Kentucky FARM AND HOME Science

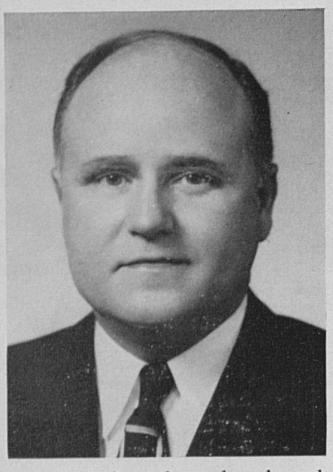
Issued quarterly by the Kentucky Agricultural Experiment Station

SPECIAL PROGRESS REPORT 1

SEE —

JULY, 1955

Greetings from the Director . . .



It is a pleasure to extend greetings and to invite you to read and evaluate this first issue of our new quarterly series of reports on work being done by the Kentucky Agricultural Experiment Station and on related Extension activities.

This quarterly publication is launched as a means of making reports of progress in research and education more readily available to agricultural and other leaders of the state, and thereby to make more effective our program of providing needed information to the public.

Research—carefully controlled investigation of the problems facing farm people—provides the solid base of facts upon which sound progress in farming, homemaking, and rural life can be built. The facts found in research, however, do little or no good until the people who need them actually find out about them and put them to use. Important discoveries which lie hidden in laboratory notebooks or in the minds of only a few people seldom light the way to progress.

By and large, it is the responsibility of the Extension Service in Agriculture and Home Economics to inform the public of results of farm and home research. For this job of information we have farm and home agents in the counties, state specialists, local leaders, homemakers' clubs and 4-H clubs. Demonstrations and meetings are used, and bulletins, magazine articles, news stories, radio talks, television shows, posters and pictures, farm visits and tours—almost every conceivable means of communication to inform farm people and influence them to constructive action in better farming and better homemaking.

One of the most effective means of reaching farm people with the message of better farming and better living, however, is to cooperate with other educational agencies, public and private, in their own approaches to the people. That is to say, the information line from experiment station and extension service to farm people is not always direct. As often as not, the word is carried by farm magazines, daily and weekly papers, radio and television stations, agricultural organizations, other state, federal and local public agencies, churches, service clubs—anyone and everyone with a zeal for economic and social progress in the Commonwealth.

It is toward improving and strengthening this indirect and cooperative way of reaching farm people with the message of research that this new quarterly is aimed. Only a small number of copies are printed, and these of course cannot reach directly any large number of farm readers.

A sound and prosperous agriculture is essential to the health and soundness of our economy and society as a whole. We are therefore in service not only to farm people but to all the people of the state. It is with this principle in mind that we invite your attention to our new quarterly, and solicit your comments and suggestions for improvement.

Sincerely,

Frank J. Welch

Frank J. Welch, Director

IN THIS ISSUE

Burley tobacco growers face a NICOTINE PROBLEM

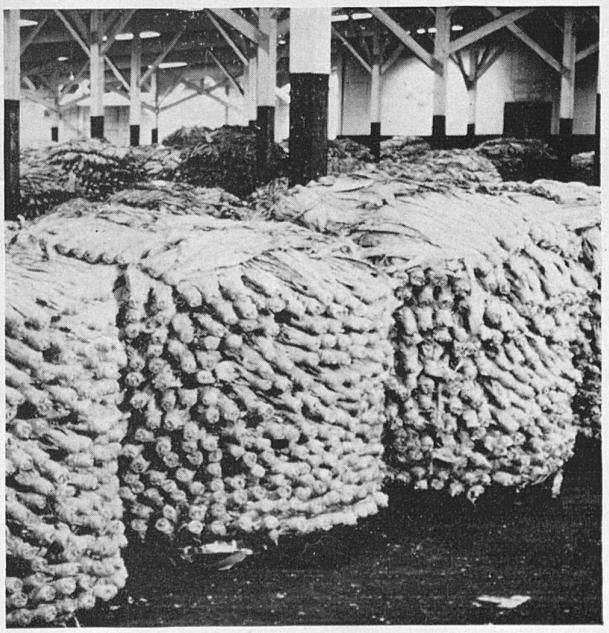
A Statement by the Agronomy
Department of the Kentucky
Agricultural Experiment Station

Since World War II the total annual production of burley tobacco has gradually increased. Despite a reduction of 10 percent in allotted acreage in 1953 and 8 percent in 1954, production in 1954 was the highest ever—about 667,000,000 pounds. At the same time, the average percentage of nicotine in the burley crop has gradually increased, from a desirable average of around 3.0 percent before World War II to averages of around 4.5 percent in recent crops—or even, in dry years, as high as 6.0 percent.

Cigarette manufacturers try to keep the nicotine content of their cigarettes at not over 2.0 percent. This they have done by using a blend of burley with other tobaccos, largely flue-cured, which are lower in nicotine content than burley. But in the past two years the average nicotine content of the flue-cured crops also has been high. This makes it harder for manufacturers to use as much burley in their cigarettes as they would like to use.

Until the last two or three years, more and more cigarettes were used each year by the American public. With this growing demand, the larger and larger crops of burley tobacco could be used eventually, and prices held up well, as they were supported by the government price support program. Now that cigarette consumption has gone down, however, the surplus supplies are becoming burdensome. This past marketing season, 221,000,000 pounds of burley tobacco went to the tobacco pools—were placed under government loans at the support price. This was more than twice as much as ever before. At the same time, manufacturers bought almost as much as usual. But they tried to buy tobacco that was lower in nicotine than the average.

Nicotine content of tobacco crops has been increasing gradually, but on the auction floor it is impossible to tell merely from looking at the tobacco and feeling of it whether it is low or high in nicotine.



Why has nicotine content increased?

Higher average nicotine content of burley tobacco crops in recent years has been the result of changes in ways of growing burley.

The burley tobacco industry in Kentucky was developed on the basis of grass-tobacco rotations. Burley was grown for one or, at the most, for two years on land that had been in sod for several years. Not much fertilizer was used; until after World War I growers still commonly thought that fertilizers "burned" tobacco. Average yields were around 750 to 800 pounds per acre.

After World War I, the use of fertilizers gradually increased and average yields of burley also increased. Production was still largely on land broken out of sod, because until the introduction of Ky 16 in 1936 there was no really good variety of burley resistant to black root rot, a very destructive soil-carried disease. Where yields of burley were from about 1,200 pounds to around 1,600 or 1,800 pounds per acre, the quality generally was best. Nearly always the tobacco was nitrogen-starved at time of topping or shortly after, and the crop ripened quickly after topping. Nicotine content was moderate except in very dry seasons.

This was the kind of tobacco which made a good reputation for burley and led to the later very great expansion of the crop.

Another factor in the quality upon which the repu-

tation of burley was built was the fact that it was first grown almost entirely on deep, well-drained soil of limestone origin. It has always grown best on this type of land. However, as production of burley has spread into other areas, since the nineteen-thirties, a considerable part of the spread has been to land which is neither naturally fertile nor well drained.

Effect of heavy fertilization and "continuous culture"

By around 1940, many growers of burley were realizing the advantages of heavy fertilization for producing large yields, and some had resorted to the practice of growing a variety resistant to black root rot year after year on the same ground in order to increase yield. To increase fertility they turned under cover crops containing either crimson clover or vetch, and they also applied manure, added commercial fertilizers, and returned tobacco stalks. On many fields, any one of these practices would have added enough nitrogen for the crop. Heavy manuring had the effect of gradually building up the nitrogen level of the soil to such extent as to leave a considerable carryover of nitrogen from one year to the next. Yields were increased enormously.

During the war period, when farm labor was scarce, these practices had some justification, for they permitted a relatively small labor force to produce enough burley to meet the needs of the armed forces as well as of the civilian population.

Effect of support prices

With the establishing of support prices for burley tobacco the producers were guaranteed a good income for their product, and they could devote their energies and thought to quantity production rather than to quality. While no doubt most producers still were interested in quality, they quickly learned that so far as dollars per acre were concerned, high yields brought high income, and that high yields were easier to produce than high quality.

Effect of pelletized ammonium nitrate

About the same time that support prices were placed under burley tobacco, a new nitrate fertilizer that was very handy to use came onto the market. This was pelletized ammonium nitrate—an excellent fertilizer, but one that was much higher in nitrogen content than the fertilizers to which farmers had been accustomed. As a result, many farmers with whom the new fertilizer became popular tended to apply more than the crop needed—and probably more nitrogen than they realized they were applying.

Result: Burley no longer the same product

As a result of these changes in growing practices, burley as produced today is, for the most part, no longer a nitrogen-starved crop at topping time. Instead of ripening quickly after topping, it often remains green until cut, and its leaves are high in nicotine and other nitrogenous compounds that make a harsh smoking tobacco.

Why do manufacturers continue to buy high-nicotine burley?

Many farmers are puzzled by the fact that companies have continued to buy burley averaging high in nicotine and have paid good prices for it, while at the same time it is evident that they will have trouble using it in cigarettes. With the control program and price supports it is inevitable that the price of such burley as is bought will be in keeping with the supports. But why do the companies continue to buy the tobacco?

The answer to this is that the companies are taking all the steps they can to avoid buying the tobacco highest in nicotine. Some companies take samples of leaf from the various market areas before the markets open and analyze the samples for nicotine. In areas where the samples are particularly high those companies buy very little tobacco. In other areas they buy more.

Another part of the answer is that it is impossible to tell from looking at tobacco leaves whether they are high or low in nicotine or other compounds that make a harsh smoking tobacco. Buyers have been trained to give preference to leaf of a certain color and texture, but they cannot tell, on the market floor, whether the tobacco they choose will have the chemical make-up their companies want. Much tobacco is purchased which the companies later find difficult to use.

The problem faced by farmers

With every cut in acreage allotments, individual farmers try to side-step the resulting loss in production by aiming at higher yields per acre. This in turn means still more burley tobacco of the type which manufacturers don't want.

Can the situation be improved?

While the damage to the burley tobacco growing industry already is great, in terms of lost demand and lost acreage, there seems to be at least a partial solution to the problem, provided that individual farmers in large numbers will face the facts squarely and set their aims on producing smoking-quality tobacco instead of the highest yields they can obtain.

To produce as high a proportion as possible of smoking-quality tobacco, farmers will need to give up growing burley on the same land year after year, and go back to a system of tobacco-sod rotations.

After a few years in grass and legumes, soil takes on a structure which is ideal for burley tobacco. This

does not mean that it will be necessary for farmers to aim at *low* yields. The very highest quality of burley tobacco can be grown on land broken out of sod, with yields of around 1,800 pounds per acre. Fertility can be kept at a good level on the sodland by proper use of grasses and legumes, fertilizers, and ground limestone. In plots at the Kentucky Agricultural Experiment Station where these practices have been followed, it is not unusual to produce burley all of which is of good smoking grade, and moderate in nicotine. Such tobacco, while not highest in yield, returns more profit per acre than any other grown at the Experiment Station. Farmers can do the same.

Each grower must decide

If individual growers, in large numbers, will take it upon themselves to go after the kind of quality manufacturers want, and to change as soon as they can from continuous tobacco fields to a system of breaking their tobacco land out of sod each year or at least every other year, without piling on more fertilizer than the crop needs, the result will be a gradual building up of burley stocks of better smoking quality and lower nicotine content. Such stocks of burley will permit manufacturers who now are loaded up with burley of undesirable quality to mix in the undesirable stocks gradually and work them off. It will also allow the manufacturers to gradually use the stocks held by the pools without great injury to cigarette quality such as will occur if manufacturers must use the objectionable tobacco in too large quantities at any one time.

It will take time to save the situation and regain the good reputation and demand for burley tobacco—but if the industry is to be saved this is the only way out that now seems practical.

QUICK NICOTINE TESTS aid burley breeding program

By R. B. Griffith, Agronomy Department

What the burley tobacco industry needs today, in the opinion of many people, is a quick and simple test for nicotine that would be practical for testing crops of individual farmers on the market floor. Only with such a test could buyers be sure they were bidding on the kind of tobacco they want. If they could be sure of this, their wants would probably be reflected in the prices they would pay. Farmers, in turn, would have an immediate incentive to produce the kind of burley wanted by the manufacturers.

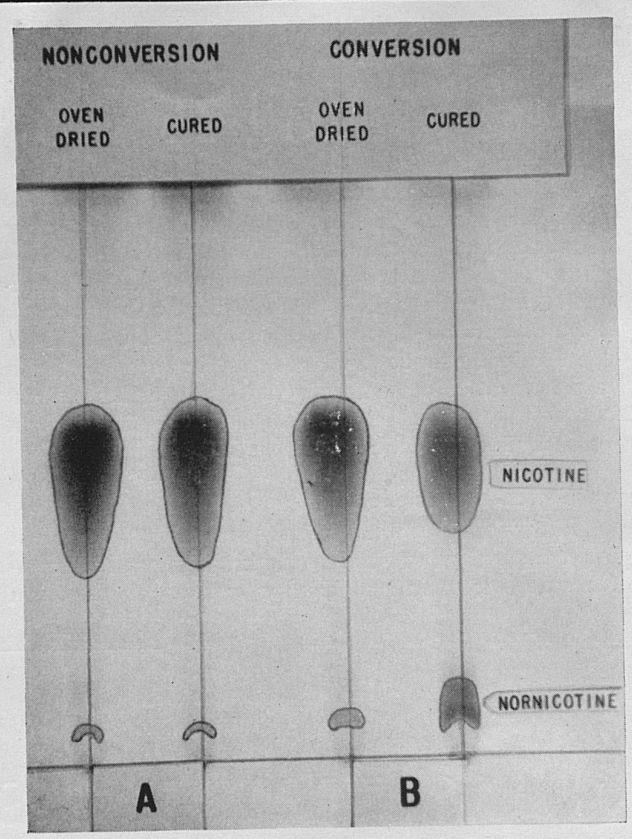
A "quick nicotine test" developed at the Kentucky Station during the past year is not yet rapid enough and simple enough to be practical for testing individual crops on a wide scale on the market floors—but it is a vast improvement over previously used cumbersome methods of analyzing tobacco for nicotine, and has been very useful in the tobacco variety breeding program.

So far, the new method has been used chiefly in finding lines or strains of tobacco within the existing burley varieties which have the characteristic of changing part of their nicotine to "nornicotine" during the curing process. This search was made in the hope that a milder burley could be developed, as it was already known that very little of the nornicotine but much of the nicotine in tobacco is carried in the smoke.

The new method uses a "paper chromatography" technique for separating the nicotine from other, closely related compounds. In the procedure, small drops of sample extract are placed on treated filter paper and through suitable manipulation of the paper the different substances in the sample extract are separated from each other. The different substances become visible and appear as colored spots on the paper. In a carefully made test, the spot of color for the nicotine appears in one position on the paper, while the spot for nornicotine, a closely related compound, appears in another. The size of the spot in each case depends upon the amount of nicotine or nornicotine in the sample. By comparing samples of the same tobacco plants before and after curing, it is easy to see which plants have the characteristic of changing nicotine to nornicotine during the curing process.

During the past year a great many such analyses were made. The plants showing the change of nicotine to nornicotine during curing were classified as "conversion plants." In the breeding program, crosses

A small drop of extract from a tobacco sample is placed near the bottom of a piece of filter paper by Dr. Griffith. After several drops from several samples are placed on the paper it is rolled into a cylinder and placed in a jar containing enough alcohol to wet the lower edge of the paper. The alcohol, as it rises to the top of the paper by capillary action, carries along the nicotine and other closely related compounds. It carries them, however, at different rates for the different substances. The paper is then removed and treated with a gas which causes the nicotine and other substances to appear as colored spots on the paper.



Spots of nicotine and nornicotine from "nonconversion" and from "conversion" plants before and after curing. The samples before curing are labeled "oven dried." Note that for the nonconversion plant the spots of nicotine and of noricotine are the same size before and after curing. This means that in this plant little or no nicotine was changed to nornicotine during curing. For the conversion plant, on the other hand, the spot of nicotine is smaller after curing than before, while the spot of nornicotine is larger after curing. In this plant, some of the nicotine had been changed to nornicotine during curing.

were made between "conversion plants" and plants not having this trait. Tests made on the progeny of these crosses established the fact that the conversion of nicotine to nornicotine during curing is an inherited trait.

In a survey of individual plants within standard varieties, "conversion plants" were found. Various conversion selections were isolated within Ky 16, one of the most popular of the burley varieties. Cigarettes made from unaged samples of these selections were turned over to tobacco companies for smoke tests. In the smoking tests, unfortunately the cigarettes were found to have off-flavors and unpleasant aroma. This was certainly not very promising—although, as the experimental tobacco used was not aged, it is possible that the undesirable flavors and aroma may be eliminated under the conditions of normal cigarette manufacture.

It is therefore too early to say definitely what part the selections based on nicotine-to-nornicotine conversion during curing will have in the improvement of burley tobacco. If the conversion lines do prove satisfactory under normal cigarette manufacturing conditions, they will prove highly useful as lower nicotine selections. If the objectionable flavor and aroma are not overcome, then the "conversion lines" within the present varieties can be eliminated from the varieties. This should improve the flavor and aroma of the remaining lines in the varieties.

Still another possibility exists. It seems likely that lower nicotine selections can be made—selections that do not have the factor for changing nicotine to nornicotine during the curing process. If these breed true, it is possible that lower nicotine selections from standard varieties will be available regardless of the outcome of the conversion lines.

As a result of this work, and also of the work with lines having very low nicotine content, we know that varieties of burley can be developed with almost any nicotine content desired. We can therefore look forward to the time when burley tobacco farmers can produce tobacco of any nicotine level desired—provided always that proper cultural methods are used in growing the crop.

Better Varieties of Burley Tobacco

By W. D. Valleau,
Agronomy Department

In developing wildfire-resistant tobacco varieties, dependable means must be used to determine to what extent the plants are susceptible. Here plant pathologists E. M. Johnson and G. W. Stokes examine a leaf which has been inoculated with the wildfire organism. This variety is susceptible to wildfire, as shown by the dead areas of the inoculated leaf, and will therefore be discarded in the breeding program.

Several disease-resistant burley tobaccos developed by the Kentucky Agricultural Experiment Station now are well known to growers. Ky 16, 22, 26, and 41A have resistance to black root rot. Ky 56, 57, and 58 are highly resistant to black root rot and mosaic. Ky 35 is resistant to mosaic and black root rot, and to the most common strains of the fusarium wilt fungus found in Kentucky. Still higher resistance is desired and, we believe, is present in some of the newer lines.

Wildfire, a bacterial disease that has been destructive in plant beds the past few years, also can be prevented by breeding. Three burley varieties carried under experimental numbers (W.F. 4-51, 17-51, and 12-53) are being tested over the state in variety tests and by farmers. These are also resistant to mosaic and highly resistant to black root rot. Other promising lines resistant to these three diseases and also to fusarium wilt are approaching the test stage.

The fifth disease that we hope to prevent completely by breeding is black shank. High resistance to black shank is found in the wild species *Nicotiana longiflora*. It looks now as though this resistance has been successfully transferred to tobacco by cross-breeding with *Nicotiana longiflora*, as some of the resulting strains show complete resistance in nearly all plants, both in the greenhouse and in the field, where susceptible varieties are killed in total by the disease. In this breeding work, burley and dark varieties having resistance to the other diseases are used as the recurrent backcross parent; consequently, the resulting varieties should be resistant to other diseases as well as to black shank.

Another phase of the breeding program that has promise is the development of burley tobaccos with lower nicotine content. Present varieties are distinctly different in nicotine content, Ky 41A being lowest in nicotine and Ky 26 highest. But within these varieties there appear to be lines that are lower than the average of the variety, and these are being selected and tested to see if they are actually lower. If the desired level cannot be reached by selection within good burley varieties, there is good evidence that, by crossing with lower nicotine tobaccos, burley varieties of nearly any desired nicotine level can be developed.

KENTUCKY FARM AND HOME SCIENCE

A report of progress published quarterly by the Kentucky Agricultural Experiment Station, University of Kentucky, Lexington

Director ..... Frank J. Welch
Associate Director ..... W. P. Garrigus
Administrative Assistant ..... H. B. Price
Editors ..... J. Allan Smith
Jos. G. Duncan
Orinne Johnson

Material appearing in this publication may be reproduced without further permission, provided that full acknowledgment is made of the source and that no change in headings or text is made without approval by the author.

Address correspondence about articles in this publication to either the editor or the authors, at the Agricultural Experiment Station, Lexington, Kentucky.

Tobacco Variety Testing at the Western Kentucky Substation

By Leo A. Link and W. D. Valleau,
Agronomy Department

Burley varieties

New varieties of burley tobacco carrying resistance to mosaic, black root rot, black shank, fusarium wilt, and wildfire are being tested for yield and quality. Comparisons are made with standard varieties grown under the same conditions. The standard varieties used are Ky 35, Ky 16, Ky 57, Ky 58, Ky 26, and Ky 41A. So far none of the new varieties having a high degree of resistance to all five of the foregoing diseases has equaled the yield and quality of the standard varieties when grown on disease-free soil.

In 1954, 10 experimental varieties were compared with the standard varieties, on replicated plots. Included were three experimental lines resistant to wildfire. One of these, WF12-53, ranked fourth in yield with 1,835 pounds per acre. The standard varieties in the test averaged 1,841 pounds per acre and the experimental varieties 1,796 pounds per acre. The highest yielding varieties were BB7-53, 2,021 pounds per acre; Ky 35, 1,976 pounds per acre; and Ky 16, 1,948 pounds per acre.

Dark varieties

Thirty-three standard and experimental varieties of dark tobacco, including both fire-cured and one-sucker types, were grown in yield and quality tests. Some of the experimental varieties have "combined resistance" to black shank, wildfire, mosaic, and black root rot.

On the basis of returns in dollars per acre, which reflect both yield and quality, the top variety in the tests was the widely grown mosaic-resistant one-sucker variety Ky 160, which returned $517 per acre. An experimental one-sucker variety, DB39-51, yielded 118 pounds less than Ky 160, but graded highest of all varieties and was second in value per acre, $498. Of the fire-cured types, Ky 153 was highest, at $474 per acre. Other standard varieties included were Brown Leaf, Madole, Ky 154, Little Crittenden, West Ky 2, and Little Orinoco. Wildfire did not become a factor in the tests this year. Madole was the only variety which showed evidence of mosaic.

Cooperation with U.S.D.A.

The joint program of the Kentucky Agricultural Experiment Station and the U. S. Department of Agriculture for the development of improved disease-resistant varieties of burley and dark tobaccos is now entering its third year. Data are being accumulated on yield and quality of advanced experimental lines in comparison with standard varieties both on the Substation farm at Princeton and in cooperation with farmers in the area. Disease plots in 1954 were located in Todd and Christian counties, and yield and quality plots were located in Henderson and Christian counties.

A new greenhouse, recently constructed on the Substation farm for use in tobacco investigations, should be of considerable aid in the program.

Burley tobacco varieties on the test plots at the Western Kentucky Substation responded somewhat differently to the severe drouth of 1953.

The tobacco at the left in the picture above is growing in various sod rotations. At the right, in the background are plots where tobacco is grown every year. In the foreground on the right are sod plots which will be in tobacco in later years. In these tests the most profitable tobacco is grown in the sod rotations.

BURLEY TOBACCO ROTATIONS

By C. E. Bortner, Agronomy Department

For many years studies at the Kentucky Agricultural Experiment Station have been made of the effect of various grass and legume rotations on the production of burley tobacco. New and different grasses and legumes and new tobacco varieties have been used in the rotations as they have come into common use in farming. In those rotations where adequate phosphorus and potassium were available for the growth of both the tobacco and the grass and legumes, high-quality useful tobacco has been produced with a minimum of nitrogen fertilization. The tobacco has obtained most of its nitrogen from that which had accumulated in the soil during the time the land was in grasses and legumes.

Wide choice of sods

It makes little difference which grasses or legumes are used, so long as grass and legumes occupy the land during most of the rotation. Bluegrass, orchard grass, Kentucky 31 fescue, timothy, redtop, and smooth bromegrass sods have been used with little difference in yield or in composition of the tobacco produced. A farmer thus has a wide choice in the grass he can use in a tobacco rotation. Red clover, sweet clover, Korean lespedeza, and alfalfa have also been used in rotations alone and in combination with grass. Combinations of these grasses and legumes over a period of years have produced tobacco above average in smoking quality.

In the accompanying table tobacco produced in continuous culture is compared with tobacco produced in rotations. These rotations were laid out to study the efficiency of the various sods and cover crops in providing nitrogen for burley tobacco. Fifty pounds of nitrogen applied to the sod increased both the yield and quality of the tobacco, as compared with that grown on similarly cropped land without nitrogen fertilization (treatments 9 and 10). Under continuous culture with a barley-vetch cover crop, 50 pounds of nitrogen was not so effective in the production of smoking tobacco as was the same amount of nitrogen with sod (treatments 10 and 2). When the nitrogen application was increased to 100 pounds in continuous culture (treatment 1), quality improved only slightly over that obtained with the 50-pound application (treatment 2). Neither the value per acre nor the smoking quality of the tobacco produced under continuous culture was equal to that of the tobacco produced on sod land (treatment 10).

Liming to maintain legumes

Liming of plots to maintain a better growth of legumes caused no significant difference in either yield or quality of leaf (treatments 11 and 9). In

Yield, dollar value and amount of smoking tobacco produced under various sod rotations and continuous culture during the 8-year period 1946-53

Treatment[2]	Sod or cover crop	Yield per acre, lb	Value dollars		Percent smoking[1]	
			Per acre	Per cwt.	Total	High quality
	Continuous culture					
1	Barley and vetch: 100 lb nitrogen	1884	971	51.53	80	22
2	Barley and vetch: 50 lb nitrogen	1747	913	52.26	79	19
3	Barley: 50 lb nitrogen	1443	748	51.83	86	22
4	Barley: 100 lb nitrogen	1776	933	52.53	78	27
	2 year rotation: (1) tobacco (2) sod					
5	Sweet clover, limed	1869	1031	55.17	83	32
6	Barley cover crop (clipped), redtop, red clover, and Korean lespedeza sod	1697	965	56.87	92	25
7	Barley harvested for grain, redtop, red clover, and Korean lespedeza sod	1655	929	56.10	91	34
8	Barley harvested for grain, plowed in fall, and crimson clover and winter vetch seeded	1633	900	55.08	79	30
	3 year rotation: (1) tobacco (2 and 3) sod					
9	Orchard grass and red clover	1700	920	54.14	89	25
10	Orchard grass and red clover: 50 lb nitrogen per acre	1887	1054	55.84	90	35
11	Orchard grass and red clover, limed	1706	930	54.52	89	24
12	Alfalfa cut for hay, limed	1812	983	54.26	81	30
13	Bluegrass and alfalfa, limed	1651	909	55.03	92	31
14	Sweet clover, limed	1666	908	54.50	92	25
	4 year rotation: (1) Tobacco, (2, 3 and 4) sod					
15	Orchard grass and red clover 4-year rotation	1757	959	54.61	90	33
	Old sod—Bluegrass sod 60 years old. No fertilizer					
16	Bluegrass sod, 60 years old, no fertilizer	2104	1237	58.80	97	52

[1] Smoking tobacco is that grading L, F or FR in color; high quality is the percent of the total crop that grades trash or lugs of the first three qualities and was L or F in color.

[2] Each received 400 pounds of sulfate of potash broadcast and disked in after plowing for tobacco except treatment 12 which received potash equal to that taken off in the alfalfa hay plus that received by the other treatments, and treatment 16 which received no fertilizer. Produced on Maury silt loam soil. Where soils are low in available phosphorus this element must be added.

using a tobacco-sod rotation it is necessary to lime in order to maintain proper stands of legumes; *however, the liming must not be overdone.* A total of 5 tons per acre was applied to the limed plots in these experiments during the period 1934-54, with never more than 1 ton being applied per round of the rotation. Sweet clover, one of our best soil-building crops, was used in these studies in both a 2-year and a 3-year rotation. The yield of tobacco in the 3-year rotation (treatment 14) was lower, and the total amount of smoking tobacco produced was slightly less than in the 2-year rotation (treatment 5). The amount of high-quality tobacco also was greatest in the 2-year rotation. Since, in the 3-year rotation, there is no cover crop on the land the winter before the tobacco crop, there is some loss of nitrogen from leaching, and as a result the tobacco runs out of nitrogen a little too early.

An additional year (3 years) in grass was somewhat more effective in the production of high quality tobacco than 2 years of grass (treatments 15 and 9). However 2 years of grass plus 50 pounds of nitrogen was more effective in the production of smoking tobacco than an additional year in sod (treatments 10 and 15).

Alfalfa in rotation

Alfalfa was tested as a crop which might be used in a tobacco rotation. It has long been thought that burley tobacco could not be produced satisfactorily following alfalfa. In these experiments, however, it was found that if land is not over-limed in preparation for alfalfa, and if enough potassium is applied for both the tobacco and the alfalfa, results may be excellent. Where tobacco was produced in a short rotation, with the alfalfa harvested for hay, the yield and quality of burley were good, and the alfalfa supplied all the nitrogen (treatment 12). Where bluegrass was included with the alfalfa (treatment 13), the yield and dollar return per acre were reduced somewhat, but the amount of smoking tobacco was increased.

Rotations vs. continuous culture

The 2-year rotations (treatments 5, 6, and 7) give some indication of the value of a year in sod, as compared with continuous culture. The returns per acre were as great or greater than with continuous culture, and the amount of smoking tobacco was greater. The yields following treatments 6 and 7 were relatively low, yet the value in dollars per hundred and as per-

cent smoking tobacco was greater than where barley and vetch plus 100 pounds of nitrogen were used continuously. Treatment 8, though a 2-year rotation, responded quite like continuous tobacco, apparently because the plot was plowed each year though it raised tobacco only every other year.

In a study of rotations one must consider the total income from the land during the cycle of the rotation. In many instances the increased value of hay and forage more than offset decreases in income from the tobacco crop. From very old sodland, such as treatment 16, one sees the potential possibilities of sodland in the production of burley tobacco. While this particular piece of land has been in sod for a great many years, it does not seem unreasonable to believe that by proper handling of rotations the overall fertility of the land can be improved to raise equally good tobacco. Some of the rotations, particularly treatments 7, 10, 13 and 15, are approaching it in percent smoking tobacco.

IMPROVING DARK TOBACCO

By W. D. Valleau, Agronomy Department

The Kentucky Agricultural Experiment Station has had a breeding program for many years looking toward the development of disease-resistant varieties of dark air-cured, fire-cured, and one-sucker tobacco. Progress has been slow because of the necessity of maintaining the thick, heavy leaf of the dark tobacco. Most of the disease-resistant tobaccos that can be used as a source of resistance are thinner and seem to transmit this character to the crosses.

However, as breeding material has accumulated the prospects are improving for introducing disease resistance and maintaining quality in dark tobacco. Mosaic-resistant varieties Ky 151, 152, 153, and 154 are available. Ky 151 is a mosaic-resistant air-cured or fire-cured type that has proved to be very desirable. It seems to be the best of the "150" series, and is the only one that is certified. Ky 160 is a mosaic-resistant one-sucker that appears to be as good as the old one-sucker varieties. Wildfire resistance has also been transferred to the air-cured and fire-cured tobaccos and is being combined with mosaic resistance. No entirely satisfactory varieties are yet available, but tests of new lines at the Western Kentucky Substation in 1954 indicate that rapid progress is being made.

Black root rot resistance has been difficult to transfer to satisfactory varieties of dark tobacco, but a new source of resistance has been discovered in one of the wild species, and now is being transferred successfully to the dark tobaccos. As a result, new dark tobacco varieties are in the making—varieties carrying resistance to the three most destructive diseases of dark tobacco—mosaic, black root rot, and wildfire, or black fire.

Supplies and Use of Dark Tobaccos Grown in Kentucky

By Dana G. Card and Robert Rudd,
Department of Agricultural Economics

Present supplies of dark air-cured tobacco are large in relation to disappearance. About 1½ year's supply is held in government loan stocks, but a smaller proportion of the 1954 crop than of the 1953 crop went under loan. This may have resulted from a crop of much better quality in 1954 than in 1953. The total supply of One Sucker and Green River tobacco as of October 1, 1954, was equal to about four times annual disappearance. The use of these types has been declining for a long time, and stocks have accumulated. Further downward adjustments in production seem inevitable.

Fire-cured tobacco depends more largely on foreign markets than does either burley or dark air-cured. Domestic use has been relatively constant for the past 8 or 10 years. Stocks, as of last October 1, were smaller than for several years, owing to drouth and a short crop in 1953. Government holdings amounted to about one year's disappearance, but the proportion of the 1954 crop going under loan is much smaller than the proportion in 1953. However, world-wide use of fire-cured tobacco is declining gradually, so continued care must be taken to avoid producing more than the market will take at price-support levels.

A Method of Selection for MEAT-TYPE HOGS

By C. E. Barnhart, Animal Husbandry Section

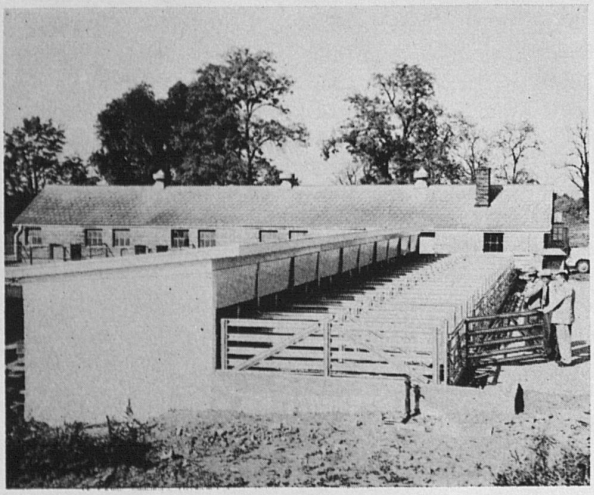
Consumers today want pork with less fat than they commonly find, and more lean meat. Some experiment stations are trying to meet this demand by developing new breeds of hogs, either by cross-breeding of our American breeds or by introducing foreign breeds for crossing.

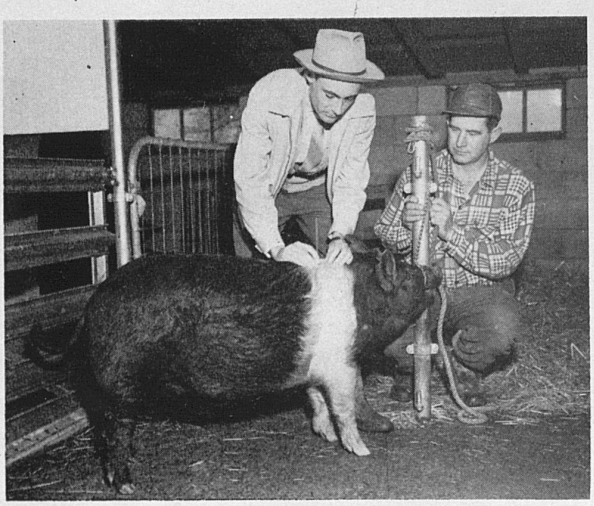
Four years ago the Kentucky Agricultural Experiment Station began a project to explore methods of selection that purebred breeders might use in their own herds to identify superior strains of breeding stock. The purebred Hampshire herd maintained at the Experiment Station farm at Lexington and the purebred Duroc herd at the Princeton Substation compose the breeding units. Birth and 56-day weight records are kept on each litter farrowed. When the litters are weaned, one gilt and one barrow from each litter are placed in a dry lot and self-fed a complete mixed ration until reaching 200 pounds. These test pigs are then taken to the Experiment Station meat laboratory, where they are slaughtered, and detailed carcass measurements are made.

Whether sows and boars remain in the herd is dependent upon their reproductive efficiency as well as the performance of their pigs. Replacements going into the herd are selected on the basis of this information, as well as their acceptability from a breed-type standpoint. Recently, before placing gilts in the breeding herd we have measured their leanness by means of "live backfat probes" as a further attempt to improve the carcass quality of the herd. The "live backfat probe" has proved a reliable guide in predicting carcass quality in hogs, and is a practical method for breeders to use in selecting breeding stock.

Although the Kentucky project hasn't been in progress long enough to establish any definite conclusions regarding the amount of improvement that is being made, however, the data collected to this point are encouraging. Considerable differences in rate of gain, feed efficiency, and carcass quality were noted between the different litters tested at the beginning of the project. By eliminating the poorer performing strains from the herd, it appears that the variability is being reduced and the average level of performance increased. It is encouraging to note that of the 47 test pigs slaughtered the first year of this project, 57 percent produced choice No. 1 carcasses, during 1954, the 30 test pigs slaughtered produced 25 choice No. 1 carcasses or 83 percent.

At left: Swine litter testing facilities at the Experiment Station farm were built with funds from a $25,000 grant from the Henry Fischer Packing Company of Louisville. Two pigs from each litter are fed from weaning to market weight to test rate of efficiency and gain. At right: A promising gilt of the Experiment Station herd is being "backfat probed" by the author, assisted by swine herdsman T. W. Cathey.





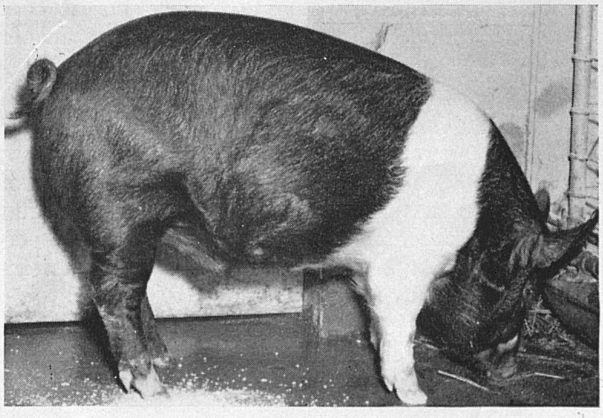
Also, the U.K. experiment has revealed that meat-type hogs make equally fast and as economical gains as fat-type hogs.

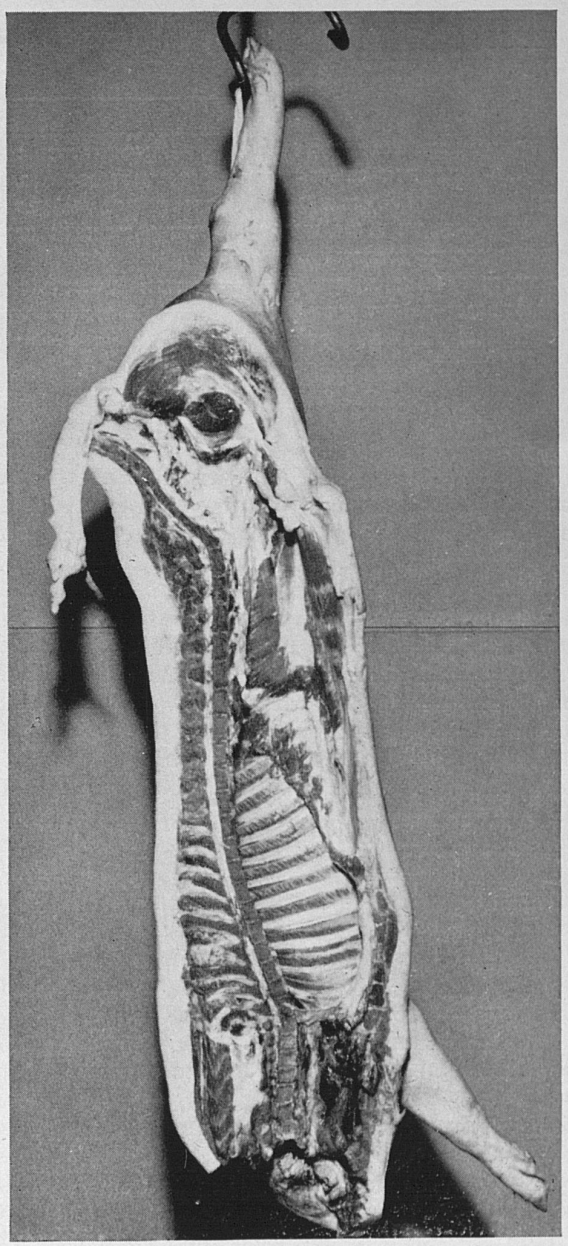
The approach to the meat-type hog problem being taken at the Kentucky Experiment Station is of a practical nature and for the most part can be used by breeders and commercial producers to locate superior producing strains. One purebred swine record association inaugurated a similar program for their breeders this past year. Three more associations have started testing programs this spring. The U. S. Department of Agriculture has recently started a field program in cooperation with purebred breeders and agricultural colleges in the Mid-west in an attempt to locate fast-gaining, economical meat-type hogs for breeding purposes.

Hog producers should have as their goal eight or more pigs per litter that average at least 40 pounds each at 8 weeks, and 200 pounds in 5 to 5½ months. These hogs should make 100 pounds of gain on 300 to 350 pounds of feed. The carcass of a good 200-pound meat-type hog should measure 30 inches in length and have an average backfat thickness not more than 1.6 inches and preferably around 1.5 inches. Fifty to 55 percent of the carcass should be composed of lean meat. The 1954 spring-farrowed pigs tested at the Kentucky Experiment Station produced carcasses with an average backfat thickness of 1.6 inches, a length of 29 inches, 53.4% lean cuts, and an average rib eye of 4.55 square inches. These pigs averaged 1.72 pound daily gain from weaning to 200 pounds.

Swine growers cannot afford to ignore the consumers' challenge to produce a meat-type hog. If they do not meet this challenge, the American housewife will buy less pork and more of other meats. The often-heard excuse, "When the packers pay me for producing lean hogs, then I'll start raising them," is a poor one. It's up to the hog producer to raise high-quality meat-type hogs if they intend to get their share of the consumers' dollar. The research results coming from the Experiment Station project described above should help Kentucky farmers to make this necessary adjustment as rapidly and economically as possible.

Of the first 28 certified Hampshire meat-type litters in the country as a whole, the Kentucky Experiment Station produced six. This is as many as any other herd in the country up to that time.





The 200-pound hog shown at the left is representative of the meat-type hogs being bred in the Experiment Station herd. He made an average daily gain of 1.73 pounds from weaning to a weight of 200 pounds. His carcass (pictured above) had an average backfat thickness of 1.46 inches, a length of 29.13 inches, 58.97 percent lean cuts, and a loin eye area of 6.27 square inches.

Silage Harvesting Costs

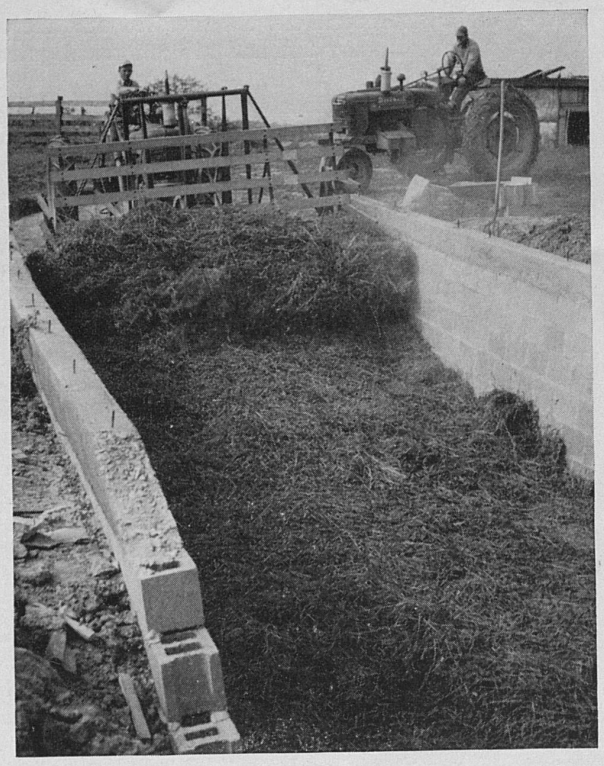
By George R. Byers,
Agricultural Economics Department

Silage harvesting costs vary with method of harvest and storage. Tower silos require elevating equipment not needed for horizontal silos of the trench, bunker, or stack types. Moisture content of silage stored in horizontal silos may be higher than is safe in tower silos unless preservative is used. With higher moisture content of the crop at harvest, direct-cut types of forage harvesters may be used. These reduce mowing and raking costs of grass silage.

In harvesting corn silage with the field forage harvester, the cost averaged approximately $2.25 per ton of silage placed in either the tower or horizontal silo. While no blower is needed in putting silage in the horizontal silo, additional labor is required in handling and packing the silage at the silo.

In harvesting grass silage with the field forage harvester direct cut, the cost averaged approximately $2.00 per ton for either the tower or horizontal silo. If the grass crop is mowed and cured a short period, the cost is approximately the same as for corn silage. Here again the similarity of cost for storing in tower and horizontal silos is due to additional handling and packing of silage in the horizontal silo which offsets the fact that no elevating equipment is needed.

A few cases were observed in storing long grass-legume silage in horizontal silos. Equipment investment and labor requirements were materially lower than in harvesting and storing chopped silage. The equipment consisted of tractors, mower, and high-lift buckrake. This long grass silage method required about 1 to 1¼ man-hours of labor per ton, as compared with 1½ man-hours on the average for the chopped silage. As a result the average cost for the long grass-legume silage handled with the high-lift buckrake was approximately $1.60 per ton.



A high-lift buckrake reduces machinery investment by about half and labor costs by about one-third, in making grass silage in a trench silo.

Control of Strawberry Rots

By W. D. Armstrong, Department of Horticulture

As a preventive of strawberry rotting in the field the material Captan has proved effective in tests, and can now be recommended to commercial growers for trial at the rate of 5 to 6 pounds of 50-percent Captan per acre of berries.

In field tests near Paducah last year, three sprays of Captan at 30, 20, and 10 days before harvest, using 2 pounds of 50-percent Captan per 100 gallons of water, and about 300 gallons per acre, increased the yield of fruit by 40 crates per acre, or from 149 to 189 crates per acre. In other plots, two applications of 7½-percent Captan dust 20 and 10 days before harvest increased the yield by 30 crates per acre.

Rotten berries averaged 7 per foot of picking row in the treated plots and 21 per foot of row in the plots not treated.

What Spacing of Rows is Best for Burley Tobacco?

By George B. Byers, Agricultural Economics Department, and C. E. Bortner, Agronomy Department

Priming burley tobacco increases income per acre by saving high-priced leaves and encouraging the harvest of ripe tobacco. Difficulty in handling the leaves in the field and damage to the standing tobacco, however, have led to an investigation of the influence of width between rows upon quality, yield, and labor requirements.

In a one-year experiment, carried in duplicate, during a dry season, no significant difference occurred in yield and quality from alternating the distances between rows—making one row 56 inches wide and a second row 28 inches wide. For the plots of alternately wide and narrow rows, the average acre-yield for primed tobacco was 2,003 pounds valued at $1,186. For the standard-width rows, 42 inches apart, the average was 2,059 pounds valued at $1,262 per acre.

Labor requirements to harvest and prepare the tobacco for market were less for the alternately wide and narrow row plots than for the plots with standard width rows. For the primed tobacco 292 hours of man labor per acre were required to harvest, cure and strip the tobacco on plots with alternately wide and narrow rows. The standard-width rows required 314 man-hours per acre. For the unprimed plots 178 man-hours per acre were used on the alternately wide, narrow rows in harvesting, curing and stripping, while 189 man-hours per acre were required for the standard-width rows.

Rows spaced alternately 52 inches and 32 inches apart returned about the same yield and income as rows spaced at the usual 42 inches, but required less labor in priming than the 42-inch rows.

With the development of machines to aid in carrying leaves from the field and to relieve the drudgery of this work, the use of wider rows becomes of increasing importance. Further research is needed to determine the best distance between rows for ease and efficiency in priming and for maintenance of economical yield.

TOBACCO INSECT STUDIES

By G. Mallory Boush, Entomology and Botany Department

Hornworms

In the summer of 1954 a series of four replicated field experiments were conducted on tobacco heavily infested with hornworms. Test materials in dust form were applied with a rotary hand duster; those in the form of emulsifiable concentrates were applied as low-pressure, low-gallonage sprays with a knapsack sprayer. Both TDE at 1 pound of the actual material per acre and Endrin at 0.2 pound actual material per acre were included as standards for comparative purposes.

Endrin consistently resulted in a quicker knockdown of hornworms and slightly higher percentage of kill than TDE. Dieldrin, though slow in acting, resulted in fair-to-good control of hornworms and excellent control of grasshoppers. Three days following treatment, Dieldrin gave 83.7, 72.3, and 88.2 percent control of hornworms at application rates of 1½, 3, and 4½ ounces of actual material per acre, respectively. Aldrin resulted in 60 percent control when used at the rate of 1 pound actual material per acre.

Materials which were not very effective at the rates applied were Diazinon at 0.5 pound of actual material per acre, Chlorthion at 1.0 pound actual material per acre, and American Cyanamid compound No. 12008 at 0.5 pound actual material per acre. These materials gave 4, 0, and 35 percent control, respectively.

Aphids

Malathion and lindane were used as aerial sprays, on a field basis, in tests for the control of green peach aphids on tobacco. Malathion was applied at dosages of 1.0 and 1.25 pounds of the actual material per acre, and lindane at the rate of 0.375 pound of the actual material per acre. The rate of application of the spray mixture was, in each case, 2 gallons per acre.

In one field treated with malathion at the 1.25-pound rate and in three fields treated with malathion at the 1.0-pound rate, the control of aphids was erratic. In some parts of the field, control was adequate, but in other parts control was ineffective.

Treatment with lindane, however, was more satisfactory. Forty-eight hours after treatment the reduction in population of the green peach aphid was approximately 80 percent.

Wireworms

Field tests on the control of wireworms in tobacco in 1954 were planned mainly to test the relative advantages of three methods of application of insecticides: (1) using insecticide in the transplanting water; (2) dipping the roots at transplanting time in an insecticide solution; and (3) broadcasting the insecticide on the surface of the ground.

Broadcast tests with granular aldrin, chlordane, and dieldrin at rates of 3, 5, and 1.5 pounds of the actual material per acre were made on three farms in Fayette County. Application was by means of a fertilizer spreader. On two other farms the same materials, at the same rates, were applied to the soil as sprays. As wireworm damage on the untreated check plots in all these tests was very low (below 10 percent), no evaluation of control by the insecticides could be made. As to effects of the insecticides on the plants themselves, no stimulation or toxicity was noted.

Several materials were tested on small plots at the Experiment Station Farm in Woodford County, but again the infestation on the check plots was too variable and low for comparisons of the effectiveness of the materials in controlling the worms. Again, however, observations were made of the stimulation or toxicity effects of the materials on the tobacco plants.

Toxicity effects, possibly influenced by the drouth, were observed on many of the plots. Plants dipped in a suspension containing 2 ounces of actual lindane in 20 gallons of water were stunted and many developed abnormally long narrow leaves. Plants dipped in a suspension of 4 ounces of actual chlordane in 20 gallons of water also were deformed.

Stunting also occurred in tests using emulsifiable insecticide transplanting solutions, except with aldrin emulsion. Eight ounces of a 5-percent lindane transplanting solution on a xylene base in 50 gallons of water killed 36 percent of the treated plants and severely stunted the others. Dieldrin and heptachlor at the rate of 8 ounces of an emulsion containing 1.5 and 2.0 pounds of the material, respectively, per gallon, caused yellowing and stunting of the plants.

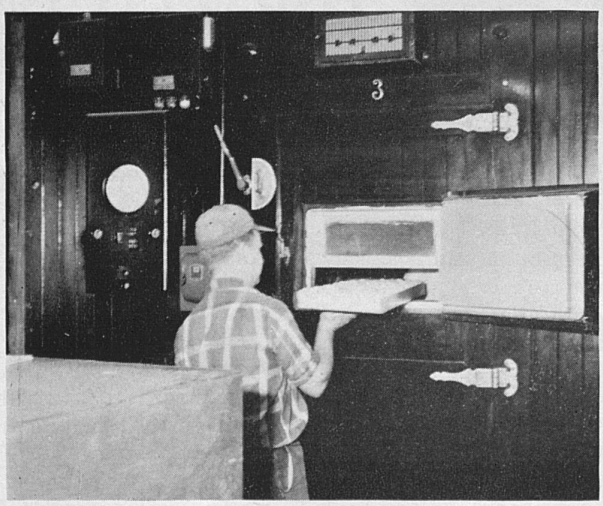
In this connection, 36 solvents were tested in laboratory and field for toxicity to newly set tobacco plants, when used as transplanting solutions. Each solvent, containing 4 percent Triton X-150 or an emulsifier, was used at the rate of 4 ounces of the test solution per 50 gallons of water and applied at the rate of ½ pint per plant. Of the various solutions tested, methyl ethyl ketone appeared to have the least toxic effects on the plants. Dowanol 50 B, methyl alcohol, ethyl alcohol, and ethylene glycol also resulted in no stunting or burning. Skellysolve "B", deobase, and No. 9 oil produced minor local leaf burning, while xylene and carbon tetrachloride resulted in serious burning and stunting of the plants.

Efficient Work Methods in Hatcheries

By George B. Byers, Agricultural Economics Department, and Donald W. MacLaury, Poultry Section

Hatcheries today carry on a mass-production business. In mass production, one of the keys to success, aside from quality of product, is efficiency of operation. Small differences in efficiency of individual processes lead to large differences in total efficiency of the plant. Higher efficiency in hatcheries, in turn, leads to the supplying of healthy chicks and poults to producers, at lower costs per unit. The Kentucky Agricultural Experiment Station, therefore, works closely with hatcheries in studies to improve over-all efficiency of operation.

In a survey of work methods and distances walked in doing work in seven Kentucky hatcheries the following averages were found in the time required for certain operations: To fill one tray of 150 eggs, 12.0



This method of setting eggs requires one man in the incubator and another outside passing the trays of eggs through the door.

minutes; set one tray, 0.5 minute; transfer one tray to hatcher, 2.2 minutes; take off chicks from one tray, 3.0 minutes; clean one tray, 6.0 minutes; make one box, 2.6 minutes.

Intensive study and development of improvements in work methods reduced the work time of several operations. The following comparisons are between the *minimum* time found in the survey and the time taken in the same hatchery after new methods were introduced. Traying time was reduced from 6.7 minutes to 3.4 minutes; setting time from 0.3 minute to 0.19 minute; and box-making time from 1.9 minutes to 1.06 minutes. These improved methods reduced the over-all labor requirement in the hatchery 20 percent.

Work is continuing on possible improvement of the other work methods involved. During the coming year the improved methods will be tried in other hatcheries.

An improved method: one man pushes a rack of trays up a ramp into the incubator, and sets the eggs by himself.

Economics of the BURLEY TOBACCO SITUATION

By Dana G. Card and Robert Rudd, Department of Agricultural Economics

Market demand for burley tobacco is linked closely to changes in domestic cigarette consumption, the form in which most burley tobacco is used. Cigarette consumption, reversing a long upward trend, has declined about 4 percent in each of the last two years. Only once before has consumption of cigarettes declined for two years in a row—and that was during the depression of the 1930's when consumer incomes were at low ebb.

Foreign outlets

In contrast to declining domestic consumption of burley tobacco, export prospects appear somewhat brighter—though exports of burley never have been a very important factor in the burley market. Foreign outlets last year accounted for 5 to 6 percent of total disappearance, the highest in about four years. This year's volume of exports should be at least as large, or larger. Expansion of exports, however, offers little prospect of offsetting losses in the domestic market if cigarette consumption continues to decline. The slight upturn indicated cigarette consumption for the first three months of 1955, as compared with the same three months in 1954, may or may not mean a reversal of the downward yearly trend.

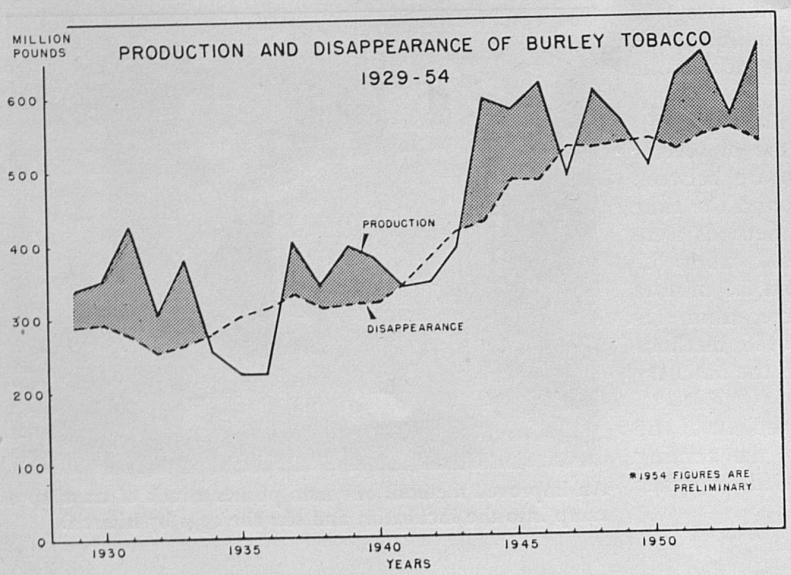
Domestic stocks and disappearance

Taking the decline in cigarette consumption and the fairly favorable export outlook into account, total disappearance of burley next year will probably be equal to this year's disappearance of about 530 million pounds. This figure, matched against the 1954 production of about 665 million pounds, points up one aspect of the surplus problem facing tobacco growers. A recurrence of last year's record burley yields, even with the 25 percent reduction accepted by growers in 1955, would mean a production of burley about equal to this year's expected use. Total supplies of burley are now equal to over 3½ times the total annual disappearance of the leaf, the highest ratio between supply and use since 1940. Production has exceeded total disappearance in all but two of the last 11 years (Fig. 1).

Another element of this problem is the record holdings of burley under loan by the Commodity Credit Corporation, amounting to about 440 million pounds, or almost one-fourth of the entire burley supply. For the 1954 season alone, 222 million pounds, about one-third of the crop, was taken under loan by the Commodity Credit Corporation. This poundage represents record high pool takings for a season, as well as record pool holdings, of burley.

Adjustment of production to demand

Two points which have not been widely discussed have a distinct bearing on problems of effective adjustment of burley production to market demand. The first of these was the break in the long upward trend in cigarette consumption. While this upward

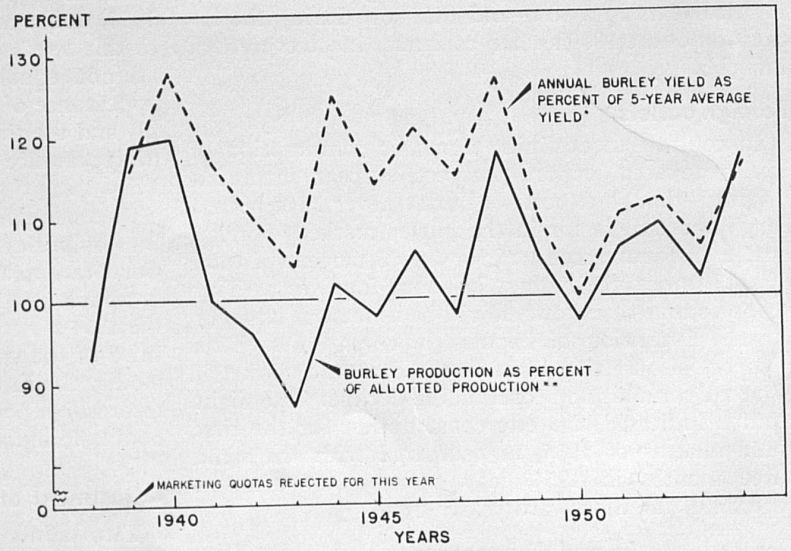


U. S. Production and Total Disappearance of Burley Tobacco, 1929-54: The shaded areas show excess of production over disappearance. Since 1943, production has greatly exceeded disappearance, and this, of course, means a rapid piling up of stocks. This chart does not show the accumulated carryover of stocks from one year to another.

Figure 1

trend prevailed, tobacco processors could safely buy more leaf each year than they would use that year. Over the period 1935-52, production of burley averaged over 20 million pounds per year higher than the corresponding year's disappearance. Once this trend in consumption was reversed, however, manufacturers had to buy more cautiously. They could no longer count on expanding consumption to take care of overpurchasing. Buyers would be expected to buy short relative to purchases in previous years, and pool takings would represent a larger proportion of the market. This in fact seems to have happened in the market season just ended, in which trade purchases appeared to be about 20 million pounds lower than a year ago.

The second point concerns the method of converting national poundage allotment to acreage allotments, which fails to recognize adequately the upward trends in average acre-yields. This failure is caused by using a yield figure which is the average of the preceding five years. In times when yields are going up from year to year, the average for a 5-year period is below



From 1939 to 1954 the actual yield per acre each year was above the average yield of the previous five years, except in 1950 (broken line). This would have resulted in total production greater than allotted production (solid line) except that from 1941 to 1948 growers failed to plant 5 to 15 percent of their allotted acres. Part of this underplanting was due to war-time labor shortages. Since 1948, growers have planted nearly all of their allotted acres and actual production has been larger than allotted production every year, except 1950. Changes in annual production above or below allotted production have followed closely the yearly differences between actual yield and the five-year average.

Figure 2

*THE YIELD FIGURE USED TO CONVERT THE STATE ALLOTMENTS IN POUNDS TO ACRES IS THE STATE AVERAGE YIELD FOR THE FIVE YEARS PRECEDING THE ALLOTMENT PROCLAMATION. THUS THE YIELD FIGURE USED TO CHANGE POUNDAGE ALLOTMENTS INTO ACREAGE FOR THE 1954 CROP WAS THE AVERAGE YIELD OF THE YEARS 1948-52. THE PERCENTAGES SHOWN ARE BASED ON NATIONAL AVERAGE YIELDS, RATHER THAN STATE YIELDS.

**ALLOTTED PRODUCTION IS EQUAL TO THE TOTAL ALLOTTED ACREAGE MULTIPLIED BY THE YIELD CONVERSION FACTOR.

the average yield in the last year of the period. Actual production of burley tobacco has come within the limits of poundage to be expected from total acreage allotted in only one year in the last seven (Fig. 2).

Why has cigarette consumption declined?

This question has, of course, a very important bearing upon the future of the tobacco industry. Unfortunately, no one knows for sure what the answer is. Several explanations, however, are possible, and no doubt each of them is involved to a greater or lesser degree in the reasons for the decline.

Perhaps the most widely offered explanation is the much publicized controversy as to whether cigarette smoking may be a contributing cause of lung cancer. Undoubtedly many persons have reacted to this controversy by reducing their consumption of cigarettes or quitting smoking altogether. Research on this question is currently under way by an independent tobacco-industry group, and the outcome of this research will almost certainly have a strong influence on future trends in cigarette consumption.

Another factor in the situation may be the number of people in the various age-groups in our present population. While the total number of people in the United States has increased about 6½ million since 1952, the number in the group from 20 to 44 years old has remained practically unchanged. Persons in this age-group probably have a higher rate of cigarette consumption than those in any other age-group, and probably a higher percentage of them smoke. During the five years before 1952, the number of persons in this age-group 20 to 44 increased 4 percent. It seems logical to assume, then, that because of this shift in relative ages of our population there would be at least a slackening-off of cigarette consumption during the past two years. As to the future, it seems likely that there will be only a very slow increase in number of people aged 20 to 44 between now and 1960—only about 0.4 percent. After 1960, the increase is expected to be more rapid.

Still other factors in the decline in cigarette consumption may be the recent increases in state and federal taxes on cigarettes, and the use of king-size and filter-tip cigarettes. The present federal tax is 8 cents per pack and some states levy additional taxes of from 1 to 8 cents per pack.

DRY CALF STARTERS

for raising dairy herd replacements

By C. A. Lassiter and D. M. Seath, Dairy Section

Raising high-quality herd replacements, and doing it economically, is one of the keys to successful dairying. The most critical period in the future milking cow's life is her first 12 to 16 weeks. If she gets off to a good start as a calf, comes through this critical period healthy and vigorous, with good growth, her chances of growing into a profitable milk cow are pretty good.

As an aid to dairymen in growing good herd replacements economically, the Kentucky Agricultural Experiment Station has experimented in the development of various dry calf starters to replace part of the whole milk normally fed to calves. A calf raised on whole milk requires 1,000 to 1,200 pounds of milk, while those raised with calf starter need only 175 to 250 pounds of whole milk in addition to the starter. With the starter, good herd replacements can be raised much more economically than is possible with whole or skimmilk. This is especially true for herds from which graded milk is sold.

Replacement of dried skimmilk

In the calf starters commonly found on the market the most expensive ingredient is dried skimmilk. Dried

Calf feeding research and metabolism studies are carried on in one of the loft wings at the Dairy Center.

skimmilk is a very high quality protein feed, and when price relationships enable it to be used economically in calf feeds it certainly deserves a place in them. However, as it is the high-priced ingredient of such starters, the Kentucky experiments were undertaken to find out whether other lower priced ingredients could be used with equally satisfactory results in the raising of herd replacements.

In the tests three products, corn, rye, and milo dried distillers' solubles, were used to replace dried skimmilk in the starters. The basal ration, used as a standard of comparison, was composed of 50 pounds linseed oilmeal, 50 pounds wheat bran, 80 pounds ground yellow corn, 120 pounds ground oats, 100 pounds dried skimmilk, 5 pounds bonemeal, 5 pounds iodized salt, and either 0.5 pound cod-liver oil or 600 grams of a vitamin A and D supplement. In the experimental rations the dried skimmilk was replaced by an equal amount of either corn, rye, or milo dried distillers' solubles. Water and good-quality alfalfa hay were fed in addition to the starter. The calves used were Jersey male calves. Males were used instead of females because the factors to be measured were growth and consumption of feed, and if the calves should not turn out well on the experimental rations they could be discarded without injury to the Experiment Station herd. Forty-four calves were fed on the four rations.

The calves on the four rations made the following average gains up to 16 weeks of age:

	Average daily gain, pounds	*Average increase in— Heart girth (inches)*	*Height at withers (inches)*
Skimmilk	0.98	11.3	6.9
Corn solubles	1.00	10.7	6.7
Milo solubles	0.99	9.9	6.7
Rye solubles	0.85	9.8	6.1

In making these gains, the calves ate the following amounts of feed:

	Average consumption of— Milk (lb)	*Starter (lb)*	*Hay (lb)*	*Pounds of feed per pound of gain*
Calves on skimmilk ration	225.0	195.4	64.9	2.62
Calves on corn solubles ration	220.9	181.1	78.3	2.56
Calves on milo solubles ration	203.7	159.9	83.9	2.43
Calves on rye solubles ration	227.7	166.0	78.2	2.86

All these gains were satisfactory except those made by the calves on the rye-solubles ration. Performance of calves receiving the corn and milo solubles was practically the same as that of those on the skimmilk ration, though the calves on the solubles rations made their gains on slightly less feed per pound of gain. Those on the rye-solubles ration made the poorest gains and had the highest rate of feed consumption per pound of gain. The rye solubles seemed less palatable than the other rations.

Further improvements in starters

The foregoing tests demonstrated that it would be practical to substitute corn or milo dried distillers' solubles for dried skimmilk in calf starters. More tests then were made to determine whether the solubles starters could be further improved. Crimped oats were used instead of the ground oats. Crimped oats appear to be slightly more palatable to calves, and less dusty, than the ground oats. Antibiotics (aureomycin and terramycin) were included. Both Holstein and Jersey, male and female, calves were used in the tests.

The corn-solubles ration used as the standard of comparison in these tests was the same (except for substitution of crimped oats for ground oats) as the corn-solubles ration used in the earlier tests.

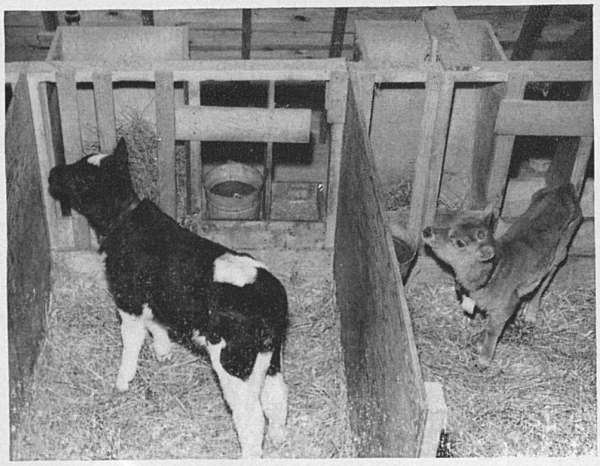
Addition of the antibiotics definitely improved the corn-solubles ration, as shown in the following results for the calves up to 12 weeks of age. The results are summaries from several experiments, involving 44 calves.

	Average daily gain (lb)	*Average consumption of— Milk (lb)*	*Starter (lb)*	*Hay (lb)*	*Pounds of feed per pound of gain*	*Scours (days per calf, av.)*
Corn-solubles	0.98	206.0	130.6	81.7	2.89	133
Corn-solubles aureomycin	1.13	203.2	143.8	85.6	2.68	0.87
Corn-solubles terramycin	1.10	210.0	144.6	70.3	2.61	1.00

In these tests the antibiotics improved the growth rate, feed consumption, and feed utilization of the calves, and reduced the occurrence of scours. Reduction of scours is the most important reason for including these antibiotic products in calf starters. By reducing scours the mortality rate in young calves is reduced, and this in turn means greater economy in producing high-quality herd replacements.

In summary, these various tests show that good healthy calves of normal size can be raised on a feeding system of limited milk, calf starter, and hay, and also that the most expensive ingredient in most calf starters (dried skimmilk) can be replaced by the less costly corn or milo dried distillers' solubles.

Calves in the individual pens are kept comfortable and at the same time entirely isolated from each other.



Fall vs. Spring Treatment of Tobacco Plant Beds for Control of Weeds

By J. F. Freeman,
Agronomy Department

Untreated (left) and Methyl Bromide treated portions of plant bed. Wild grass has crowded tobacco plants out on the untreated soil.

As weather and soil conditions for treating tobacco plant beds usually are more favorable in the fall than in the spring, experiments were conducted with various treatment materials at the Kentucky Agricultural Experiment Station during the 1952-53 and the 1953-54 seasons to compare the effectiveness of spring and fall treatments. The results obtained are given in the accompanying table.

Conditions as near optimum as possible were provided for each treatment in the tests. Each year the bed site was on ground which had been in bluegrass sod for 5 years.

Not including the treatments with cyanamide (which was applied only in the fall, as it is not suitable for spring application), the spring treatments were slightly more effective in killing weed seeds than the fall treatments. The averages were 79 percent kill for fall treatments and 83 percent for spring treatments, the basis of comparison in each case being weed counts per square yard on treated and on untreated beds.

The slight percentage difference in favor of spring treatment is of no practical significance, and is outweighed by the better treating conditions in the fall, the difficulty of applying early enough in the spring for the treatment materials to leave the ground in time for seeding the tobacco, and the better control of wildfire by fall treatment. Furthermore, in one of the two years, methyl bromide was as effective in fall treatment as in spring treatment.

In comparing the different materials, it is interesting to note that thorough burning of plant bed soil gave about as good control of weeds as did gassing with methyl bromide, the most effective of the other treatments.

The drench treatments look promising, but have not proved effective enough in these tests to be recommended.

Calcium cynamide was appreciably more effective at the 2-pound rate than at lower rates.

Good tobacco plants were grown by following recommended plant-bed practices following each of the treatments in these tests.

Control of weeds in plant beds (percentages based on weed counts per square yard in treated and untreated beds)

Treatment	Percent control 1952-53	1953-54
Burned with wood fire		
Fall	....	77
Spring	96	83
Fumigated, methyl bromide		
Fall	94	80
Spring	94	91
Drenched, Chlorobromopropene (CBP) and water		
Fall	77	67
Spring	86	67
Drenched, allyl alcohol		
Fall	77	....
Spring	77	....
Drenched, soluble sodium cyanamide and water, fall	....	74
Calcium cyanamide, applied:		
1 lb per sq yd, fall	58	....
1½ lb per sq yd, fall	78	....
2 lb per sq yd, fall	85	81
No treatment—number of weeds per square yard	747	169

To What Extent is Tobacco of one Type Substituted for Another in Cigarette Blends?

By Robert Rudd and Milton Shuffett,
Department of Agricultural Economics

Since World War I, when the American blended cigarette began its rise to prominence as the major form of tobacco consumption, the exact composition of cigarette blends has been a closely guarded trade secret. It is well known, however, that burley, flue-cured, and Maryland tobaccos are the American tobaccos used in the blend. The question of the extent to which the cigarette types of tobaccos are substituted for one another in the cigarette blend, as indicated by the data on price, supply, and utilization of the cigarette types of tobaccos, for the years 1933 to 1952, is being studied by the Kentucky Agricultural Experiment Station.

Burley producers are now much interested in this question. On the one hand, mounting stocks of cigarette leaf confront the domestic market and, on the other, rising agricultural self-sufficiency in other parts of the world points to possible losses in the export market for flue-cured tobacco, burley's principal competitor. About 40 percent of total production of flue-cured tobacco now is exported.

Simply stated, the means of determining the extent of substitution among types of tobaccos are the shifts in use among the types in response to changes in relative prices of those types. Statistical tests along this line suggest that year-to-year purchases are made by manufacturers as though substantial substitution were possible between flue-cured and burley tobaccos. However, when total supplies and disappearance rather than annual purchases are considered, the evidence points to the use of cigarette types in relatively constant ratios. These two sets of findings are not inconsistent in view of the manufacturers' practice of holding stocks for aging and blending purposes equal in amount to two or more years' utilization.

While these relationships among cigarette types of tobaccos existed during the 20 years 1933-52, there is no evidence that such relationships hold now or that they will be maintained in the future. The current decline in consumption of cigarettes and the large supplies of leaf tobacco relative to use, may lead manufacturers to attempt adjustments in blends so as to take advantage of price or quality differences in the types of tobacco. Such incentives were present throughout the period studied, but the opportunities for varying blends were perhaps limited by lack of aged leaf while cigarette consumption was rapidly expanding.

Control of Tobacco Suckers

By C. E. Bortner, Agronomy Department

Mineral oil in various forms has been tested for several years as a means of controlling sucker growth on tobacco. While control of suckers has been moderately successful, damage to the leaves and stalks has also been considerable. Use of the oil has sometimes led to stalk rot; at other times it has caused the leaves to drop.

All of this testing of mineral oil for control of suckers has been done in the relatively dry seasons of recent years. Therefore, nothing can be said about the quality of tobacco or the degree of sucker control which might be expected from use of mineral oil in wet or even in normal seasons. No recommendations are made for the use of mineral oil in control of suckers on tobacco.

Another material tested to a limited extent for control of suckers in tobacco is maleic hydrazide. While a fair degree of sucker control has been obtained with this material, chemical studies are yet to be made to determine what effect, if any, the material has had on the chemical composition of the tobacco. Until maleic hydrazide has been thoroughly tested, no recommendations will be made for its use on tobacco in Kentucky.

Growers are interested in chemical means of controlling suckers of tobacco in order that they may reduce the labor expended for this purpose. Nevertheless, it must be remembered that burley tobacco has come to prominence as a crop produced with suckers allowed to grow from time of topping until harvest. The growing suckers affect the chemical composition of the rest of the plant. For instance, when allowed to grow they tend to hold down the nicotine content in the rest of the plant.

Use of chemicals which would prevent all sucker growth might therefore change the chemical composition of the plant so as to make the leaf less desirable or even useless in the manufacture of products in which it now is used. Growers cannot afford to lose sight of this quality factor.

New Disease of Apples in Kentucky

By W. D. Armstrong, Department of Horticulture

A new disease of apples has been found to be causing serious damage in some Kentucky apple plantings as well as in Indiana, Illinois, and other nearby states. The organism *(Botryosphaeria ribis)* causing this disease, known as currant cane blight, has a wide range of hosts and causes a characteristic bark canker and a soft type of fruit rot. In Kentucky, bark damage and limb and twig killing have been most severe on Rome, Paducah, and Golden Delicious varieties, and fruit rotting has been serious on Golden Delicious, Red Delicious, Rome, Paducah, and others in few orchards.

This trouble has been noticed only recently but has spread rapidly within plantings. It is thought that the after-effects of the severe winter of 1950-51 and of the severe drouths of the past three years have made the trees more susceptible to the canker phase of the disease. Little is known so far about control of the canker phase, but captan and zineb seem to be helpful in curbing the rotting of the fruit.

Studies of this disease are being made in several midwestern states.

Earlier Yields of Market Tomatoes

By Clyde Singletary, Department of Horticulture

In an attempt to induce earlier yields, tomatoes being grown in northern Kentucky for early market were treated with a spray composed of boron, corn sugar, and a fruit-setting hormone in combination with the insecticide parathion and the fungicide manzate. Treatment was applied on May 20 and May 25, 1954, with a knapsack sprayer. Check plots were sprayed with parathion and manzate only.

The first fruits were harvested July 2 and another harvest was made July 6. Yield of these two harvests from the plots receiving the full treatment averaged 1326 pounds per acre. The fruits averaged 5 ounces each and 85 percent were marketable. In contrast, only 136 pounds averaging about 2 ounces each were harvested on these same dates from the plots treated only with parathion and manzate, and few of these were marketable. However, the *total* yield (early plus later harvests) from the plants given the full treatment did not differ significantly from the yield of plants treated only with parathion and manzate.

Treatments in the field and in the greenhouses at Lexington have given about the same results, but the tests in northern Kentucky demonstrated the importance of having the chemicals together in solution and applied as a whole plant spray. When the chemicals were applied separately, one following the other, the effects were not so pronounced as when they were mixed together.

Nimblewill in Bluegrass Lawns

By James Herron, Department of Entomology and Botany

Nimblewill *(Muhlenbergia schreberi)* is a fine-stemmed perennial grass troublesome on lawns. Tests were begun last year to control this pest in mixed bluegrass and nimblewill turf. Several materials, at different rates of application, were applied as sprays at the end of May, June, July, and August. Materials used were potassium cyanate, maleic hydrazide, TCA sodium salt, alanap, sodium chlorate, and premerge.

In November, at least 80 percent of the top growth of nimblewill was killed on plots treated with either maleic hydrazide at rates of 40 or 60 ounces per 1000 square feet, or TCA sodium salt at the rate of 10 ounces per 1000 square feet. Top growth of bluegrass had been injured, but was recovering. On plots treated with the other materials in May, June, and July, both the bluegrass and the nimblewill were injured, but both were recovering.

Grass on plots treated August 31 with potassium cyanate, maleic hydrazide, and TCA was severely injured and had not recovered by November 12. On the plots treated August 31 with premerge or with sodium chlorate there was no evident injury to either the bluegrass or the nimblewill.

Penalty for private use to
avoid payment of postage $300
KENTUCKY
AGRICULTURAL EXPERIMENT STATION
LEXINGTON, KY.
FRANK J. WELCH, Director

FREE—Report of Progress.
Ky. W-7-55—3,000
Permit No. 1109

TO

POSTMASTER: Please return free if unclaimed. See Postal Laws and Regulations.

New Facilities at the Western Kentucky Substation

Recently completed structures at the Western Kentucky Substation, near Princeton, will greatly enhance the performance of several research projects. The new facilities were made possible by a grant of funds by the State Building Commission in 1954. Shown here are (right, top) swine litter testing pens, (right, middle) feed processing and storage building, and (right, bottom) a portion of the new greenhouse. Also shown (below) is the addition to the administrative building to provide quarters for Extension specialists working in western Kentucky.