ELECTRICITY IN THE PRODUCTION AND CURING OF TOBACCO

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At the present time electricity is making a tremendous contribution
to the economical production and curing of tobacco. This statement may seem
far-fetched if not altogether erroneous when first considered. But by observ-
ing the many advantages of an electrified farm home or farm shop, the whole
complexion of the statement becomes clearer and more concrete. Under present
conditions the tobacco farm can and will afford the many conveniences, labor
saving devices and electrically operated appliances of proven usage on many
farms throughout the Southeast.

Improved sanitation, diet, bodily comfort in winter or summer, and
peace-of-mind contributed by the automatic water system, refrigerator, range,
home freezer, attic fan, washing machine, freezer locker plant and automatically
controlled home-heating system are entries of great value for the credit side of
the ledger. The tobacco farmer, or any farmer, living under such improved
conditions, surrounded by a family of thinking partners rather than a family of
tired laborers, becomes a better, more efficient and more intelligent farmer
greatly improving the stability of his farm and the general well-being of his
community.

It has been the happy privilege of the author, in working with farm
people and talking with authorities engaged in the field of agriculture for the
past 25 to 50 years, to observe a rapid up-swing in the standard of living on
farms in the Southeast during the past 10 years. Our farmers now have available
and are using more energy, both body and mechanical, than ever before in the
history of the world as witnessed by the tremendous food and fiber production during the recent war. State Agricultural Colleges and other sources of information have recently been literally swamped with demands for suggestions, plans and technical advice on improving practices, processes and efficiency of the farm as a whole. Who can say that rural electrification has not played a very important role in this upward trend throughout the Southeast?

Thus, it may be seen that electricity does contribute tremendously to the production of tobacco as well as all other farm enterprises. However, to thoroughly understand the possibilities of the use and fullest application of electricity to the production and curing of tobacco, one must make a thorough study of the complete cycle of tobacco from the plant bed to the cigarette, cigar or pipe. For instance, in the Southeast, there are three principal types of tobacco grown, (1) Bright or flue-cured, (2) Burley or air-cured and (3) Dark-fired.

Up to the time the tobacco is sold on the warehouse floor all three types are handled somewhat similarly with the exception of the curing process. Bright tobacco is cured in a relatively small barn of inexpensive construction, usually a perfect cube of 16, 18 or 20 feet with a low-pitched roof. As the leaves ripen on the stalk from the ground up, they are pulled from the stalk or "primed" a few leaves at each priming; hauled to the barn; strung on sticks; and placed within the barn on tier poles at regular intervals. The attached bulletin "Bright Leaf Tobacco Curing" covers this phase quite thoroughly. In the cases of burley and dark-fired tobaccos, the whole stalk is cut, placed on sticks and hung on tier poles within a somewhat larger barn where the leaves are cured on the stalk. Burley tobacco is cured by a natural movement of atmospheric air while dark-fired tobacco is cured by smoking at an air temperature slightly above atmospheric, similar to the method employed in smoking meat on the farm.

It is not the intent of this paper, however, to provide a thorough study of any phase of the tobacco industry. Possibly the following specific suggestions
may prove helpful in the future application of electricity to tobacco farming or conducive to further investigations in this field.

Treatment of Plant Bed Soil

The development of electric soil pasteurizers or sterilizers began about 1931 and, with the exception of the more recent chemical treatment, is generally as economical as any other method and usually more convenient. Pasteurization applies only to liquids, but as no other term accurately describes the treatment, it is used here to mean the partial sterilization (of soil) at a temperature (160° F.) which destroys most weed seeds and harmful microorganisms. Following are the five types of electric soil pasteurizers: (1) Resistance, (2) Indirect-heat, (3) Humidified hot air, (4) Electric-steam pan and (5) Continuous process. Of these five types the electric-steam pan appears to be the most practical for treating soil in tobacco plant beds. A minimum of labor is required since the soil is treated in place in the plant bed at a cost only slightly above that of the other electric methods. An additional reduction in energy requirements of 12 percent can be realized by covering the bed with sash about a week prior to treatment.

From tests of pasteurizing soil with the electric-steam pan in tobacco plant beds in Virginia during 1939, 1940 and 1941 the following conclusions were derived:

(1) The electric energy required for pasteurization increases with an increase in the moisture content of the soil treated.

(2) The time required to affect pasteurization increases with an increase in the moisture content of the soil treated.

(3) The electricity cost for operating the electric-steam pan is from 1.45 to 1.96 cents per square foot of soil treated, with electricity at three cents per kilowatt hour and pasteurizing to an average depth of four inches.

(4) Covering the plant bed with glass or a glass substitute for three to seven days before pasteurization of the bed soil will reduce the heat requirements
for treatment by 3.5 to 12.4 percent.

(5) Pasteurizing to a depth of four to five inches with the electric-steam pan kills 71.7 to 98.2 percent of all weed seeds present in the soil treated.

(6) The wood cost for treating soil by surface burning is from 2.75 to 6.25 cents per square foot of soil treated, with wood at three dollars per cord and pasteurizing to an average depth of four inches.

(7) The method of applying infra-red or radiant heat for pasteurizing soil in place in a plant bed is not satisfactory. Before pasteurization temperature is reached, at a depth to be effective, the surface soil is raised to a harmful temperature.

(8) The above (No. 7) also applies to a large extent to the method of surface burning to provide pasteurization of soil in place in a plant bed.

The principal drawback to electric pasteurization has been the general practice of moving the plant bed to a new location each year. However, some of our tobacco farmers are now maintaining the same bed site year after year by treating the bed soil each year. At least one North Carolina farmer has followed this practice for seven years with good results. Several methods of chemical treatment of plant bed soils have now been developed which are not only effective and economical but also provide some fertilization for growing the plants.

**Control of Blue Mold in Plant Beds**

Several investigators have reported successful control of blue mold in plant beds by the application of electric soil-heating equipment. Concurrent with these reports were those of other investigators announcing the development of a chemical treatment which is more economical than the electric method and appears to be quite effective. Whether or not the application of germicidal lamps to the control of blue mold is effective or feasible is yet to be determined.

When first considered, it appears improbable that germicidal lamps will prove feasible since ultra-violet rays are not generally beneficial to plant growth.


Water For the Plant Bed and Transplanting

The economy of the electric water system has been proven but many of our farmers have not yet realized it. The tremendous quantities of water used each year by tobacco farmers would unquestionably make the automatic water system a real asset. Watering the plant bed sometimes proves quite beneficial to the growth and production of plants. During dry seasons a good soaking of the plant bed, about a day before transplanting, will aid in removal of plants and help to prevent injury to the plants.

Tobacco farmers literally haul tons upon tons of water many miles each year to provide a little water for each plant as it is set in the field. Thankful indeed is the farmer when a rainy season sets in at the time of transplanting to eliminate the hauling of water. Electricity can make one of its greatest contributions to the production of tobacco by providing a "rainy season" every year, wholly or in part, with an automatic water system. It would seem sensible for the tobacco farmer to install a pump of at least 350 gallons per hour capacity coupled to a large storage tank.

Irrigation of Tobacco

The irrigation of tobacco is past due for serious and thorough investigation. The practice would need to be employed with care and cannot, as yet, be generally recommended.

Surface irrigation of 1.3 acres of burley tobacco was carried out and observed by the Tennessee Valley Authority cooperating with a farmer near Concord, Tennessee in 1936. The total irrigation water pumped between May 27 and June 27 was 197,280 gallons. This was equivalent to 5.06 inches of rainfall. During the same period a natural rainfall of 1.03 inches occurred. After this period natural rainfall was sufficient to make irrigation unnecessary. An unirrigated check plot was otherwise treated similar to the irrigated area except that water was applied with buckets at the time of setting the plants. Observations from the above operation were as follows:
1. Tobacco on the check plot showed only a very limited growth, all of which came after the July rains. This tobacco was small and immature and was not worth the time and labor to harvest it.

2. The irrigated tobacco produced 1,438 pounds which sold at 50 cents per pound and gave a net return of $553.07 per acre.

3. The total operating cost of the centrifugal pump driven by a gasoline engine was $9.94 for 93 hours of operation.

4. An average of one hour of labor was expended for each hour of irrigation.

The University of Georgia has recently reported an irrigated tobacco yield of 1,400 pounds per acre on Tifton Pebbly Loam soil against a non-irrigated yield of 1,000 pounds. Also reported was an irrigated tobacco yield of 1,610 pounds per acre on Norfolk Sandy Loam soil against a non-irrigated yield of 852 pounds. The relative quality of tobacco and other factors were not observed.

Many tobacco farmers are now using equipment for spraying the crop in the field. It would seem logical to include in any investigation of tobacco irrigation the possibility of using a spray irrigation system for applying both water and liquid spray when needed.

The Curing of Tobacco

A thorough discussion of tobacco curing could easily involve several weeks' time. Perhaps, in this brief discussion, it would be well to differentiate between the terms "curing" and "drying". No simple, brief and adequate definition of these two terms, as applied to the processing of agricultural products, is provided by our standard dictionaries. To clarify understanding here, "drying" may be simply defined as a process, the primary objective of which is the removal of free water from a substance. Likewise "curing" may be defined as a process, the primary objective of which is the attainment of certain chemical changes within a substance usually accompanied by the removal of free water from the substance. Thus, certain farm processes can be better understood by applying these terms as in hay drying, grain drying, sweet potato curing and meat curing.
The curing of bright tobacco is unique among the curing processes of all other farm products in that it involves both "curing" and "drying" as defined above. The process is frequently described in four stages as yellowing, setting the color, drying the leaf, and drying the stem. The total process typically requires about 95 hours. About 20 hours are required to complete the first or yellowing stage which definitely comes in the category of "curing". An additional time of about 15 hours is required to complete the second or setting the color stage. This second stage is the most critical and important period of the process and involves changing from "curing" to "drying". The last two stages are primarily "drying" operations though some "curing" takes place in the ribs and stem of the leaf.

Some improvements have been made in the application of the process during years past but it is still an art. Science, however, can contribute much to making it a more definite and fool-proof process.

Tests conducted in Australia and the United States have shown that electricity is too costly for heating flue tobacco barns. However, when the proper attention is given to construction of curing barns the time may come when it will prove economical. For instance, some authorities now point out the economy of insulation for curing barns, but as yet the economical thickness and best type of insulation has not been determined. These factors should be easily determined and will become more and more important as the supply of wood becomes scarcer and scarcer.

Electricity is now playing an important part in the curing of tobacco through the operation and control of the coal stoker and certain oil burners. In addition to the coal stoker an electric fan controlled by a humidistat has shown promising results for several years in providing proper ventilation for curing bright tobacco at the Oxford Experiment Station.

Fire losses and other data pertinent to tobacco curing is now being obtained by an Extension Service survey in North Carolina. An estimate, based on
the reports thus far received from 37 counties and the total bright tobacco acreage, shows a total of 180,000 flue tobacco barns existing in the State. Each of the 37 counties has an average of 3,570 barns, of which 68.9 percent are heated with wood, 4.9 percent with coal and 26.2 percent with oil. An average of 66 barns were lost by fire in each county during the 1946 season. Of this loss, 50.9 percent were heated with wood, 3.7 percent with coal and 45.4 percent with oil. Further conclusions should not be drawn until all reports have been received and summarized. This summary will prove very interesting to everyone concerned with the curing of bright tobacco.

The curing of burley and dark-fired tobacco is a simpler and lower cost process than the curing of bright tobacco. Almost no published information on the curing of dark-fired tobacco is available, however, it closely resembles the process applied to the curing of burley tobacco with the exception of the use of smoke from partially smothered fires within the curing barn. The curing of burley tobacco is accomplished by the natural movement of atmospheric air through the barn. A partial control of this air movement and the resultant cure is realized by the manual manipulation of a large number of ventilators.

Growers periodically report serious damage to the burley crop from "house-burn" which occurs during the curing process. Periods of foggy or rainy weather with high humidity are conducive to the development of "house-burn" and under existing curing practices there is frequently no remedy until the condition has caused serious damage. The Kentucky Agricultural Experiment Station has concluded, after extensive investigations, that the use of heat in a (Burley) tobacco-curing barn as a means of reducing the relative humidity is practical.

It seems very probable that the use of an electric fan and artificial heat or both controlled by a humidistat to provide ventilation dependent upon relative humidity within the curing barn would prove a practical solution to burley tobacco curing. Mr. George R. Shier, Consulting Engineer with the Howard S. Sterner Company of Columbus, Ohio, advised the author by letter more than a
year ago, that tests were planned wherein electric fans would be employed in burley tobacco curing barns in Ohio. No report from these tests has been issued

"Ordering" Tobacco

Immediately after bright tobacco is cured it is very dry and brittle and cannot be handled without seriously breaking and damaging the leaf. It is frequently necessary to remove the tobacco from the barn immediately after curing to make room for other tobacco from the field. This means that it must be brought in "order" or in "case" as soon as possible by allowing it to absorb moisture from the air until it becomes pliable and can be handled without damage. The same problem is frequently encountered in handling other types of tobacco.

The rate at which tobacco comes in "order" is dependent upon the relative humidity and temperature of the air surrounding the tobacco. The higher these two factors the quicker tobacco comes in "order". Tests conducted by the Tennessee Valley Authority in cooperation with the Tobacco Experiment Station at Greenville, Tennessee, showed that with air temperature between 73 and 75 degrees F. burley tobacco of the same initial moisture content came in good "order" in three, four and 25 hours with relative humidities at 99, 90 and 86 percent respectively. With air temperature between 40 and 45 degrees F. it was impossible to bright burley tobacco into good "order" during a 16 hour treatment with the average relative humidity at 95 percent. The moisture content of burley tobacco in good "order" ranged between 12 and 22 percent depending upon the grade. No similar information is available for bright tobacco.

Electricity should be well adapted to the "ordering" of tobacco. Small electric steam generators, water sprays or evaporative screens employed with an electric fan and controlled by a humidistat would prove effective for this operation.

Electric Lights for the Tobacco Farm

Lights in haymows, silos, cellars and barns are considered indispensable on most farms where electricity is available. Yard lights, too, have proven
valuable in protecting against thieves and in shortening the time required for after-dark work. During certain seasons there is much handling, loading and unloading of tobacco that must be done after dark.

The use of lights has been almost totally neglected in the windowless tobacco curing barn where the farmer and his helpers spend a lot of time climbing and balancing precariously on tier poles. Here is a need for light as great as that of the dairy barn at milking time. In the flue-tobacco barn it would probably be necessary to install asbestos covered wire and follow other precautionary measure because of the high temperatures encountered during the curing process.
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SELECTED REFERENCES


