TOBACCO

The research work with tobacco at the Georgia Coastal Plain Experiment Station is being conducted in cooperation with the Division of Tobacco and Plant Nutrition of the United States Department of Agriculture and The University of Georgia College of Agriculture.

In 1932 most of the experiments were concluded and new tests were planned to include the more recent problems and to eliminate some of the old tests on which it was believed that sufficient data had been obtained. The results of the experiments terminated in 1932 are given in Bulletin No. 22, "Bright Tobacco Culture in the Coastal Plain of Georgia." Therefore it is necessary to give only a brief summary of these results here. A more detailed report may be had in the above mentioned bulletin which may be obtained without charge, upon request to the Experiment Station.

**SOILS:** The soils of the Coastal Plain area, best suited to tobacco, are the Norfolk sandy loams and loamy sands, and the light phases of the Tifton sandy loams. Soils planted to tobacco should be light in texture, friable, well drained and comparatively low in ammonia.

**VARIETIES:** The varieties of flue-cured tobacco best suited to the Coastal Plain area of Georgia are those of the light type group. Of these, Jamaica, Cash and Yellow Pryor have proved the most profitable. Several other popular varieties such as Bonanza, White Stem Orinoco and Yellow Mammoth have not been tested long enough to furnish conclusive data, but seem to produce well under Georgia conditions. The heavy type varieties such as Warne, Adcock and Gold Leaf are not recommended.

**SEED BEDS:** Seed beds should be sterilized either by steam or by burning, when it is possible to do so. If it is not possible to sterilize, new beds on virgin soil should be provided. Fertilizers
should be applied liberally and only tobacco fertilizers used. Two
to three pounds per square yard, of a high grade tobacco fertilizer
(8-3-5 or 8-3-8) on first year beds, usually will supply sufficient
plant food to grow the plants rapidly enough for early transplant-
ing. Somewhat smaller quantities may be used on old beds. Seed-
ing should be done at the rate of one well rounded tablespoonful
of good seed for each 100 square yards of bed. Seed beds should
be sown in late December or early January.

TRANSPANTING AND CULTIVATION: Soil to be trans-
planted to tobacco, should be finely pulverized into a mellow, loose
condition. Transplanting should be done in late March or early
April. The plants should be set approximately two feet in the
drill and in rows four feet apart. Cultivations should be frequent
and designed to keep the soil mellow and loose. Topping and suck-
ering should not be delayed, or losses in yield and quality will
occur.

FERTILIZERS

FERTILIZER FORMULAS AND RATES OF APPLIC-
ATIONS: The fertilizer formulas used for tobacco do not neces-
arily have to be the standard 8-3-5 or 8-3-8 mixtures (ammonia
basis) in order to be excellent fertilizers for this crop. The only
requirements are that the proportion of the elements be approxi-
mately the same as contained in these standard formulas and that
certain fertilizer materials be used in making up the mixed goods.
The proportions of phosphorus, ammonia and potash recommend-
ed for tobacco are: Eight parts phosphorus, three parts ammonia
(2½ parts nitrogen) and five to eight parts potash or an 8-3-5 to
an 8-3-8 formula or the equivalent. In tests with rates of appli-
cation of potash the high potash formulas have proved the most
profitable. Therefore the 8 per cent potash formula is to be rec-
ommended over the 5 per cent goods.

The rate of fertilizer application per acre will depend upon
the soil type, the general state of fertility of the soil, and the
last crop grown on the area under consideration. On most soils of the Norfolk series which are so widely used for tobacco, 1000 to 1200 pounds of fertilizer per acre will prove satisfactory. On the average Tifton soils 1000 pounds of fertilizer is sufficient under most conditions. However, on fertile soils and soils that have been cropped heavily to legumes or that have had a legume crop directly preceding tobacco, it may pay to further reduce the fertilizer application to 800 pounds per acre.

PHOSPHORUS: Phosphorus is essential in all tobacco fertilizers as practically all soils used for tobacco in the Coastal Plain area are deficient in this element. The virgin soils are especially low in phosphorus. Phosphorus deficiency is evidenced by a small, abnormally green plant which never ripens properly. Too much phosphorus causes premature ripening or “firing” in the field. Tobacco fertilizers should contain approximately 8 per cent phosphorus where applications of 1000 pounds or more of the mixture is used per acre. Superphosphate is a satisfactory and convenient source of this element.

AMMONIA: The ammonia supplied to tobacco should be carefully controlled. Excessive quantities cause the plant to grow large and coarse which makes curing difficult. Insufficient quantities prevent the plant from making its maximum growth and thereby reduce the yield, although the quality may be fair. Tobacco fertilizers should carry 3 to 4 per cent ammonia which should be derived from certain types of materials. Horse manure as the sole source or as a partial source has given excellent results. In commercial fertilizers it is recommended that one-half the ammonia be derived from high grade organic materials such as cottonseed meal, fish scrap and/or high grade tankage. The remaining half of the ammonia should all be derived from nitrate of soda or one-fourth from nitrate of soda and one-fourth from nitrate of potash, calcium nitrate and/or urea (which because of its solubility and availability may be classed in this type of materials).
POTASH: Potash has a more important bearing on quality than any element in a tobacco fertilizer. Where no potash is applied the plants make only limited growth and soon break down. Such plants produce the lowest quality of tobacco. Potash should be contained in tobacco fertilizers to the extent of from 5 to 8 per cent of the mixed goods. The sources of potash giving the heaviest yields (muriate of potash and kainit) contain chlorine, which in large quantities may impair growth and injure the burning quality of the leaf. However, small quantities of chlorine have proved beneficial. The potash recommendation therefore, includes 2 per cent of potash per ton (40 pounds of K₂O per ton of fertilizer) from high grade muriate and the remainder from sulphate of potash or sulphate of potash magnesia. It is desirable that the last named material and/or some other material carrying available magnesia be used to supply magnesia to the mixed goods as a preventive of sand drown.

SPACING: There is no particular advantage in spacing closer than two feet apart in rows four feet apart when heavy fertilizer applications are used. Spacing closer than 22 inches in the drill increases the yield but lowers the quality, while spacings of from 22 to 24 inches in the drill give good quality even with a fertilizer application of 1600 pounds of 8-3-5 per acre on light sandy soils.

CURING: The factors involved in curing flue-cured tobacco are so numerous that no definite program can be given that will apply in any except a general way. Good cures can be expected only when uniform, well ripened tobacco is put into the barn, and undivided attention is given it until the cure is finished.

INSECT CONTROL: Attention to insect control should begin as soon as the plants begin to grow. By following recommended practices complete control is only a matter of diligence.

OUTLINE OF TOBACCO EXPERIMENTS BEGUN IN 1933: Below is given a brief outline of the new work. No data are available on these tests since they have been in progress only one year.
AMMONIA TESTS: This series involves 30 plots duplicated on the Norfolk and Tifton sandy loam soils which make a total of 120 plots. The ammonia is applied at two rates, 30 and 40 pounds NH₃ per acre. Since all previous tests have indicated that horse manure is an excellent source of ammonia as well as a supplement to the regular commercial fertilizer application special consideration was given horse and cow manure in planning these tests. These manures are used as the total source of nitrogen, as a partial source of nitrogen and as a supplement to the regular complete commercial fertilizer application. Since the modern tendency in fertilizer manufacture is towards chemically pure materials, such materials were also given consideration in planning these tests. A few of the more common ammonia sources were also included as a means of comparing the results with previous data.

CALCIUM AND SULPHUR TESTS: Recent experiments have shown that calcium and sulphur have an important relation to the type of growth and quality of tobacco. This series of tests is designed to determine the effects of calcium and of sulphur in varying amounts and the relation of phosphorus, potash and magnesia applied at varying rates to the effects of calcium and sulphur. These tests are being conducted on Norfolk sandy loam.

FERTILIZER FORMULA TESTS: This series of tests is a continuation of the old formula series in a revised form and is duplicated on the Norfolk and Tifton sandy loam soils. The new series does not include the low formulas or the incomplete formulas that are known to be of no value. In the place of these, higher grade formulas are being tested. The source of materials used are the combinations now recommended rather than single sources for each element as was used on the old series.

FRACTIONAL APPLICATION TESTS: In order to determine the advisability of applying fertilizer to the tobacco plant at various stages of growth these tests were begun in 1931. The plan includes a comparison of applying all of the fertilizer pre-
vious to transplanting, to applications made at 20-day intervals for 40 days after transplanting. The plan also includes the determination of the nitrogen content of the growing plant at 20-day intervals for 80 days after transplanting. These tests are being conducted only on the Tifton sandy loam soil.

**POTASH SOURCE TESTS:** Previous results indicate that the source of potash best suited for tobacco depends largely upon elements other than potash that are carried in potash materials. For this reason the potash source tests have been reduced to five plots duplicated on the Norfolk and Tifton sandy loam soils and the problem approached from the angle of the elements other than potash that are contained in potash materials. This problem constitutes a large part of the calcium and sulphur tests.

**PHOSPHATE SOURCE TESTS:** These tests which were begun in 1933 are the first tests that have been conducted with phosphate sources on tobacco at this Station. The series includes tests with 16 per cent superphosphate, the high grade phosphates, precipitated bone, basic slag and precipitated raw rock phosphate on both the Norfolk and Tifton sandy loam soils.

**FERTILIZER PLACEMENT TESTS:** In 1933 fertilizer placement tests were begun in cooperation with the Bureau of Agricultural Engineering, United States Department of Agriculture, and the National Fertilizer Association. These tests are designed to determine the effect of placing the fertilizer in various positions relative to the root crown, upon the stand, rate of growth, type of growth, and quality of tobacco. Only one series on the Norfolk sandy loam is used.

**VARIETY:** In planning the new tests with varieties only those varieties known to be suited to Georgia conditions were included. The purpose is to determine which of these varieties are best suited to our soil and market demands. The Tifton sandy loam is the only soil type used.
TOBACCO DISEASES

TOBACCO—DISEASE SURVEY: Due to increased demands for more experimental tests with tobacco mildew, (P. americana), and to limitation of funds for travel, the usual examinations of Georgia tobacco beds and fields were curtailed in 1933. The few observations made, however, indicated that the crop was more free than average from disease troubles.

Early in February a hard freeze killed from 5 to 10 per cent of seedlings in plant beds. Following this temporary setback, an epidemic of downy mildew enveloped the entire district during March, resulting in a direct loss of about 5 per cent of the seedlings. The late appearance of this disease was responsible for slight losses in 1933 as contrasted with the heavy damage experienced in 1932 when the outbreak appeared earlier in the season and when the plants were small.

Observations made on diseases in the field indicated that the Georgia crop was the cleanest produced in recent years. However, prolonged drought in localized areas reduced both yield and quality of leaf in these sections. This drought constituted the principal handicap to the crop in general. No mildew damage was seen in the field. Losses from root knot, (Heterodera radicicola), were less in 1933 than in any of the three preceding seasons. Southern root rot, (Sclerotium rolfsii), was the only common field disease as prevalent as usual, but the damage resulting from it was not appreciable. Granville wilt, (Bacterium solanacearum), appeared to a limited extent in several localities and was serious on two farms. Mosaic and leaf spot troubles were of minor importance. Of the leaf spot diseases, frog eye, (Cercospora nicotianae), was more prevalent.

TOBACCO—VARIETAL SUSCEPTIBILITY TO DISEASES: All domestic tobaccos of the flue-cured type and many others have proved to be about equally susceptible to root knot and downy mildew. White Burley, or as it is locally called, suckerless, seems
Farmers studying effect of crop rotation in controlling nematode on tobacco.

to be less able to withstand both these diseases. One species of native tobacco and one variety of (Nicotiana rustica), although quite susceptible to root knot, were observed to be highly resistant to downy mildew.

TOBACCO ROOT KNOT—RELATION OF CULTIVATION PRACTICES: In cultivation tests continued in 1933, root knot damage was much greater in tobacco that was set on a high ridge on well drained soil than in adjoining tobacco set on a level or slightly below level and later cultivated to a ridge. On the other hand, the plants set on a high ridge started growth more rapidly and lived to a better stand. These results are in line with earlier observations and indicate that while there may be some advantages in setting plants on a slight ridge, extremes should be avoided in lands subject to drought. Plowing up tobacco stalks immediately after harvest, and exposing diseased roots to drying, again served to destroy many nematodes in the soil and to partially control root knot in following crops.
A demonstration of root knot control by crop rotation. LEFT: Tobacco following two successive years of sweet potatoes. Every plant is severely affected with root knot. RIGHT: Tobacco following two successive years of root knot resistant native weeds that were allowed to grow unmolested. There is no serious root knot development in this plot.

TOBACCO ROOT KNOT—CROP ROTATION TESTS: Results obtained from several rotation experiments continued in 1933 verified observations made during the last three seasons; namely, that the rotation of tobacco with one or more of a few root knot resistant crops promises to be the cheapest, most practical and most effective method of controlling this disease in Georgia fields. No new important nema resistant crop was discovered during the year. Among crops most common in Georgia the peanut has proved to be the most effective in preventing nema injury in succeeding tobacco. Oats followed by native resistant weeds (beggar weed, pursley [Richardia scabra, St. Hil.], crab grass and other grasses) and velvet beans are also valuable in this respect. The above three crops are the only ones that have given consistently favorable results in controlling root knot by crop ro-
rotation. When tobacco is to be planted after oats it is preferable to allow the land to lie idle after cutting the grain and to turn under the weed growth in the fall or winter. While crab grass is less nema resistant than the other two named weeds it usually is safe in most fields. In average soils good quality leaf can be produced after either harvested peanuts or oats and weeds. For nutritional reasons it is not often advisable to plant tobacco immediately after velvet beans. This crop is valuable as a soil builder and wherever possible it should be included in the rotation but two years in advance.

A three or four year system is usually required in preference to a two year rotation. Results also indicate the advisability of changing the crop on the same land every year. A system in which peanuts are planted the first year, oats and weeds the second year and tobacco the third has given excellent results in producing root knot free tobacco of fine quality. Another system calling for corn and velvet beans the first year, harvested peanuts the second, and tobacco the third, has also proved promising.

In past years corn was observed to be helpful in eliminating root knot from succeeding crops of tobacco. However, recent results have shown that it is not always safe in the rotation. Brabham peas and wilt resistant cotton are even more questionable and their use is not advised here. Where corn is planted two years in advance and a crop of peanuts allowed to immediately precede tobacco, good control of root knot is usually obtained. Where cotton, Brabham peas and more susceptible crops are included these should be planted three years in advance of tobacco.

**TOBACCO MILDEW ("BLUE MOLD")—SPRAY TESTS:**
No spray or dust has yet been tried that gives complete control of tobacco mildew. Some materials, however, are of particular benefit because they give partial control by delaying the disease one or two weeks, thereby allowing the plants to become larger and more able to withstand the mildew. In seasons when the outbreak is expected early, or when the seedlings are small, the spray method has been found profitable. Weekly or semi-weekly appli-
Disease control measures can best be adapted to narrow plant beds, which can be weeded and cared for without any necessity for having to walk in them. The root knot nematode can be carried into plant beds on the feet of man and livestock, and also on tools. In unprotected places it is highly advisable to construct artificial windbreaks to prevent damage from freezes.

cations have been sufficient to ward off mildew for a short period and in this way save many seedlings. Large seedlings are rarely killed by the attack and little or no benefit has been derived by treating plants after they approach near transplanting size. Spraying is beneficial only when done before disease development begins. Applications made afterward not only fail to protect the plants but may injure them.

During the plant bed season of 1933 several promising sulphur and copper containing sprays and dusts were compared for their efficacy in preventing mildew. Dusting sulphur, colloidal and lime sulphur sprays, and potassium sulphide were not effective. Likewise several common local remedies failed to show promise of control. Sprays have been of more value than dusts.
Certain sprays containing copper, when applied twice a week preceding outbreaks, have been moderately successful against mildew. Among these Bordeaux mixture (3-3-50 or 4-4-50), Copper-soap (1-5-50), and a Copper-Lye-Syrup mixture (2 pounds bluestone, 2 pints black strap molasses, and 13 ounces lye in 50 gallons of water) appeared to give best indications of control. The addition of 3 to 5 pounds of potash fish oil soap to each 50 gallons of spray promised to enhance the value of the Copper-Lye-Syrup formula.

Slight stunting of seedlings usually follows from the use of most sprays, including Bordeaux. When this mixture is properly prepared and timely applied it causes no appreciable burning or stunting. But during the hottest period of warm days, or when the seed beds are very dry and the plants wilted, spraying may result in serious injury. This difficulty can be overcome by late afternoon applications and by watering the beds when dry.

Copper-Soap spray, consisting of one pound of bluestone and five pounds of potash fish oil soap in each 50 gallons of water, is more effective against mildew than Bordeaux mixture. However, unless it is properly prepared it may cause severe injury and hence be of little value. In preparing Copper-Soap it is necessary to first dilute the two ingredients separately before mixing them. Thus in making up a 50 gallon quantity the correct procedure is to dissolve one pound of bluestone in 25 gallons of water (do not use metal containers) and five pounds of the fish oil soap in another 25 gallons, and then slowly pour the two solutions together, stirring vigorously as they are mixed. It should be used immediately after preparation. More dilute mixtures of Copper-Soap are less likely to cause injury but they are also less effective against the mildew.

The Copper-Lye-Syrup mixture is believed to be of considerable value because it is the only spray thus far tried that promises to give good control of mildew without stunting or injuring the plants. In this respect it is superior to any other material used in the tests. Another advantage is that it does not paint the
foliage. In preparing this mixture it is necessary to dissolve the ingredients in small amounts of water and mix them into a paste ten days or two weeks in advance. This stock solution or paste can be kept several weeks and enough may be prepared at one time to last through the spray period. In making up paste for 50 gallons of the mixture, add the following ingredients in the order named:

Dissolve 2 pounds bluestone in 1 gallon water
Add 2 pints black strap molasses
Dissolve 13 ounces lye in 3 quarts water and add to the above mixture. Stir thoroughly. This paste, which is at first green, should not be used until after it begins to turn brown.

The resulting 2 gallons of paste are sufficient to make 50 gallons of spray by diluting with water, although twice this strength has been used with safety.

The addition of 3 to 5 pounds of potash fish oil soap to each 50 gallons will improve the mixture.

Approximately 10 gallons are required to cover a 100-yard bed of plants one-third mature. For smaller seedlings less than this amount will be needed.

**TOBACCO MILDEW—TEMPERATURE EXPERIMENTS:**
Observations made in fields and hotbeds have shown that tobacco mildew is favored by mildly cool or springlike weather and that high temperatures are distinctly unfavorable for its development. In the 1933 season no appreciable mildew damage occurred in tobacco hotbeds covered with glass sash and heated to July temperatures, despite the fact that the disease was very severe in adjoining beds not heated. Where a minimum temperature of 70 degrees Fahrenheit was maintained at night and the day temperature allowed to approach 95 to 100 degrees, plants grew rapidly and reached transplanting size safely in less than six weeks from the time of seeding. While these tests suggest a natural method for complete mildew control, the growth of tobacco plants in customary hotbeds involves considerable expense and skill, and the practice is not advocated to Georgia growers at present. Meanwhile, tests are being made to determine the possibility of lessening the cost of such seed beds and of utilizing some cheap substitute cover for glass.
Excepting the very serious epidemic of 1932, mildew has not been important enough in Georgia to warrant the employment of expensive control measures. Since hotbeds are too expensive under present conditions, it is suggested that growers continue the cheaper practice of sowing more beds, locating them in new places where possible and separating them as far apart as practical. By eliminating all unnecessary shade and removing the covers on warm days after the plants are large enough to withstand open air conditions, disease damage is checked to a limited extent.

Where spraying is practiced it is advisable to discontinue applications a week or two before time for transplanting, because freshly sprayed seedlings do not live well under all conditions when set immediately afterward. Allow seriously affected plants to recover and put out new growth before attempting to transplant them.