TOBACCO

The flue-cured tobacco research program at the Georgia Coastal Plain Experiment Station is a cooperative project in which the Division of Tobacco and Plant Nutrition, Bureau of Plant Industry, of the United States Department of Agriculture and the University of Georgia College of Agriculture are engaged.

The program is divided into two phases: First, soils, fertilizers, varieties, and rotations; second, disease control. In the following report which is primarily a progress report, general recommendations of the Station are included for the benefit of tobacco growers who wish to use this publication as reference.

RECOMMENDATIONS

Soils: High quality flue-cured tobacco can be grown only on light sandy soils that have bright yellow to orange colored subsoils. In the Coastal Plain of Georgia the predominating soils of this type are the Norfolk and Tifton series. The best types of these two series are the Norfolk sandy loams and loamy sands and the light phases of the Tifton sandy loams. The coarse sands are too open and too low in water holding capacity to produce tobacco profitably. The typical pebbly Tifton soils are too heavy to produce good quality tobacco. Regardless of the type of soil used it should be low lying enough to have a good supply of moisture but with elevation sufficient to warm up quickly in the spring. It should also be soft and mellow with a low ammonia (nitrogen) reserve.

Varieties: A number of varieties under proper conditions, will produce the thin highly colored leaf now demanded by the manufacturers. The most satisfactory of these are the Jamaica, Gold Dollar, Bonanza, Virginia Bright Leaf, Yellow Mammoth, and Yellow Pryor. The heavier varieties include Warne, Gold Leaf, Adcock, White Stem Orinoco and the Gooches which produce a heavy red type of tobacco in little demand on the Georgia markets.

Plant Beds: The seed-bed is the foundation of the crop and every reasonable effort should be made to produce a good supply of early, thrifty plants. Within certain limits the rate of growth of tobacco seedlings is governed largely by the location of the beds. Regardless of moisture present and fertility of soil used, plants in beds sloping to the north, or plants in beds shaded by trees or buildings will not grow as fast as those on a bed with a south or southeastern exposure with no shade.

The best soils for seed-beds are the deep loamy, moist soils commonly known as “gallberry land”. Soils that have washed down from adjoining fields are likely to be heavily infested with nematode and are therefore to be avoided.

Sterilization of the seed-bed is highly desirable and should be done wherever practical. This may be accomplished by steaming the soil or by burning wood or any other available combustible material on the bed. Heat will penetrate the soil more readily if it is loosened before the heat is applied. Soil can be effectively loosened with a spade or plow stock, but should never be turned as the turning process puts the top and most
fertile part of the soil out of reach of the shallow feeding roots of the seedling. If sterilization of the soil is not practiced, seed-beds should be located on new soils each year.

Rate of fertilization of seed-beds will depend on the method of handling. Old beds that are sterilized and used year after year accumulate considerable residual fertilizer and therefore require a smaller annual application than new beds. Old beds require about 1 to 2 pounds of commercial fertilizer per square yard, while new beds require from 2 to 3 pounds per square yard. Plant bed fertilizers should have the potash derived from some source other than muriate or kainit.

Seeding should be done in late December or early January, at the rate of one tablespoonful of good clean seed per 100 square yards of seed-bed area. The seed should not be covered except by rolling with a heavy roller or tramping with the feet. Tobacco seed will not germinate unless the surface of the bed is moist.

FERTILIZERS

Phosphorus. Soils of the Coastal Plain that have never had an application of phosphorus contain little or no available phosphorus and therefore produce little or no growth of the tobacco plant. Phosphorus increases the rate of growth, size of plant, and promotes normal ripening or maturity. Plants grown without sufficient phosphorus are slow to start growing, never mature properly and produce small green leaves that are worthless.

Experiments with varying rates of phosphorus applications show that while 40 pounds of phosphorus (P₂O₅) will produce approximately as much yield as double this amount, it takes from 80 to 100 pounds of phosphorus (P₂O₅) per acre to produce both optimum yield and quality. The recommendation of an application of 800 to 1000 pounds per acre of a fertilizer analyzing 10 per cent phosphorus is based on these findings. Any form of readily available phosphorus is satisfactory as long as the calcium and sulphur requirements of the plant are satisfied.

Nitrogen: The terms nitrogen and ammonia both mean the same thing when used in relation to fertilizers except that ammonia is only 82.3 per cent nitrogen.¹ This plant food is used almost entirely to increase the size of the tobacco plant and thereby increase the quality insofar as size will permit. Excessive applications of nitrogen increase the size of the leaf to such an extent that quality is destroyed. Light applications of nitrogen reduce the size of the plant but do not materially reduce the quality. The ideal application is one that combines optimum yield and quality and will vary with the nitrogen reserve in the soil. On average soils 24 to 27 pounds of nitrogen per acre are sufficient, or in terms of field applications 800 to 900 pounds of a fertilizer analyzing 3 per cent nitrogen. On light sandy soils the application may be increased.

¹Footnote: Recent changes in Georgia laws governing the labeling of fertilizers require that all fertilizers be labeled in terms of nitrogen and in whole numbers only. This change will require some adjustment of formulas on the part of the manufacturers and of per acre applications on the part of the growers. It is believed that the simplest solution is to raise the nitrogen to 5 per cent and both the phosphoric acid (P₂O₅) and potash (K₂O) to 10 per cent and apply at the rate of 800 to 900 pounds per acre. This will give practically the same plant food per acre as was applied in 1000 pounds of the old 8-3-8 formula made on the ammonia basis.
to 30 to 33 pounds nitrogen per acre either by using heavier applications or higher analysis goods.

Certain nitrogen carrying materials are objectionable and without going into detail as to why these materials are objectionable it is sufficient to say that the nitrogen in flue-cured tobacco fertilizers should be derived as follows:

One-third from high grade organic materials such as cottonseed meal, fish meal and high grade tankage, and two-thirds from a combination of inorganic nitrates and urea, or inorganic nitrogen alone.

**Potash:** This element has a direct bearing on the quality of flue-cured tobacco. Extreme potash deficiency becomes evident as soon as the plant begins growth and is characterized by reduced growth, rough crinkled leaves that fire around the margins and between the veins. This firing gradually increases in scope until the whole leaf is involved. However, very often potash deficiency symptoms occur and materially lower the quality on fields of tobacco that have an application of 1000 pounds of fertilizer analyzing 5 per cent potash. Experiments show that potash may be applied profitably at rates as high as 120 pounds K\textsubscript{2}O per acre or 1000 pounds per acre of fertilizer analyzing 12 per cent potash. There is little danger of damage from excessive applications of this element as is the case with nitrogen.

Potash materials carry elements other than potash and it is these elements that determine the potash materials to be used in tobacco fertilizers. Two per cent chlorine is desirable in flue-cured tobacco fertilizers and since nitrate of potash is a source of chlorine as well as potash, enough of this material should be used to supply the desired amount of chlorine. The same amount of magnesia (MgO) as chlorine is desirable and may be derived from sulphate of potash magnesia in the same way that chlorine is derived from nitrate of potash. The remaining potash may be derived from any other available form that does not contain chlorine.

**Magnesia:** A deficiency of magnesia causes a characteristic fading out of the green coloring between the veins on the lower leaves of the tobacco plant. This bleached appearance known as “sand droun” advances upward on the plant until all of the leaves are involved. “Sand droun” is not a very prevalent deficiency in Coastal Plain soils of Georgia but is known to occur and should be guarded against. It is therefore recommended that all flue-cured tobacco fertilizers contain two per cent magnesia (MgO), one-half of which should be water soluble. Sulphate of potash or other soluble magnesia salts are satisfactory sources of the water soluble magnesia while dolomitic limestone may be used for the water insoluble portion.

**Chlorine:** This element increases the spread of leaf and vigor of the plant when used in small quantities. However, excessive quantities destroy the burning qualities of the leaf and may, under drought conditions, retard growth and cause the leaf to become thick and fleshy and curl upward. Twenty pounds of chlorine per acre seem to be about the optimum application or 2 per cent in a 1000-pound fertilizer application. The proper source of chlorine has been discussed under “potash”.
Animal Manures: These materials when well rotted, finely pulverized and judiciously used have no equal in improving the quality of flue-cured tobacco. Manures (cow or horse) should be applied at a rate of 2 to 3 tons per acre in the row about two weeks before applying the commercial fertilizer. It should be covered and left until the fertilizer is applied. In applying commercial fertilizers the manure application should be disregarded and the same amount of fertilizer used as if no manure had been applied.

Fertilizer Formulas and Rates of Applications: Summarizing the foregoing discussion of the various elements it is evident that flue-cured tobacco fertilizers should contain approximately 10 parts phosphorus (P₂O₅), 3 parts nitrogen, 10 to 12 parts potash (K₂O), 2 parts magnesia (Mgo) and 2 parts chlorine (Cl). These proportions are percentages or parts per hundred. The rate of fertilization will be governed by the soil. On light Norfolk soils applications as high as 1100 pounds per acre may be used profitably while on heavy soils a minimum of 800 pounds is recommended. Soils too heavy for the 800 pounds per acre application should not be used for tobacco.

SPACING AND TOPPING

Spacing in Drill and Row: Attempts have been made experimentally to increase the yield per acre by using heavy fertilizer applications and increasing the number of plants per acre. There are no advantages in spacing the rows closer than 4 feet and the plants closer than 22 inches in the row. Closer spacing increases the yield slightly but is offset by a decrease in quality. The crowded condition of close spacing causes the plants to grow long slender weak stalks and thin lifeless leaves.

Topping: In recent years there has been a tendency among some growers not to top tobacco. In seasons of abundant rainfall plants that are not topped may make a desirable type of leaf. However, in dry weather the greater leaf area of plants not topped causes them to suffer much more from drought than plants which have been topped. It is therefore advisable to always top the plants except where individual plants are excessively rough.

CURING

The wide variations in conditions that govern the procedure to be followed in curing flue-cured tobacco make it impossible to give a schedule that will apply except in a general way. Such a schedule may be had upon application to this Station.

Progress Report of Tobacco Experiments Begun in 1933.

The foregoing is a summary of recommendations based on all of the work with tobacco fertilizers previous to 1933. Much of the work was revised at this time, the results of which will be published in the near future. The following is a general trend of results to date.

Footnote: In previous publications the formula 8–3–8 or 8–3–12 has been expressed in terms of phosphoric acid, ammonia and potash in the order named. Substituting the term nitrogen for ammonia and rearranging the order this is the same as 2.37–8–8 or 2.37–8–13 in terms of nitrogen, phosphoric acid and potash in the order named.
Ammonia Tests: In previous tests horse manure as a partial source of ammonia, gave such excellent results, that tests were planned to determine just how far it was possible to go in using it as a source of ammonia. Results indicate that both cow and horse manure are excellent sources of ammonia and may be used for the total ammonia needs which require about 5 tons per acre, or as the organic part of the nitrogen supply which requires about 3 tons per acre. Two tons of manure per acre serve as a profitable supplement to the normal commercial fertilizer application. In all cases the manure should be well rotted, finely pulverized and applied in the row two weeks before the commercial fertilizer is applied.

Cottonseed meal as a source of all the ammonia in tobacco fertilizer produces excellent quality but in certain seasons yields were lower than desirable. There is practically no difference in the values of the two sodium nitrates as sources of ammonia. Ammonia from urea-ammonia-liquid-impregnated superphosphate does not leach as badly as the nitrates and therefore is decidedly advantageous during periods of heavy rainfall early in the growing season.

Complete Fertilizer Tests: These tests involve the omission and varying rates of potassium, sulphur, calcium and magnesium and the omission of chlorine and boron. Results strongly indicate that there are certain ratios that should exist between all the elements in a fertilizer and that the maximum efficiency of one element is not dependent upon the quantity of it present but upon the presence of other elements in definite quantities. The omission of sulphur gives typical deficiency symptoms similar to drought spot together with a yellowing of the leaves early in the growing season. Apparently excessive sulphur has no objectionable effect.

Fertilizer Formulas: The only significant finding of these tests over the previous tests is the fact that considerably more potash may be used than was once believed necessary. It is recommended that the potash content of flue-cured tobacco fertilizers be 8 per cent or higher.

Fractional Applications of Fertilizer: Many field crops which grow over a longer period of time than tobacco are distinctly benefitted by splitting the fertilizer application into two or more parts and applying one or more top dressings during the growing season. Due to the nature of flue-cured tobacco and the rapidity of its growth it is only under rare conditions that splitting the application or top dressing is justified. Severe leaching by excessive rain soon after the fertilizer has been applied or where the initial application was too small, are about the only occasions that will justify additional applications. Such applications should be made as soon as the need is known and certainly not later than twenty days after transplanting. The amount and rate of application will depend entirely on the deficiency to be corrected.

Fertilizer Placement Tests: Placing the fertilizer in close proximity to the root system will cause heavy mortality of plants during a dry season. When wet weather prevails soon after transplanting, the soluble salts in the fertilizer are dissipated rapidly enough to avoid any toxic effect. Placing the entire fertilizer application on one side of the row resulted in some one-sided plants and leaves. Placing the fertilizer 2½ to 5 inches to the side of the roots is only slightly superior to placing it in the row and
thoroughly mixing it with the soil. In the absence of suitable machinery for side placements it is recommended that the latter practice be followed.

Potash Sources: The potash source tests have become so involved with the use of sulphur and chlorine that these tests are no longer considered of any value. The secondary elements contained in these sources are being studied under complete fertilizer tests.

Phosphorus Sources: Response of the tobacco plant to phosphorus is striking. With slowly available forms such as basic slag and soft phosphate (raw rock phosphate), the plants are decidedly slow in maturing and ripening. However, the final growth is large and luxurious but the quality poor. Superphosphate, triple superphosphate and di-calcium phosphate all promote quick growth and ripening with little perceptible difference in the three.

Boron Tests: Boric acid applied at the rate of 4½ pounds per acre showed no beneficial or toxic effects. Applications of 21½ pounds per acre showed slight toxic effect by reducing early growth but no effect upon plant mortality. Double this amount in 1935 showed decided toxic effects.

TOBACCO DISEASES

The 1937 plant-bed season witnessed the most severe epidemic of tobacco blue mold (downy mildew) that has occurred in the United States. Many beds were destroyed completely, while approximately 80 per cent of all the plants in the State were killed outright by the disease. Due to a mild January the causal fungus (Peronospora tabacina) began to develop much earlier than usual. First symptoms were observed in an old seedbed in Berrien County January 25, at which time the disease appeared to have been present for at least ten days. From the last week in January until the first of April, temperatures were favorable for optimum fungus development, and during this time every plant-bed in the State was affected. Because of many very early beds and the mild season, some plants were almost large enough to be put into the field five weeks earlier than normal. Disease development occurred in some beds before the seedling leaves were more than one quarter inch in size; in others not until some of the plants were nearly large enough to set; and in all instances loss of plants resulted. This was the first year in which such large seedlings were observed to be killed outright. In general, however, higher percentages of the smaller seedlings were lost. Plants not killed outright were slow in recovering, and transplanting was delayed from two to five weeks later than the normal. During this period of delay, temperature and soil moisture conditions were favorable for transplanting, with the result that good stands were eventually secured in most fields and a fairly good crop produced. Growers continued setting the scattered plants left by mold, until almost a normal acreage was planted. However, in some instances, it was necessary to bring in plants from Florida and South Carolina, this resulting in still further delay. Many growers failed to set their expected acreage. Occasional spotting of leaves due to blue mold was observed in a few fields of tobacco early in the season, but this resulted in no actual damage.

Damping off (Rhizoctonia sp. and Pythium sp.) caused slight losses in a
few tobacco beds in January, at a time when the seedlings were small. Root-knot (*Heterodera marioni*) developed to some extent on the roots of tobacco seedlings during the latter part of the delayed plant-bed period. Many slightly affected seedlings were set in the field during late April and in May, and the majority of these produced normal stalks of tobacco.

The most important field disease in Georgia was root-knot, although it was slightly less prevalent than in 1936. While there was an estimated loss of 4 per cent due to this disease in 1937, it was present to some extent in every field examined in the State. Sore shin (*Sclerotium rolfsii* and *Rhizoctonia* sp.) was the second most important field disease. It began to develop in most fields during July and caused an estimated loss of about two per cent of the crop. Frog-eye leaf spot (*Cercospora nicotianae*) appeared throughout the belt during the last month of the growing season, but caused no appreciable damage. This disease usually is pronounced on late crops. More Granville wilt (*Bacterium solanacearum*) was observed in 1937 than in any previous year. It was present in at least five per cent of the fields observed in the southern part of the State. Since only occasional affected stalks were found, actual damage was negligible except in one field where a 25 per cent loss resulted. This disease has never been an important one in Georgia. Only a few stalks of Fusarium wilt (*Fusarium oxysporum var nicotianae*) and black shank (*Phytophthora parasitica var nicotianae*) were observed in the State, while mosaic (*virus*) was almost entirely absent except on the suckers late in the season. These three diseases have not been of any economic importance in Georgia flue-cured tobacco within the past nine years.

*At left perfect stand protection was secured by spraying.*
*At right blue mold killed 41% of the tobacco plants and delayed transplanting one week. Pictures made March 26, 1938.*
BLUE MOLD CONTROL BY SPRAYING

Several spray mixtures which may be prepared at home from certain vegetable oils, a suitable spreading or emulsifying agent, and the proper form of cuprous oxide have been found to be of decided value in preventing heavy plant-bed losses during severe mold epidemics. The spray should be applied twice a week, beginning in advance of the appearance of mold in the bed, and continued until the plants are ready to set or until all of them have become infected and subsequently recovered. The treatment does not prevent plants from being infected, but it lessens disease intensity to the extent that affected beds rapidly recover and show little or no real damage. The spray method insures sufficient protection to prevent appreciable loss of plant bed stands and delay in transplanting. Thus it is possible to secure enough usable plants in season to set normal acreages even in years of severe epidemics. Sprayed plants live well in the field and produce normal crops. Spraying is of greatest value during severe epidemics, while in more normal seasons when little or no control is required, there is no particular gain from the treatment, except in preventing a few days transplanting delay. It is merely an insurance for protecting plants against unforeseen mold activity. The expense of the treatment does not exceed $3.00 per 100 yards, including cost of materials and depreciation on equipment. Hence, it is cheaper to spray for blue mold protection than to sow extra beds as an insurance against crop loss.

As yet, no commercially prepared concentrated spray mixture has been tried that is as satisfactory as home made preparations. For this reason, growers who intend to spray will find it advisable to acquaint themselves with the different materials for mixing. More than one source of supply is available for most of the materials, and since some of these vary in composition and consistency, the different amounts of these to be used in each 50 gallons of spray mixture are given below. Use only one form of copper, one emulsifier and one oil. Do not use lime in this mixture.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Amount for 50 Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuprous oxide (red copper oxide)</td>
<td>8 ounces (85-88% copper)</td>
</tr>
<tr>
<td>or 12 ounces (50% copper)</td>
<td></td>
</tr>
<tr>
<td>Spreader or Emulsifier</td>
<td>1 qt. lethane spreader (liquid)</td>
</tr>
<tr>
<td>or ½ to 1 lb. drepf (powder)</td>
<td></td>
</tr>
<tr>
<td>Cottonseed oil</td>
<td>2 qts. refined or crude oil</td>
</tr>
<tr>
<td>Water</td>
<td>to make a total volume of 50 gallons</td>
</tr>
</tbody>
</table>

If more or less than a 50-gallon volume of spray is required, the amounts should be increased or decreased accordingly.

If red copper oxide is not available in suitable form, an inexpensive yellow cuprous oxide can be made at home from bluestone, lye and blackstrap molasses. The procedure for preparing this mixture is described in the previous annual report of this Station. From 1½ to 2 gallons of this home made stock solution of yellow oxide is used to each 50 gallons of spray mixture. The same procedure for mixing the new spray materials should be followed as have been suggested in the past for the standard
red copper oxide-lethane spreader-cottonseed oil formula. Also the usual amounts of 3 to 7 gallons of spray to each 100 yards of bed area should be used for each twice-weekly application, the smaller amount being used on small plants. Beds may be sprayed through the cloth provided the cover is not lying flat on the plants. Enough materials to make 50 gallons of mixture should be sufficient to spray a 100-yard area ten times provided none of the materials is wasted. Only enough should be prepared at one time to make one application, because the mixture will not keep.

BLUE MOLD CONTROL BY GAS TREATMENT

Benzol is the principal material used for controlling mold by gas treatment. The vapors from this volatile liquid, when confined in sufficient concentrations underneath the covers of tightly enclosed tobacco beds, will prevent mold damage. In order to get best results with this method it is necessary to place a number of evaporating pans inside the bed, fill these with the correct amount of benzol each night, and then cover the beds with an extra heavy cotton cover containing 50 to 65 threads per inch. This cover must be removed early each morning to permit the plants to receive a normal amount of light. Ordinarily the benzol should be applied for a continuous period of about thirty days, although it may be possible to shorten this time in some instances. The cost of this treatment varies from $15 to $30 per 100 yards a season for materials and supplies, this amount varying according to prices and the duration of the applications. Under commercial conditions, this method is somewhat more effective as a control than spraying. The method is not adaptable to large beds or to wide beds. Best results have been obtained where the beds were not over 50 feet in length nor more than 12 feet wide.

Equipment and Materials for Gas Treatment

Sidewalls of beds should be made with boards so constructed as to be reasonably gas proof. Walls should be 8 to 10 inches high.

Framework or roof over the bed should be constructed of material strong enough to hold up the extra cover when wet with rain or dew, and to prevent the cover from sagging. The average height of this framework should be at least 12 inches over the bed surface.

Cloth Cover for holding in the benzol vapors should be sewn in one piece and made larger than the bed area to allow for shrinkage, curvature of the roof and for fastening along the sidewalls. One side of the cover should be fastened permanently to the bed so that the loose edge can be rolled back conveniently. This heavy cover should be in addition to the regular tobacco cloth.

The three above preparations should be made well in advance of any anticipated mold outbreak.

Evaporating Pans should be provided in sufficient numbers so that approximately one one-hundredth of the bed area will consist of pan area. Pans should be about six feet apart. From 18 to 25 pie plates or shallow cake pans will be sufficient to provide enough evaporating surface for a 100-yard bed. These pans should be placed upon an upright or stand
about 6 inches high and provided with a cover to prevent rain from spattering benzol on the plants. If this number does not provide for the correct evaporating ratio or permit the required amount of benzol to evaporate before morning, place a roll of cotton cloth, about six inches square, in the pan. This will tend to increase the rate of evaporation and permit the use of much smaller pans.

Benzol can be purchased much more economically in large lots than in gallon cans. From 20 to 25 gallons of benzol are usually required to treat a 100-yard area one season, the nightly dosage varying from 3 quarts to 4½ quarts for this area. Where there are 18 to 25 evaporating pans per 100 yards, six ounces of benzol in each pan will be sufficient. Fill all pans as rapidly as possible and then pull the extra cover over the bed immediately, taking care to fasten the edges firmly.

Because of the high cost and cumbersome nature of the method, benzol treatment is not generally recommended. Tests are still being made to determine whether an inexpensive gas method can be developed. Benzol treated plants grown under heavy covers do not always live normally when set in the field, due to their tender spindling condition.

BLUE MOLD CONTROL BY CULTURAL PRACTICES

Where it is not possible to adopt other methods of control, it will be advisable to sow an extra bed area in order to insure a sufficient number of plants. Beds should be located in sunny places that are not too dry nor extremely wet. It is always best to destroy all tobacco beds immediately after the transplanting season and also tobacco stalks in the field.
after harvest. It is never advisable to sow beds unusually early, especially in old locations, because to do so encourages early mold development and subsequent severe outbreaks. If all growers carefully follow these practices and locate their seed beds in new places each year, possibly the disease could be controlled in this way and severe losses prevented. However, a few early beds sown in old locations, or a few holdover plants in old beds, will be sufficient to enable the blue mold fungus to develop early each season and spread as rapidly as usual.

ROOT-KNOT NEMATODE CONTROL BY CULTURAL PRACTICES

Crop rotation of tobacco with a very limited number of nematode resistant crops, together with certain other cultural practices, is the most effective and practical method known for controlling root-knot. It is inexpensive and does not involve operations too difficult for the average grower.

Crop Rotation: Root-knot can be successfully prevented in fields where tobacco is planted after two or more successive crops of Spanish peanuts (harvested) or oats, where weeds are permitted to grow after the oats. Two-year rotations, while sometimes successful in preventing the disease, are not very reliable in Georgia. Runner peanuts and crotalaria also are highly resistant to root-knot nematodes, but because these add considerable amounts of nitrogen to the soil they should be planted two years in advance of tobacco.

Rotations with corn, cotton, root-knot resistant soybeans (Laredo and Biloxi) and root-knot resistant cowpeas (Brabham and Iron) are of only slight value in preventing root-knot in heavily infested fields. None is reliable enough to be recommended except in a limited way. Frequently corn and cotton may be included to good advantage in three and four-year rotations with tobacco, provided a more resistant crop such as peanuts or oats is included in the cropping system. Field peas, sweet potatoes and truck crops are not recommended in tobacco rotations.

Sanitation: The sanitary practice of removing as many as possible of the diseased tobacco roots from the soil immediately after harvest will be of value in preventing root-knot in future years. If the diseased roots can be brought to the surface before they decay, and the soil removed from them so they become air dry, all the root-knot nematodes in them will be killed. The removal of roots from other crops in the rotation in a similar way will be still further beneficial. These sanitary measures, however, are not always of distinct value unless followed by fallow cultivation for at least several weeks.

Fallow Cultivation: In addition to removing plant roots, the practice of turning the land every ten days or two weeks during hot or dry weather of August, September, October and November will rid the surface soil of nearly all root-knot nematodes. In oat rotations, it will be possible to turn the land just after the oats are cut, at which season the weather usually is hot and dry, and kill nematodes in great numbers. Where sanitation and fallow cultivation are practiced in conjunction with crop rotation, root-knot damage may be reduced.
SHADE TOBACCO STATION

On July 1, 1937, an appropriation made by the Georgia Legislature for research work on shade (cigar wrapper) tobacco became available. Since the Georgia Coastal Plain Experiment Station is not located in the shade tobacco belt of Georgia, it was evident that a branch station would have to be set up in the area to be served. In the search for a suitable location, considerable time was spent examining soils and interviewing growers in the shade tobacco area.

A suitable location about one mile north of Attapulgus, Georgia, on the Attapulgus-Bainbridge road, was leased. An agronomist and a pathologist were employed to take immediate charge of the work under the direction of the Tifton Station.

Plans for the work include both nutritional and pathological problems and are based on the needs of the growers as determined by a survey.

The nutrition work plans include tests to determine the optimum ratio between various elements of a shade tobacco fertilizer, the most profitable ratio of organic to inorganic nitrogen, the effect of varying rates of animal manures, the best sources of organic nitrogen and phosphorus, and a comparison of certain fertilizer formulas.

Four acres were provided with shade in the early spring, and 120 one-fourth-acre plots with 60 treatment duplicates were established. In measuring results of the tests it is planned to follow the tobacco through to the finished product and get final value of the leaf as reflected by burn, taste and aroma.
Pathological work was begun on breeding and selection for resistance to root-knot and black shank, the most serious afflictions of shade tobacco. An isolated soil was infested with nematodes and infested with black shank for studies of control methods.

**REPORT OF FIELD STATIONS IN McIntosh COUNTY**

The field stations are so located as to deal with the more productive soil types in the county. Experiments are conducted in cooperation with farm owners.

There are two distinct classes of soils in McIntosh County: First, the delta islands which are composed of alluvial soils known as Altamaha clay; and, second, the upland types composed of sands, sandy loams, and clay loams. In this second group only the better drained soils are used for experimental purposes.

Tests on the delta soils are confined to various phases of lettuce production. Experiments on the upland soils are conducted with several truck crops that have shown commercial possibilities. Included in the list of tests are planting dates, variety trials, fertilizer formula tests, and rates of applying fertilizers.

An outline and discussion of work at the field stations follow:

**FIELD STATION A.**

**Soil Type:** Bladen Sandy Loam

The tests in progress at “Field Station A” are:

1. Vegetable—Variety Trials
2. Vegetable—Planting Dates
3. English Pea—Fertilizer Formula Test

**Vegetable Variety Trials:** Several varieties of each vegetable are being tried to determine those best adapted for commercial planting and for home use. Listed below are the varieties that are showing to best advantage:

**WINTER VEGETABLES**

<table>
<thead>
<tr>
<th>Broccoli:</th>
<th>Mustard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Sprouting</td>
<td>Tendergreen</td>
</tr>
<tr>
<td>Cabbage:</td>
<td>Giant Green Curled</td>
</tr>
<tr>
<td>Copenhagen Market</td>
<td></td>
</tr>
<tr>
<td>Charleston Wakefield</td>
<td></td>
</tr>
<tr>
<td>Carrot:</td>
<td>Radish:</td>
</tr>
<tr>
<td>Chantenay</td>
<td>Early Scarlet Globe</td>
</tr>
<tr>
<td>Oxheart</td>
<td></td>
</tr>
<tr>
<td>English Peas:</td>
<td>Rape:</td>
</tr>
<tr>
<td>Improved Telephone</td>
<td>Dwarf Essex</td>
</tr>
<tr>
<td>Thomas Laxton</td>
<td></td>
</tr>
<tr>
<td>Kale:</td>
<td>Rutabaga:</td>
</tr>
<tr>
<td>Early Green Curled</td>
<td>Improved American</td>
</tr>
<tr>
<td>Lettuce:</td>
<td>Spinach:</td>
</tr>
<tr>
<td>Imperial 847</td>
<td>Bloomsdale</td>
</tr>
<tr>
<td>Imperial 615</td>
<td>Aragon</td>
</tr>
<tr>
<td>Imperial 515</td>
<td></td>
</tr>
<tr>
<td>Imperial F</td>
<td>Turnips:</td>
</tr>
<tr>
<td></td>
<td>Purple Top</td>
</tr>
<tr>
<td></td>
<td>Shogoin (best for summer use)</td>
</tr>
<tr>
<td></td>
<td>White Egg</td>
</tr>
</tbody>
</table>