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A. C. TRUE, Director

Section of Illustrations,
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46 slides

SYLLABUS

OF

ILLUSTRATED LECTURE

ON

TOBACCO GROWING.

33036 to 33486.

BY

J. N. HARPER, M. Agr.,

Director, Agricultural Experiment Station, Clemson College, S. C.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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PREFATORY NOTE.

This syllabus of a lecture upon Tobacco Growing by J. N. Harper, M. Agr., Director of the South Carolina Agricultural Experiment Station, Clemson College, S. C., is accompanied by 46 lantern slides illustrating the topic. The syllabus and views have been prepared for the purpose of aiding farmers' institute lecturers in their presentation of this subject before institute audiences.

The numbers in the margins of the pages of the syllabus refer to similar numbers on the lantern slides and to their legends as given in the Appendix. Those in the body of the text refer to the list of authorities and references at the end of the bulletin.

In order that those using the lecture may have opportunity to fully acquaint themselves with the subject, references to its recent literature are given in the Appendix.

JOHN HAMILTON,
Farmers' Institute Specialist.

Recommended for publication.

A. C. TRUE, *Director.*

Publication authorized.

JAMES WILSON, *Secretary of Agriculture.*

WASHINGTON, D. C., *July 10, 1907.*

TOBACCO GROWING.

By J. N. HARPER, M. Agr.

INTRODUCTION.

Tobacco was first cultivated in America. The early explorers of this continent found the natives making use of tobacco for smoking, chewing, and medicinal purposes. Tobacco was cultivated by the first colonists in colonial Virginia, and as early as 1619 20,000 pounds of tobacco were shipped to England from this colony. (Ref. 1, p. 5.) Its consumption rapidly increased after this time, so that within a few years it became the leading export of Virginia and was one of the main sources of revenue for the people.

View.

In 1731 the provinces of Virginia and Maryland exported \$1,875,000 worth of tobacco. (Ref. 1, p. 6.) Kentucky early became a leading tobacco State, and that Commonwealth now produces one-third of the entire yield of the product in the United States. Tobacco is now being grown in 25 States of the Union, 776,000 acres being devoted to this crop. More than 633,000,000 pounds were produced in the United States in 1905, the farm value of this crop being \$53,500,000. (Ref. 2, p. 717.)

VARIETIES.

Tobacco belongs to the Solanaceæ family, which includes, among other plants, Irish potatoes, tomatoes, red peppers, and jimson weeds. There are more than one hundred varieties of tobacco in cultivation. The leading varieties grown in America are the White Burley, Zimmer Spanish, Cuban, Orinoco, Connecticut Seed Leaf, Yellow Pryor, Havana Seed Leaf, and Sumatra Seed Leaf. (Ref. 3, p. 12.)

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SELECTION FOR SEED.

View.

- No plant responds so readily to careful selection as does the tobacco plant. It is a plant that crosses readily, and to improve the seed it is necessary to place a sack over the flowers before the pistil is ready to receive the pollen, thus preventing insects from bringing pollen from undesirable plants and crossing. (Ref. 4, p. 19.) The first step in saving seed is to select the type of tobacco that one wishes to grow. It is easy to pick out a desirable tobacco plant, because all of its characteristics are before the eye. If one is breeding for a long leaf, a broad leaf, or a narrow leaf, or a plant that holds its leaves up well, or one that has long internodes, or short internodes, or one that has pointed leaves or round leaves, or one that has fine veins or coarse veins, or one that has width between veins, he can readily do so by selecting his plant and protecting its pistil from cross-pollination. All lateral flowers should be pulled off, leaving only a few at the top. A few days before the pollen is ripe a sack should be placed over the flowers in order to prevent any possible cross-fertilization. (Ref. 5, p. 12.) If one wishes to cross or hybridize with some other plant, he can do so by taking the stamens out before the pollen is ripe and the day after applying to the flower from which the stamens were removed the pollen from another plant by means of a camel's-hair brush. All small leaves, suckers, and lateral branches immediately below the seed head proper should be carefully removed and the mouth of the bag tied around the stalk just under the lowest remaining branches. (Ref. 6, p. 229.) Many of the improved varieties of tobacco have been brought about by crossing standard varieties, and many of the standard varieties of tobacco, such as the White Burley, have been improved by careful selection and preventing cross-pollination with undesirable plants.

THE PLANT BED.

- It is necessary to thoroughly prepare the soil in making preparation for a seed bed for young tobacco plants. The bed should be located in some well-protected place and should have a southern exposure so as to obtain as much heat from the sun as possible. The bed should be burned thoroughly to destroy all weed seed and insect eggs, and this will also put the soil in good physical condition. (Ref. 14, p. 7.) The bed should be protected by being surrounded by boards and the upper side should be ditched to prevent water from flooding it. The bed should also be protected in the early spring by

cotton canvas. The seed should be sown after the bed has been burned and plowed and thoroughly raked and has been rid of all stones and trash. The seed should be sown at the rate of 1 thimbleful to every 36 square feet. Before sowing the seed, the light ones should be separated from the heavy ones and only the heavy ones should be sown. This can be done by a recently invented apparatus which blows the light or chaffy ones out from the heavy ones. It has been proved that the plants grown from light seed produce not only a very small yield, but tobacco of inferior quality. (Ref. 7, p. 2.) Before sowing, the seed should be mixed with a good quantity of corn meal. This will dilute the seed to such an extent that it will be possible to sow them evenly and not too great a quantity to the bed. Four seeds to every square inch is sufficient. The seed should be tested for their germinating powers before sowing. This is done by placing a definite number of seeds, say 100, on a moist piece of blotting paper in a broad glass jar and keeping moist in a dark, warm place. In a few days all good seed will germinate. The seed should be sown early in the spring and raked in.

View.

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TRANSPLANTING.

The young tobacco plants should be heavily fertilized with nitrates and potash salts, and should be transplanted when the leaves are a little larger than a silver dollar. The earlier the tobacco is set out the better the quality and the greater the yield. Transplanting is usually done by hand, and when thus transplanted the setter should be careful that the hole is made deep enough to allow the roots of the plantlet to be perfectly straight down, otherwise a disease will set up that will greatly injure the plant. Machines are now being used to a considerable extent, and with their aid tobacco can be set out in dry weather and a good stand obtained. It is necessary to water the young plants when they are set out during dry weather.

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SOIL.

No plant is so affected by different types of soils as is the tobacco plant. The variety of the tobacco grown in a given locality depends upon the type of soil in that locality. (Ref. 16, pp. 8 to 18.) The texture of the soil seems to influence the character and quality of the tobacco more than does its chemical composition. Under given climatic conditions the class and type of tobacco depend upon the character of the soil

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View.

upon which it is grown, especially on the physical properties, while the grade is dependent largely upon the cultivation and curing of the crop. (Ref. 17, p. 14.) If the texture of the soil is known, it is possible to say what type of tobacco is suited for that soil. Before the tobacco is set out the soil should be thoroughly prepared by deep plowing, rolling, and harrowing and the rows should be laid off at a uniform distance with a marker. If sod land is to be planted in tobacco it should be plowed early in the spring to give the sod time to thoroughly rot.

FERTILIZING.

- There is no plant that is so susceptible to fertilization as is tobacco. Its quality is greatly affected by fertilizers. It is a plant that requires large amounts of potassium and nitrogen. The potassium should be in the form of a sulphate, as the chlorids are detrimental to its quality. Phosphorus increases the yield on most types of soils but has no effect on the quality of the tobacco. (Ref. 15, p. 140.) Tobacco can not be grown for a number of years on the same soil, therefore it must be in a system of rotation with other crops. In the blue-grass region of Kentucky, where White Burley is grown entirely, it enters a rotation with corn, wheat, clover, timothy, and blue grass, the fields remaining in blue grass for a long term of years. In other parts of the country where a number of other varieties are grown it is rotated with corn, wheat, and clover. Coarse and heavy manures are detrimental to the quality of the tobacco unless they are well rotted. Tobacco stems are an excellent fertilizer for tobacco, and as much as 1,500 to 2,000 pounds can be used to the acre.

CULTURE AND HARVESTING.

Tobacco should be planted in rows, varying from a distance of 3 to 4½ feet, depending upon the variety, and the distance the plants are set in the row also depends upon the variety. Some varieties, as the White Burley, are set 15 to 20 inches, while others, as Yellow Pryor, are set 3½ feet.

- The cultivation should be clean and shallow. The plants should be topped when they first begin to bloom. The number of leaves left varies from 16 to 24, depending upon the variety. (Ref. 19, p. 11.) All suckers should be pulled off before they get to be 6 inches long. Tobacco should never be cut before it is thoroughly ripe. This is indicated by the color of the tobacco. It begins to turn yellow on ripening. The whole plants are either cut down with

small knives made for the purpose or the ripe leaves are picked, leaving the others to ripen. The cigar-tobacco types are primed, whereas the heavy tobaccos and White Burleys are cut whole and placed on sticks. (Ref. 18, p. 28.) An hour or so after tobacco has been cut and placed on sticks it should be put on trestles in the field to prevent sunburn. It is best to leave on the trestles for a day or two before hauling to barn. (Ref. 11, p. 107.) Tobacco that is placed on sticks should always be hauled to the barn on tobacco frames rather than in bulk on an open wagon body.

View.

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CURING.

There are many styles of houses used for tobacco, depending upon the method of curing. The flue-cured tobacco is cured in a house that can be made almost air tight, with a ventilator in the top which can be closed. The Virginia Bright Leaf is cured in this way. The White Burley is cured entirely without artificial heat, requiring from five to six weeks in its curing. Barns in which tobacco is air cured should have lateral, horizontal ventilators rather than perpendicular ones, because the tobacco is not so liable to house burn. The flue-cured tobacco requires only a few days for its curing. (Ref. 20, pp. 3 to 15). After tobacco has been thoroughly cured, it should be stripped and sorted into different grades, and after a certain time it should be put down in bulk for fermentation. The fermenting of tobacco is an art and the process of fermentation is due to enzymes rather than to bacteria as was once thought. (Ref. 9, p. 21.) These enzymes are destroyed when the temperature of the tobacco is raised above 152° F. (Ref. 21, p. 26.) Before tobacco is placed in hogsheads, it should be dried out and placed in case so that it will contain about 11 per cent moisture. Fermentation takes place more rapidly at a high temperature than at a low temperature. The stripping, grading, and sorting should be done only by an expert. The dark, heavy export tobaccos are cured in close barns by an open fire under the tobacco and require close attention during all of the stages of curing. It is possible to cure the tobacco a bright yellow or a dark mahogany by simply varying the temperature and the humidity of the atmosphere and length of time in curing.

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QUALITY.

The quality of the tobacco is judged largely by the burning qualities of the leaf, the elasticity, the flavor, the quality and color of the stem, and the quality and color of the veins,

View. the general texture and thickness of the leaf, the substance and nature of the gum in the leaf, the quality of the leaf, whether coarse, harsh, fine or silky, and toughness and behavior when handled, color of the leaf, and the breadth of leaf, and proportion of stem, and the length of leaf from point to butt.

COMPOSITION.

The analysis of cured tobacco will vary considerably. However, the analysis of the crude ash is not very variable. Some tobaccos contain a large amount of nicotine, such as the Perique, while other varieties contain only a small amount of nicotine, as the Sumatra wrapper. (Ref. 8, pp. 359 and 360.)

SHADING.

33 Where the soil texture and other conditions are favorable for the growth of tobacco, it can be grown successfully even where the weather conditions are not favorable for it, by being grown under canvas. Nearly all of the types of tobacco grown in the United States have been experimented with by this method. By growing tobacco under shade it will resist
34 a drought, the soil retains the moisture, a very much larger yield is produced, the tobacco is of a finer quality, insect depre-
35 dations are prevented, considerable labor is saved in cultivation, and the physical condition of the soil is greatly improved. Sunburn, injury due to heavy wind storms and rains, and injury from early and late frosts are also prevented. Undesirable cross pollination is lessened to a certain extent, the seasons are considerably prolonged, and few of the plants have to be reset, while the southern varieties can be grown farther north. (Ref. 22, p. 5.) It is questionable, however, whether it pays because of the great expense.

DISEASES AND INSECTS.

36 Tobacco is subject to a number of diseases, among them black spot, white rust, leaf blight, mildew and stem rot,
37 mosaic disease, and wilt; and there are parasitic plants, such
38 as broom rape, that do considerable damage. (Ref. 23, pp. 3 to 19.)

39 The wilt is a bacterial disease and can be detected by the discolored vascular tissues of the stems. (Ref. 25, p. 91.)
40 Rotation is the only means to prevent it. Most of the fungus

diseases can be prevented by clean cultivation, clean seed bed, and some care taken in transplanting to discard all diseased seedlings. Applications of solutions of formalin (1½ pints formalin to 50 gallons of water) to plant beds to prevent bed rot (<i>Rhizoctonia</i>) have given results that were beneficial. (Ref. 10, p. 1.)	View. 41 42 43
The mosaic disease is probably a purely physiological one, caused by sudden changes in atmospheric conditions and soil conditions. (Ref. 26, p. 9.)	44
Tobacco is attacked by a number of insects, chief among them are the northern tobacco worm (<i>Protoparce celeus</i>) and the southern tobacco worm (<i>Protoparce carolina</i>). Insect depredations are prevented by use of Paris green spray (¼ pound to 30 gallons of water). (Ref. 28, p. 9, and Ref. 27, pp. 21 to 32.)	45 46

APPENDIX.

LANTERN SLIDES.

No. of
view.

1. Tobacco plant with flowers at proper stage of maturity for bagging.
From Maryland Sta. Bul. 103, Pl. I.
2. Broad Leaf White Burley tobacco.
From Kentucky Sta. Original.
3. Stand-up White Burley.
From Kentucky Sta. Original.
4. Tobacco flowers showing proper stage of maturity for bagging to prevent cross-pollination.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LXIV, fig. 1.
5. Tobacco flowers at proper stage of maturity for using pollen from stamens in cross-pollination.
From Kentucky Sta., Division of Entomology and Botany.
6. Tobacco flowers and seed pods.
From Kentucky Sta., Division of Entomology and Botany.
7. Florida Sumatra seed plant properly labeled, with flowers covered by bag.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LXIII, fig. 2.
8. The Connecticut Broad Leaf tobacco plant capped to protect from cross-fertilization.
From Maryland Sta. Bul. 103, Pl. II.
9. Type leaves of hybrid and parent types of tobacco. (1, Havana seed, female parent; 2, hybrid; 3, Sumatra, male parent.)
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LIX, fig. 2.
10. Rounded type of leaves of tobacco seedlings.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LX, fig. 1.
11. Pointed type of leaves of tobacco seedlings.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LX, fig. 2.
12. Variations in length of internodes of Connecticut-Cuban tobacco plants.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LXII, fig. 2.
13. Tobacco seed beds showing method of construction and protection and young plants ready for setting
From Connecticut Sta.
14. Apparatus for separating the heavy tobacco seeds from light ones.
From U. S. Dept. Agr., Bureau of Plant Industry Bul. 91, Pl. IV, fig. 1.
15. Setting out tobacco plants by hand.
From Connecticut Sta.
16. Setting out tobacco plants with machine.
From Connecticut Sta.
17. The texture of the typical cigar tobacco land of Connecticut.
From U. S. Dept. Agr., Bureau of Soils Bul. 11, Pl. III.

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view.

- 33205-18. The texture of the typical Bright tobacco land of Virginia and North Carolina.
From U. S. Dept. Agr., Bureau of Soils Bul. 11, Pl. IX.
- 33218-19. Dark fire-cured tobacco fertilized with 400 pounds of fertilizer, costing \$5 per acre and furnishing 12 pounds of ammonia, 36 pounds of phosphoric acid, and 12 pounds of potash, gave a yield of 673 pounds of tobacco, which sold for \$45.50 gross.
From Yearbook of 1905 of U. S. Dept. Agr., Bureau of Soils, Pl. VII.
- 33226-20. Dark fire-cured tobacco fertilized with 850 pounds of home-mixed fertilizer, costing \$16.44 an acre and furnishing 73½ pounds of ammonia, 57 pounds of phosphoric acid, and 75 pounds of potash, yielding 883 pounds of tobacco, which sold for \$81.09 gross.
From Yearbook of 1905 of U. S. Dept. Agr., Bureau of Soils, Pl. VIII.
- 33232-21. On left; plat of New Hybrid of Connecticut and Seed Leaf by Cuban; yield, 1,715 pounds per acre; quality of filler, excellent.
On right; plat of Zimmer Spanish; yield, 1,455 pounds per acre; quality, medium.
From Ohio Sta.
- 33242-22. Plat of White Burley tobacco ready to cut.
From Kentucky Sta. Original.
- 33256-23. Cuban and Sumatra tobacco grown under canvas and ready to prime.
From Kentucky Sta. Original.
- 33266-24. Tobacco being cut and placed on sticks preparatory to hauling to barn.
From Connecticut Sta.
- 33276-25. Curing barn for dark fire-cured tobacco.
From Yearbook of 1905 of U. S. Dept. Agr., Bureau of Soils, Pl. X, fig. 1.
- 33286-26. Tobacco barn showing lateral perpendicular ventilators.
From U. S. Dept. Agr., Bureau of Soils.
- 33296-27. Tobacco barn showing method of hanging tobacco.
From U. S. Dept. Agr., Bureau of Soils.
- 33306-28. Tobacco barn showing lateral horizontal ventilators and top ventilators.
From Kentucky Sta. Original.
- 33316-29. White Burley tobacco. (1, Flyer or trash; 2, Bright Leaf or Good Leaf; 3, Short Red Leaf.)
From Yearbook of 1899 of U. S. Dept. Agr., Bureau of Soils, Pl. XXXII.
- 33326-30. Cigarette and manufacturing tobacco. (1, Dark Mahogany; 2, Light Mahogany; 3, Bright Lemon Yellow.)
From Yearbook of 1899 of U. S. Dept. Agr., Bureau of Soils, Pl. XXXI.
- 33336-31. Maryland Smoker, bright "Colony" Leaf.
From Yearbook of 1899 of U. S. Dept. Agr., Bureau of Soils, Pl. XXIX.
- 33346-32. Florida Cigar Filler, Cuban seed.
From Yearbook of 1899 of U. S. Dept. Agr., Bureau of Soils, Pl. XXXV.
- 33356-33. Field under canvas for growing of Sumatra Leaf.
From Connecticut Sta.
- 33366-34. Field of White Burley tobacco growing under canvas.
From Kentucky Sta. Original.
- 33376-35. Plants from diseased and resistant strains of Sumatra seed.
From Yearbook of 1904 of U. S. Dept. Agr., Bureau of Plant Industry, Pl. LXIII, fig. 1.
- 33386-36. Portion of a tobacco field that is badly infested with wilt disease showing all stages of the disease.
From North Carolina Sta. Bul. 188, fig. 4.
- 33396-37. A healthy field near the diseased field showing no signs of the wilt.
From North Carolina Sta. Bul. 188, fig. 14.

No. of
view.

- 33436-38. Roots of tobacco plants showing healthy plants in center and others in various stages of disease.
From North Carolina Sta. Bul. 188, fig. 9.
- 33446-39. Roots of tobacco plants attacked by *Thielavia*.
From Ohio Sta.
- 33426-40. Tobacco plant attacked by broom rape.
From Ohio Sta. Bul. 150, Pl. IV.
- 33436-41. Northern tobacco fly.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 4.
- 33446-42. Southern tobacco fly.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 3.
- 33455-43. Pupæ of tobacco worms; upper, southern; lower, northern.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 2.
- 33466-44. Southern tobacco worm infected with parasites.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 1.
- 33476-45. Northern tobacco worm.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 1.
- 33486-46. Southern tobacco worm moulting.
From Kentucky Sta., Division of Entomology and Botany, Bul. 66, fig. 1.

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25. The Granville Tobacco Wilt. North Carolina Sta. Bul. 188.
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