



Extension Drought Assistance: Tobacco Irrigation

Tobacco is a relatively drought-tolerant crop. However, the water requirement of the crop is high during periods of rapid plant growth and leaf expansion. The yield and quality of cured tobacco may be significantly increased with proper irrigation. Availability of water for irrigation in the southeastern United States and the cost of irrigation necessitate proper timing of irrigation for optimum crop response and maximum economic benefit to the grower.

Soil characteristics differ widely across the region in which flue-cured tobacco is grown. The soil type present on a farm will determine how, and in what quantity, irrigation water may be supplied. Furthermore, field size and layout will influence the manner in which a grower may most efficiently irrigate and thus affect the cost of irrigation.

FACTORS INFLUENCING IRRIGATION SCHEDULING

Crop Growth Stage. Following an initial establishment period when slight leaf growth occurs, growth rapidly accelerates until flower development and plants are topped. Early research of tobacco plant growth has indicated that over a typical nine-week growth period (from transplanting to flower development), only 2.5 percent of the total growth occurs during the first three weeks following transplanting. During the next three to four weeks the rate of growth increases rapidly and approximately 80 percent of the total growth occurs during the four weeks prior to topping. A severe deficit in soil moisture during this rapid growth phase will greatly reduce the normal growth of tobacco. Cell expansion may be retarded and leaf size significantly

reduced. After topping, drought stress will delay ripening of the leaves.

The availability of water for irrigation and the associated expense are the limiting factors to irrigating tobacco. Therefore, water should be applied to the crop when the maximum benefit will occur.

For purposes of irrigation scheduling, the tobacco production season may be divided into four periods based on stage of crop development:

- **Transplanting**—A light irrigation immediately following transplanting will help settle soil around the roots of transplants and may reduce potential injury from fertilizer salts. Such irrigation will improve the survival of transplants and increase plant stand. However, due to the associated expense and labor constraints at transplanting time, irrigation immediately following transplanting is generally not practical except during periods of extremely dry or hot weather. If irrigation is necessary following transplanting, water should be applied before plants become severely wilted and limited to 0.5 inch.
- **Transplanting to lay-by**—Irrigation of tobacco during this period is generally not recommended. Moderate stress from lack of water between transplanting and lay-by will encourage deeper root penetration into the soil, resulting in better utilization of available soil moisture later in the season.
- **Lay-by to flower development**—The most critical and responsive time for irrigation is the period of rapid growth and leaf expansion between lay-by and flower

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development (topping time). Tobacco during this stage generally requires one inch of water per week supplied through rainfall, irrigation, or both.

Irrigation should be applied frequently enough to supply continual water needs to ensure proper leaf development which will affect both yield and quality. One method to determine when irrigation is necessary is to observe plants for signs of wilt before 11:00 a.m. or if the soil appears ashy in color (color will vary with different soil types). An additional method would be to maintain a water balance sheet for the crop and to supply water (through rainfall and irrigation) at a rate of one inch per week. Soil tensiometers, commonly used for irrigation scheduling in crops such as vegetables and small fruits, are not suitable for use with tobacco. Research conducted in Virginia indicated that irrigation scheduling by tensiometers resulted in overirrigation and reduced leaf quality.

- **Posttopping through harvest**—After topping, the water requirement of tobacco is reduced as leaves mature and ripen. Physiological changes within the plant result in reduced transpirational loss of moisture from the plant. As a result, irrigation following topping and into the harvest period is generally not necessary, except during periods of extreme drought. Extensive irrigation during harvest will usually result in regreening of the leaves and further lengthening of the growing season, particularly with tobacco that has been overfertilized.

Extreme drought stress may also delay the normal ripening process and thus lengthens the growing season. Yield and quality losses occur when leaf margins "burn" or develop necrotic tissue

as a result of high temperatures and drought stress. Also, leaves harvested with inadequate moisture content will not yellow properly and will increase curing costs and decrease quality.

Soil Water-Holding Capacity. The texture or particle size of a soil affects its water-holding capacity and thereby the frequency at which water must be replenished. Sandy or coarse-textured soils have less water-holding capacity than soils composed of smaller particles. Table 1 lists available water-holding capacities of soils used for tobacco production. Other factors, such as soil compaction, surface roughness or cultivation, and organic matter content, will affect the water-holding capacity of a soil.

Table 1. Estimated Available Water-Holding Capacity in the Root Zone of Soils Commonly Used for Tobacco Production (from Collins and Hawks, 1993)

Soil Type	Available Water-Holding Capacity (in.)*
Sands	0.7 to 0.9
Loamy sands	0.8 to 1.2
Sandy loams	1.1 to 1.4
Sandy clay loams	1.2 to 1.5
Fine sandy loams	1.3 to 1.7
Clay and silt loams	1.6 to 2.5

* Inches of available water in the tobacco root zone.

Soil Water Loss and Utilization by the Plant. Plant-available soil water is lost by evaporation directly from the soil surface and through transpiration of plants that use the soil moisture. The sum of the two, evapotranspiration, represents the rate at which soil moisture must be replenished to prevent a moisture deficit and resulting plant-water stress. Estimated values for daily evapotranspiration rates are presented in Table 2. These average rates are

modified by daily temperature and relative humidity, cloud cover, plant growth, and uptake of water.

Table 2. Average Daily Evapotranspiration of Soils in the Coastal Plain and Piedmont of North Carolina (from Collins and Hawks, 1993)

Month	Inch per day
April	0.11
May	0.14
June	0.17
July	0.16
August	0.14

Soil Water Infiltration Rate. The infiltration of water into a soil will greatly influence the rate at which irrigation water should be applied. The ability of water to enter a soil is related to soil texture. Infiltration rates may range from 0.75 to 1.0 inch per hour for sandy soils to less than 0.2 inch per hour for a sandy clay loam. Water infiltration is modified by soil compaction, soil structure, vegetation worked into the soil, and the preexisting water content of the soil. Crusting of the soil surface typically reduces the water infiltration rates. Water applied in excess of the infiltration rate of a given soil will run off the field and thus is not available to the tobacco crop.

SIX MANAGEMENT PRACTICES TO MAXIMIZE UTILIZATION OF AVAILABLE SOIL MOISTURE BY FLUE-CURED TOBACCO

1. Earlier transplanting will allow better root system development before typical dry periods occur. Early transplanting also will reduce exposure of transplants to high temperatures. However, risk of cold temperatures or frost always is present with earlier transplanting, particularly in the

Old Belt of North Carolina and Virginia.

2. Planting on a raised-row ridge or bed will provide better root growth from the warmer soil temperatures that result from better drainage. Form beds early to provide good soil moisture.
3. Reducing injury to tobacco root systems will increase the ability of the plants to utilize available soil moisture. Transplanting too early following soil fumigation, over-application of herbicides, or improper fertilizer placement will result in injury to root systems. The application of fertilizer, chemicals, or both in the transplant water also may result in root injury during periods of dry weather following transplanting. When insecticides are applied in the transplant water, adequate transplant water volume is essential to reduce injury to transplants. Additional plant stress may be avoided by minimizing root injury from improper cultivation.

4. Maintain a soil pH of 5.5 to 6.0 by using lime according to soil test recommendations following regular soil sampling. Proper soil pH will encourage root growth by preventing toxic levels of aluminum and iron, and will increase the early-season availability of phosphorus.
5. Cultivation to break soil crust will increase the infiltration of water from rainfall or irrigation. However, loss of available soil moisture may be reduced by minimizing cultivation during periods of hot, dry weather.
6. Subsoiling of some tobacco soils may improve root growth in compacted soils or naturally occurring hard pans, thus reducing moisture stress during periods of dry weather. Research conducted in North Carolina has shown that yield increases were consistent in the coastal plain where hard pans are more predominant. The most responsive soil series were Norfolk, Wagram, Tomtley, and

Marlboro. Appling and Vance soils were less responsive and Goldsboro and Cecil soils did not respond to ripping or subsoiling.

OTHER CULTURAL PRACTICES TO IMPROVE WATER USE EFFICIENCY

- Avoid overfertilization with nitrogen. Overfertilization delays maturity of the crop and is further worsened by drought conditions.
- Minimize competition for soil moisture from weeds through proper use of herbicides and timely cultivation.
- Early topping and effective sucker control will reduce the plant's demand for water. Sucker control is made more difficult by the wilted condition of plants under drought conditions.

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