as on any of the sprayed plots. The three fungicides appeared to be about equally effective. It was recognized that even better control might have been obtained if the first application had been made at least two weeks earlier since some build-up of the disease was already evident on May 16.

Control Suggestions

On the basis of these trials and other observations the following suggestions can be offered for the control of iris leaf spot:

1. Remove as much of the dead leaf material as possible in the fall. If it is not removed in the fall, an early spring clean-up is desirable.

2. Begin spray treatments with the first active growth of the plants and repeat at two-week intervals during the growing season. This interval may be shortened or lengthened, depending on the amount of rainfall. Frequent rains wash the protective material away thus making more frequent applications necessary. Extended periods without rainfall would permit the interval to be lengthened. The essential part is that a protective fungicide be on the leaf surface during the active life of the leaf.

3. Sprays of wettable Zineb, Mancozeb, and Phaltan—used at the rates

suggested by the manufacturers—are effective.

4. A good spreader should be added to the spray mixture. If none of the materials manufactured specifically for this purpose is available, one of the soap detergents can be substituted. Add small amounts of detergent to the mixture until a satisfactory wetting of the leaf surface by the spray is obtained.

5. Most insecticides can be incorporated in the spray mixture, if desired, in order to save repeated applications of individual pesticides.

6. Cumulative benefits can be expected if a good program is followed each year. Fewer spores of the fungus will be present in any year if good control is obtained the previous year.

CATERPILLARS

(Continued from Page 3)

a small branch. In the spring, at about the time that the leaves of the host tree start to expand, the small larvae inside the eggs eat their way through the shell. The eastern tent caterpillars immediately construct tents in the crotches of small branches and feed on the new leaves.

The eastern tent caterpillars leave a trail of silk as they move about. The silk is produced in silk glands and is spun into thread by spinnerets located near the caterpillar's mouth. When one caterpillar follows another an accumulation of silk thread occurs that results in a path of silk. When the caterpillars are disturbed they rapidly descend from their branch on a strand of silk. If they do not hit another branch or leaf, the caterpillars can be seen to pull themselves back up to their original position by catching the strand of silk in their mouthparts and gathering it into a ball between their legs.

Growth

As the young caterpillars feed and grow their bodies expand, but the head capsule, which is hard, remains the same size. After a time a new skin is formed under the old and the caterpillar crawls out with a new skin and a larger head capsule. This change is called moulting, and the time between moults is called an instar. The tent caterpillars usually have five larval instars. Early in the instar the head capsule appears large compared to the body, but later in the instar, when the body has expanded, the head appears relatively small. The first instar caterpillars consume about 5/100 square inch of leaf, and the fifth instar consumes about 18 inches. This is a 360-fold increase in area of leaf consumed.

The eastern tent caterpillar constructs a larger tent as it increases in size. The tent serves as a protective retreat for caterpillars at night and during periods of unfavorable weather. The caterpillars usually stay on the same tree from the time of hatching until just prior to pupation. If they consume all the leaves on that tree, they will then migrate to other trees or near-by lower vegetation.

During the last larval instar many of the caterpillars move off the host tree and wander about in a very unpredictable manner. They seldom

DEAD bodies of cirrus killed caterpillars.

are observed feeding during this period of migration. It appears that the caterpillars are in search of a secluded place where they can spin a cocoon and transform to the pupal or resting stage.

May Spin Cocoon

The eastern tent caterpillar may spin a cocoon in its tent, in a bark crevice, or in a sheltered location such as the corner of a building or in empty containers. The forest tent caterpillar spins its cocoon in leaves, which are always curled around the cocoon; but sometimes it selects secluded locations such as bark crevices or the under side of rocks.

After about two weeks a moth emerges from the cocoon. The moths at first have crumpled wings which they straighten by forcing blood into the wing veins. Once the wings have expanded and the veins have dried and stiffened, the moths fly away in search of a mate. The females are weak fliers, but the males are known to fly a mile or more in quest of a female. The long-distance attractant is a chemical which can be produced only by virgin females. Once a female has been bred she can no longer attract the males. Soon after breeding, the females lay their eggs in groups of 100 to 350 around small branches of the appropriate species of tree.

The female covers the egg mass with a foam-like material called spumaline which is hygroscopic and

thus absorbs water which keeps the eggs from drying out. The eggs remain on the branches during the winter and hatch the following spring when the cycle starts again.

Nature Fights Back

Many factors influence tent caterpillar populations. Among the most interesting are the predators and parasites. Birds, small mammals, beetles, wasps, and spiders undoubtedly consume some of the caterpillars. One of the most important parasites is the flesh fly *Sarcophaga aldrichi*, a large fly with gray and black stripes on its back. It is known in some areas as the "government fly" because of the mistaken idea that it was released by the federal government to control the caterpillars. It sometimes occurs in large numbers and is rather annoying to man, but fortunately, it cannot bite. Unlike most insects, the female fly lays a small maggot instead of an egg. The maggot is deposited on the cocoon of tent caterpillars. It bores through the cocoon and kills the enclosed pupa by its feeding activity. When the maggot is full-grown it falls to the ground and remains there over winter and in the spring emerges as an adult fly.

There are many wasps and flies that lay eggs in or on the egg, larval or pupal stage of the tent caterpillars and develop at the expense of the host. Occasionally a parasite will itself be parasitized—this is called hyperparasitism. A parasite in a parasite in a parasite is also known to occur, but this is rare and is probably of little significance in the biological control complex.

The caterpillars are known to suffer from nematode, fungus, and virus infections. The latter two sometimes destroy a large percentage of the caterpillars over a wide area. The most common virus disease is a polyhedrosis which causes a breakdown of the caterpillar's tissues, leaving only the outer skin. The dead caterpillar body usually hangs by one of its prolegs from a branch as a limp bag, which will break at the slightest disturbance and spill its viruliferous contents on the leaves and branches below. Caterpillars that come in contact with this material will contract the disease. Material that dries on the branches may serve as a source of infection for several years. Some experiments have been performed in which the virus material has been

(Continued on Page 12)

These station projects were active in the year 1960 - 61

(Abbreviations of funds supporting projects and other abbreviations: AMS-Agricultural Marketing Service; ARS-Agricultural Research Service; CES-Cooperative Extension Service; H-Hatch Funds; NE-northeastern Regional Research; NEM-northeastern Regional Marketing Research; State Funds; SCS-Soil Conservation Service; USDA-United States Department of Agriculture.)

Administration

General administration of federal-grant fund research (H 1)
Planning and coordination of cooperative research (H 2)

Agricultural Biochemistry and Nutrition

Identified growth factors in proteins (H 5)
Prevention of rancidity in carcass fats of turkeys and hogs (H 6; coop. Animal Science)
Measuring the nutritive value of forage crops (H 46, NE-24; coop. Animal Science)
The influence of autoxidized fat in the diet on protein requirements (H 118; coop. Home Economics)
Metabolic relationships among amino acids, peptides and phospholipids (H 150, NE-37; coop. Home Economics)
Miscellaneous chemical investigations (S 5)
The hemocellulolytic acidity of rumen bacteria (S 125)

Agricultural Economics and Rural Sociology

The economics of broiler production on West Virginia farms (H 85; coop. Poultry Science, CES)
Effects of national production control and price support programs on incomes of farmers in the Appalachian area (H 100, IRM 1; coop. Interregional)
The economic evaluation of the use of irrigation on West Virginia farms (H 101)
The effects of population change and migration upon agriculture and rural community life in West Virginia (H 102, NE 31)
The effect of advertising and promotion on milk sales (H 114, NEM 14)
Effects of market innovations on costs of and returns for poultry (H 115)
Manpower utilization and agricultural adjustment potentials in Fayette, Raleigh, and Summers counties, West Virginia (H 121; coop. CES, ARS, W. Va. Dept. of Employment Security, USDA)
The evaluation of the marketing information for consumers (M.I.C.) program in the Wheeling-Steuersville area (H 122; coop. CES, Federal Extension Service)
Market structure and development of floricultural products (H 124, NEM 8)
Producer-output relationships of forage production on dairy farms in West Virginia (H 134, NE-43; coop. Agronomy and Genetics)
The economic analysis of the physical and monetary costs incurred in the procuring, slaughtering and distributing of livestock, meat and meat products of local and wholesale slaughtering establishments in West Virginia (H 135, NEM 7; coop. Farmer's Cooperative Service, AMS)

An analysis of specification buying and production of livestock and meat in West Virginia (H 136, NEM 7; coop. Farmer's Cooperative Service, AMS)
Improving farm income from apple sales through changes in market organization and structure (H 137)
Economics of reducing the frequency of retail milk delivery (H 138, NEM 25)
Market development of ornamental nursery products (H 139, NEM 15)
Adjustments needed to enhance the competitive position of West Virginia in marketing broiler products (H 151, NEM-21)
Tobacco marketing in West Virginia (Title II, ES 234; coop. AMS, Kentucky Agricultural Experiment Station)

Agricultural Engineering

Poultry house design for West Virginia (H 65, NE 8; coop. Poultry Science)
The mechanization of forage crop harvesting, processing, storing, and feeding (H 69, NE 13; coop. Animal Science, Dairy Science, Reedsville Farm)
Factors involved in the use of supplemental irrigation under West Virginia conditions (H 92, NE 22; coop. Agronomy and Genetics, Reymann Memorial Farms, Ohio Valley Experiment Farm)
Agricultural climatology of West Virginia (H 105, NE 35, Weather Bureau, U. S. Department of Commerce)
Curing and handling of burley tobacco (H 123; coop. Agronomy and Genetics, Ohio Valley Experiment Farm)
Hydrology of watersheds on shale soils (H 130; coop. Agronomy and Genetics)
Study of the design of operating characteristics of a grain conveyor using fluidization principles (S 63; coop. Engineering Experiment Station)
Preliminary and exploratory investigations pertaining to agricultural engineering (S 97)
Cost of installing and using electrical equipment (S 129; coop. Dairy Science, Animal Science, Poultry Science, Statistics, W. Va. Farm and Home Electrification Council)

Agronomy and Genetics

The influence of fertility and management on several ladino clover-grass mixtures (H 19)
Corn genetics and breeding (H 29)
Selection and breeding of superior strains of red clover for West Virginia (H 34)
Crop rotation experiments (H 43; coop. Ohio Valley Experiment Farm)
Maintaining profitable stands of alfalfa (H 50; coop. Plant Pathology, Reymann Memorial Farms, Ohio Valley Experiment Farm)
Weed control in corn (H 52; coop. Reymann Memorial Farms, Ohio Valley Experiment Farm)
Alfalfa breeding and genetic investigations (H 66)
The influence of several management practices on the performance of alfalfa and ladino clover grown alone and in association with grasses (H 68)
Some chemical properties of the major soil types of West Virginia (H 81)
Using nitrogen fertilizer efficiently (H 82; coop. Ohio Valley Experiment Farm)
The molybdenum status of West Virginia soils (H 104)

Nutrient availability in relation to soil structure (H 106, NE 11)
The production of burley tobacco (H 108; coop. Ohio Valley Experiment Farm)
The correlation between various laboratory methods of determining available nitrogen in northeastern soils and the responses to added nitrogen to crops grown on the soils in greenhouse and field studies (H 112, NE 39)
Studies of soil properties that affect establishment and growth of oak stands in West Virginia (H 117)
The growth and control of quackgrass *Agropyron repens* under various conditions (H 128, NE 42; coop. Biology)
The microclimate and soil moisture regime in forested soils as affected by topography and its effect on site productivity in mixed oak stands (H 140)
The performance of several alfalfa varieties grown under different climatic conditions with emphasis on the influence of fall cutting (H 141)
The influence of cutting and fertilization treatments on the productivity and persistence of orchardgrass and timothy (H 142, NE 29)
Information that will facilitate the production of winter barley resistant to powdery mildew in the Northeast (H 143; coop. Plant Pathology, ARS)
Biochemical studies on cold resistance of alfalfa (H 152)
Rate and time of application of K fertilizer in relation to yield and longevity of alfalfa stands (H 153; coop. Ohio Valley Experiment Farm, Reedsville Experiment Farm)
Evaluation of improved varieties, synthetics and new forage species for the Northeast (H 154, NE-28)
Field crop variety testing (S 6)
Soil survey work in West Virginia (S 8)
The establishment and testing of grass and legume species and strains for soil conservation (S 87; coop. Nursery Division, SCS)
Preliminary investigations in soil science (S 94)
Preliminary investigations in crop production and genetics (S 128)

Animal and Veterinary Science

The relation of birth weight within breeds to growth rate of purebred mutton-type lambs (H 12)
Nutritional requirements of swine for growth (H 22)
Breeds as a factor in the production of ewes retained for flock replacement and for the production of market lambs and wool (H 23; coop. Reymann Memorial Farms)
Methods to increase non-protein nitrogen utilization by ruminants (H 45; coop. Agricultural Biochemistry)
Respiratory diseases of poultry (H 53, NE-5; coop. Reymann Memorial Farms, Agricultural Biochemistry, Poultry Science)
Avian infectious anemia-synovitis (H 88; coop. Agricultural Biochemistry)
Reproductive efficiency of beef cattle (H 90, S 10, Southern Region)
The pathogenicity of infectious agents for the uterine mucosa (H 127, NE 40; coop. Dairy Science)
Nutrition, soil, and herbage interrelationships in a syndrome resembling hypomagnesemia tetany in ruminants (H 131; coop. Agronomy and Genetics)

Exploratory or preliminary investigations on diseases, feeding and management of farm animals (S 89)
 Increasing the utilization of low-quality hays by wintering beef cattle in West Virginia (S 111; coop. Reymann Memorial Farms)
 Methods of feeding growing-fattening pigs for economical production of lean carcasses (S 113; coop. Agricultural Biochemistry)
 Studies on infectious synovitis (S 117; coop. Agricultural Biochemistry)
 The effects of two systems of selection of breeding stock on beef cattle performance (S 118; coop. Reymann Memorial Farms, Dairy Science)
 The efficacy of certain anthelmintics in the control of sheep parasites (S 132)

Dairy Science

The transmission of milk and butterfat production and body conformation by dairy sires (H 7)
 Comparison of young bulls with proven bulls in artificial breeding (H 27; coop. W. Va. Artificial Breeder's Coop., CES)
 The use of type and production records as a basis for a dairy cattle improvement program (H 35; coop. Ayrshire Breeder's Association)
 The effects of early versus delayed breeding of dairy heifers (H 107)
 Improving the quality of cottage cheese in West Virginia plants (H 133; coop. Plant Pathology, Bacteriology, and Entomology)
 Preliminary or exploratory investigations on diseases, feeding and management of dairy cattle (S 86)
 Miscellaneous investigations of dairy products (S 90)
 Selecting for milk production in Jersey cattle (S 106)
 Chemical inhibition as a means of preserving bovine sperm (S 114; coop. College of Arts and Sciences)
 Effects of increasing the upper limit of feeding concentrates to Holstein cows (S 120; coop. Animal Science)
 The effects of continuous feeding of chlorotetracycline to dairy cows (S 127; coop. Agricultural Biochemistry, Statistics)

Forestry

Efficient forest management practices for West Virginia cut-over and burned-over hardwood forest lands (H 36; coop. W. Va. Conservation Commission)
 Timber management for the market demands in southern West Virginia forests (H 56; coop. Island Creek Coal Co.)
 Factors affecting natural regeneration in upland oak types (H 67; coop. Plant Pathology)
 Production of plantation-grown Christmas trees in West Virginia (H 119; coop. Agronomy and Genetics, W. Va. Conservation Commission, W. Va. Christmas Tree Grower's Association, Maryland Departments of Research and Education and Forests and Parks)
 Revegetating spoil banks with forest tree species (H 120; coop. SCS)
 Marketing lumber in West Virginia (H 125, NEM 24; coop. U. S. Forest Service)
 Quality control of lumber dimension in West Virginia hardwood sawmills (H 129)
 Utilization and management of sprout black cherry (H 145)
 Population studies of forest small mammals in West Virginia (H 147)
 Forest fire protection through public interest in game management in southern West Virginia (H 149; coop. Island Creek

Coal Co., W. Va. Conservation Commission)
 Plantings of forest trees and shrubs at Greenland Gap (S 56)
 Determination of optimum growth of West Virginia hardwoods (S 60)
 Conversion of unproductive hardwood stands to desirable forest types (S 107)
 Silvicultural management of Virginia pine in West Virginia (S 126)

Horticulture

Improvement of potato varieties for West Virginia (H 4; coop. Plant Pathology)
 Nutrition of apple trees in West Virginia (H 16; coop. University Experiment Farm)
 Improvement of apple juice (H 21; coop. Agricultural Biochemistry)
 The selection, breeding and propagation of the low-bush blueberry *Vaccinium vacillans* (H 31)
 The effect of certain chemicals on color, finish and maturation of apples (H 39)
 Selection, breeding and propagation of nursery crops (H 59; coop. Reedsville Experiment Farm)
 Effects of herbicides on tree fruits and small fruits (H 116)
 Miscellaneous horticultural investigations (S 27)
 Variety tests of tree and small fruits (S 29)
 Variety and strain studies of vegetables (S 31)
 Lily bulb production trials (S 61; coop. USDA)
 Chemical thinning of apples and peaches (S 69; coop. University Experiment Farm)
 Propagation and selection of edible nut-bearing trees suitable to West Virginia (S 98)
 Testing azaleas (S 112; coop. Reedsville Experiment Farm)
 Turf trials for home lawns (S 116)
 The improvement of Geranium, *Pelargonium hortorum*, through breeding (S 121)

Plant Pathology, Bacteriology and Entomology

The relation of genetics and environmental factors to growth, physiology and reproduction of fungi (H 3)
 Black rootrot of apple (H 9)
 The microbiology of strip mine spoil (H 13)
 Decay as a factor in sprout reproduction of yellow poplar (H 14; coop. Forestry, USDA)
 The nutrition of fungi and bacteria with special reference to substances which induce, stimulate, or inhibit growth and reproduction (H 28)
 The fungicidal efficiency and phytotoxicity of orchard sprays as influenced by methods of application, timing, and environmental factors (H 30; coop. University Experiment Farm)
 Testing new fungicides and insecticides for values as pesticides on small fruit and vegetable crops (H 32)
 Factors influencing losses from root rots of forage legumes (H 51)
 Biology and control of tree-wilt pathogens (H 57, NE 25; coop. W. Va. Dept. of Agriculture, W. Va. Conservation Commission)
 Improvement of tomato varieties for West Virginia (H 58; coop. Horticulture)
 The symbiotic relationships between microorganisms and insect vectors of plant diseases (H 62)
 The structure and function of specialized tissues in insects (H 63)
 Biology and control of nematodes affecting fruit trees and forest seedlings (H 72,

NE 34; coop. University Experiment Farm, USDA)
 Diseases of forage grasses (H 78)
 Arthropods affecting livestock in West Virginia—their distribution and control (H 79; coop. Animal Science, Dairy Science)
 Cereal and forage crop pests—their distribution, incidence and control in West Virginia (H 80; coop. Agronomy and Genetics)
 Virus diseases of sour cherry and other stone fruits (H 89; NE 14; coop. University Experiment Farm, USDA)
 The possible relationship of metallic ion toxicity to drought injury in shade and forest trees (H 109; coop. Forestry)
 The cause and control of "hemlock canker" (H 113)
 The microbiology of farm ponds (H 132)
 Studies of psychrophilic bacteria important in the spoilage of dairy products (H 146)
 Gum defects in black cherry, *Prunus serotina*, Ehrh., associated with attack by shot-hole borer, *Scolytus rugulosus* (Ratz.), and similar or related defects caused by other agents (H 148; coop. USDA Forest Service)
 Miscellaneous plant disease investigation (S 19)

Poultry Science

Broiler rations for high efficiency (H 17)
 Simplified methods of improving initial interior egg quality and shell quality through selective breeding (H 44)
 Improving the reproduction performance of turkeys (H 49)
 Breeding for efficient production of eggs and meats (H 74; coop. Reymann Memorial Farms)
 The effect on hatchability, chick viability and growth rate of fortifying chick embryos (H 111)
 Evaluating crisscross breeding of poultry (H 144)
 Increasing genetic variation in poultry for selection purposes through the use of gamma radiation (H 153, NE-6; coop. Statistics)
 Radionuclide mineral metabolism of chick which differ genetically (S 124)
 Development of economical broiler ration (S 130; coop. Reymann Memorial Farms)
 Nutrition of egg producers (S 131)

University Experiment Farm

The effect of chemical spray schedules on the quality and quantity of apples produced (H 83; coop. Entomology Research Branch of USDA)
 Apple and peach insect control (S 91; coop. Bureau of Entomology and Plant Quarantine)
 Delicious budspot evaluation tests (S 115)

staff of station

April 1962

Administration

Paul A. Miller, Ph.D.
 President of the University
 E. J. Nestus, Ph.D.
 Dean
 A. H. VanLandingham, Ph.D.
 Director

Agricultural Biochemistry and Nutrition

W. R. Lewis, Ph.D., Agr. Biochem.
 Shih-chieh Chen, M.S., Asst in Biochem.

Financial Statement for the Year July 1, 1960 to June 30, 1961

Classification of Receipts and Disbursements	Hatch	Regional Research Fund	Title II	Non-Federal Funds	TOTAL
RECEIPTS					
Received from the Treasurer of the U. S.	\$510,299.00	\$ 93,220.00	\$ 2,000.00	....	\$605,519.00
State appropriations:					
Main Station .....	....	....	....	\$366,497.00	366,497.00
Special (Oak Wilt Research) ..	....	....	....	9,966.00	9,966.00
Special endowments, fellowships and grants:					
Foundations .....	....	....	....	7,700.00	7,700.00
Industry:					
Private corporations .....	....	....	....	16,234.00	16,234.00
Farm and trade associations .....	....	....	....	2,550.00	2,550.00
es .....	....	....	....	186,702.00	186,702.00
Balance forward July 1, 1960 .....	....	....	....	173,707.00	173,707.00
Total Available	\$510,299.00	\$ 93,220.00	\$ 2,000.00	\$763,356.00	\$1,368,875.00

DISBURSEMENTS					
Personal services	\$436,823.77	\$ 51,317.26	\$ 1,734.71	\$362,588.00	\$852,463.74
Travel	11,109.74	7,667.65	230.14	5,765.00	24,772.53
Transportation of things	170.18	164.02	....	914.00	1,248.20
Communication services	270.10	67.72	....	8,300.00	8,637.82
Utilities and utility services	2,334.65	1,604.06	....	28,162.00	32,100.71
Mating and reproduction	11,856.03	5,488.32	17.55	4,339.00	21,700.90
Other contractual services	2,268.12	876.28	....	24,924.00	28,068.40
Supplies and materials	22,177.92	14,348.88	17.60	123,340.00	159,884.40
Equipment	14,192.82	10,778.96	....	34,763.00	59,734.78
Buildings and structures (contr.) .....	....	....	....	....	....
Leases and assessments	8,960.38	....	....	2,379.00	11,339.38
Total Disbursements	\$510,163.71	\$92,313.15	\$2,000.00	\$595,474.00	\$1,199,950.86
Reverted Balances	135.29	906.85			1,042.14
Non-reverted Balances					
Available for 1961-62 ..				\$167,882.00	\$167,882.00

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(Continued on Page 12)

CATERPILLARS

(Continued from Page 8)

collected and sprayed on caterpillar infested trees. Some of the tests have been encouragingly successful.

Weather conditions, especially late frosts and long periods of very hot or cold weather after the caterpillars have hatched, undoubtedly affect the success or failure of the populations.

Whether or not all the complex factors which affect the population are somehow integrated to result in periodic cycles appears doubtful to this writer; however, many people are convinced that definite cycles occur. There are records of heavy populations of the eastern tent caterpillar as early as 1646, and "caterpillar years" are experienced in some parts of eastern United States at annoyingly frequent intervals.

Control Methods in Use

Applied control measures for the eastern tent caterpillar consist of the removal of unwanted apple and wild cherry trees. Spraying the early instars of the caterpillars of both species with almost any insecticide is effective. If the insecticides are applied with care and according to the current recommendations of county agents, there is almost no danger in their use. Burning destroys the tents, a few caterpillars, and usually damages the tree. It is a crude and inefficient control measure and therefore is not recommended.

It is very difficult to predict populations of the tent caterpillar. Winter counts of egg masses will only indicate the possibility of a caterpillar year. If egg masses are plentiful and weather conditions favorable, there should be many caterpillars. Most of the biological control agents do not affect the population until the caterpillars are at, or beyond, the destructive and nuisance size. They serve only to reduce the population before the eggs are laid for next year's caterpillars.

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(Continued from Page 11)

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Edwin Gould, B.S., Entomologist-in-Charge

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Martha R. Traxler, Chief Clerk
R. J. Watts, M.S., Suptr., Off. of Bus. Relations and Records

QUACKGRASS CONTROL

by Collins Veatch
Agronomist

QUACKGRASS, *Agropyron repens* (L.) Beauv., is a real problem in cultivated fields in some areas in West Virginia. It competes with corn and potatoes for water and nutrients, and in potato fields the rhizomes may penetrate the tubers and render them unmarketable. Quackgrass starts growth early in the spring and it may seriously reduce small grain production. Quackgrass may produce a good quantity of acceptable forage in meadows and pastures. However, it will shorten the life of an alfalfa stand, and to prevent spreading it must be cut before seed formation.

Eradication is an expensive process no matter how it is accomplish-

ed. In corn and potatoes it is more economical to control the quackgrass by reducing or eliminating the competition of the quackgrass for the season. Good control over a period of years may lead to eventual eradication.

Quackgrass can be eradicated by shallow plowing and frequent cultivations or fallowing of the infested area, or by chemical sterilization. Methyl bromide fumigation of the soil will eradicate quackgrass and permit immediate reseeding or use of the area. Other herbicides such as calcium chlorate, monuron, sodium trichloro acetate (TCA), and dalapon, when used in sufficient quantity to kill the quackgrass, will leave the soil sterile for varying periods of time, depending upon the quantity of herbicide used as well as rainfall and temperature.

Dalapon (sodium salt of 2,2-dichloropropionic acid) has been used to control quackgrass in potatoes. Grass seedlings may be controlled by applying 3 lb./A of dalapon about a week before the potatoes emerge. Established quackgrass has been controlled in potatoes, with little damage to the potatoes, by applying up to 10 lb./A of 85% dalapon one week before the potatoes emerge.

One of the simplest methods of controlling quackgrass in corn is to make a pre-emergence application of atrazine at the rate of 4 lb./A atrazine (4.8 lb. of 80% atrazine). With this rate of application, some atrazine residue may remain in the soil and reduce the growth of the following crop. To avoid this possibility it is suggested that a pre-plowing application be made of atrazine or amitrole, using 2 pounds of active material per acre. Apply the herbicide about two weeks before plowing. The corn may be planted as soon as the area is plowed. Then make a pre-emergence application of atrazine at the rate of 2 pounds per acre active material (2.4 lb. 80%). This should be followed by one or two cultivations.

Dalapon, at the rate of 4 pounds per acre, may be applied to quackgrass in the fall. This treated area should then be spring plowed and planted to corn, with a pre-emergence application of atrazine as suggested. The application of dalapon in the spring on land for corn may lead to serious damage unless ample time (4 to 6 weeks) is allowed, between plowing and planting, for the herbicide to decompose.