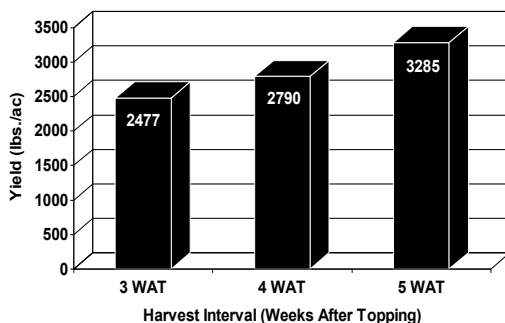


## HARVESTING, CURING, STRIPPING, MARKETING AND TOBACCO SPECIFIC NITROSAMINES

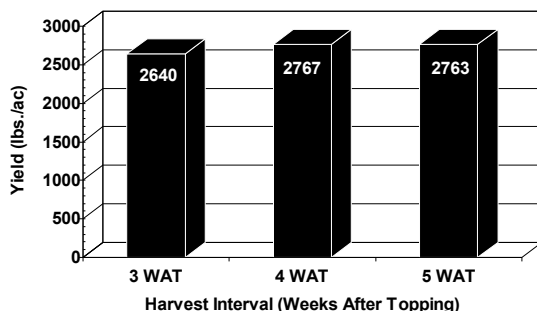
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### Harvesting

Growers should only harvest mature, ripe tobacco. Burley tobacco usually matures and is ready for harvest 3 to 5 weeks after topping, at which time the upper 1/3 of the plant should have a distinct pale green to yellow appearance, and the bottom of the plant should be completely yellow. The midribs of the leaves should fade from a green color to a pale yellow color as the plant ripens. The amount of nitrogen fertilizer applied and soil moisture will have some influence on the time of maturity and, more directly, the quality of the tobacco at maturity. There are also differences among varieties in time of maturing or ripening. Ms KY 14 x L8 is the earliest maturing variety available and NC 2000 is the latest maturing variety. Growers are often hesitant to allow the upper leaves to ripen for fear of losing some of the lower leaves. However, added growth and weight of the upper leaves will usually more than make up for the loss of down-stalk leaves. Generally, growers in the southwest portion of Virginia gain a tremendous amount of yield by waiting at least 4 to 5 weeks after topping before harvesting (Figure 1.). However, this may be different for burley growers in the piedmont area of Virginia. Yields are generally maximized at 4 weeks after topping and can start to decrease between 4 and 5 weeks after topping (Figure 2.). Thus, growers in the piedmont area should look at how long it will take to harvest their crop. If it can be harvested in a week they should let the tobacco stand 4 weeks after topping. However, if it's going to take longer they should start at 3 weeks after topping. Burley tobacco should not be cut sooner than 3 weeks after topping.



**Figure 1. Burley tobacco yields averaged across ten varieties harvested 3, 4, and 5 weeks after topping Glade Spring, VA 2006.**



**Figure 2. Burley tobacco yields averaged across ten varieties harvested 3, 4, and 5 weeks after topping, Blackstone, VA 2007.**

Currently there are several methods of cutting burley tobacco. Some growers allow the tobacco to be cut and placed in piles of 5-6 stalks, and then return to place this tobacco on a stick. Others use two person team, one cuts the plants and hands it back to the other person to spear the plant on the stick. The most efficient method is for one person to cut and spear the tobacco as they go through the field. Tobacco should be cut and speared onto a stick so that the butts of the plants are towards the sun to minimize sunburn damage. Immature tobacco is much more susceptible to sunburn compared to mature tobacco. Sunburnt tobacco can result in a cured leaf with a undesirable green color. Immature tobacco is much more likely to sunburn than mature tobacco.

Under ideal conditions for the best quality burley tobacco should be left in the field on the stick only long enough to wilt sufficiently enough to handle without breaking. However, in many tobacco is so big and heavy it requires more time to loose enough moisture to become light enough for workers to handle. Tobacco should not be left in the field longer than 3 to 5 days unless it is scaffolded, otherwise quality will be sacrificed. It is especially important that the tobacco not be allowed to get muddy. Tobacco placed on scaffolds may be left in the field for up to 12 days with little or no damage from the weather and will lose about 40% in weight.

### Curing

The curing of burley is not a simple drying process but involves a series of physical and chemical changes that begin when the plant is cut and ends when the plant is dry. The major steps include wilting, yellowing, browning or coloring, and drying. The entire process requires six to eight weeks.

Optimum curing conditions occur when temperature is in the general range of 60-90°F and relative humidity is 70-75%. In the early stages of curing, it is impractical to attempt to maintain these optimum ranges through a 24-hour period. In normal weather, the humidity within a barn filled with

green tobacco will approach 100% each night. A good cure can still be obtained if ventilation is provided to dry out the barn the next day.

Most burley barns in Southwest portion of Virginia are extremely open and allow for over ventilation. Thus, when ambient conditions are drier than ideal, tobacco can cure up “variegated”, “K” or “paw-pawed”. This tobacco has a mottled or yellow color to the leaf. This is a result of an incomplete cure where the tobacco simply dried down rather than cured down. Ideally barns should be built or remodeled to allow for management when ambient conditions are less than ideal.

Houseburn can be a problem in curing burley if humidity and temperatures are high for an extended period of time. It may be called many other names such as barn rot, pole sweat, stem mold, leaf rot, and others; but it is a partial decay of tobacco tissue during the curing process. It is caused by several species of fungi and bacteria that are present on tobacco leaves. Injury occurs when these micro-organisms attack leaves that become moist during periods of high humidity that last longer than 24 hours. Damage can be measured in weight loss and lowered leaf quality and can range from mild to severe. Symptoms include a white or gray mold and an odor of rotting tobacco. Injury is worse on the lower tiers and on the leeward side of the barn.

Supplemental heat can be an advantage during rainy weather or prolonged periods of high humidity. The objective in using heat is to raise the temperature within the barn only 6-8°F or just enough to dry the leaf surface and thereby prevent the proliferation of organisms that cause houseburn. Some type of heat spreader should be used on burners to prevent hot spots that can set undesirable colors in the curing leaf. Maximum temperature increases should not exceed 10-15°F. Heat can also be used to prevent setting green color by freezing on freshly harvested late-cut tobacco. Few growers have the capability of adding heat and must rely on managing air flow.

Many curing problems can be relieved or prevented by proper manipulation of barn equipment. Generally, ventilators and doors should be open during fair weather and closed during rainy weather and at night. This process can be reversed during extremely dry weather when tobacco is curing too fast. New barns should be located on high ground with good air circulation and with the long side exposed to prevailing winds.

Much tobacco in Virginia is cured on some type of field-curing structure. The curing environment is managed primarily by stick spacing and cover management. Stick spacing should be much closer in this type of structure, approximately 4-5 inches. **All curing structures should be covered & managed.** Curing burley tobacco without on curing structures without covering and management reduces quality and yield of cured leaf. A general recommendation would be to leave the sides of the cover up during the yellowing stage of curing and then lower the sides for the rest of the

curing process. An exception would be during hot dry conditions the sides should be lowered during the day to slow down the curing process. Tobacco should be removed from the field-curing structure as soon as possible after the curing process is completed. This will minimize damage due to weather, primarily wind.

### Stripping and Marketing

Stripping the leaves from the stalk and sorting into groups enables leaf buyers to obtain the specific grades needed by the manufacturer. The one priced market in the early 1990's resulted in much of our burley being graded into one or two grades. The biggest advantage we have in U.S. burley production is quality. If not properly separated by stalk position, quality is sacrificed and the overall sustainability of burley production in Virginia is weakened.

Generally there are four distinguishable grades of tobacco on a stalk. These grades include Flyings (X), Lugs (C), Leaf (B), and Tips (T). The flyings group (X) consists of leaves grown at the bottom of the stalk. These leaves are flat and have a blunt or oblate tip. They are relatively thin bodied and show a certain amount of injury. The lug group (C) consists of leaves which grow above the flyings and up to about midportion of the stalk. These leaves have a rounded tip and, when cured have a tendency to fold and conceal the midrib. They are thin to medium bodied. The leaf group (B) is made up of leaves grown above the lugs. The cured leaves, especially from the upper stalk position, have a tendency to fold and conceal the face of the leaf. These leaves are medium to heavy bodied. The tips (T) are those top 3 or 4 leaves at the top of the stalk. They have same general characteristics of the leaf group. The practice of mixing grades may offer a slight labor savings, but it does not meet the needs of most buyers. With an over-supply situation and a weak market, mixed tobacco generally sells for less than properly sorted good quality leaf. Three groups is the least number that should be used in preparing any burley crop for market. Currently much of the burley purchased in Virginia is purchased through a contract rather than the auction system. Some manufacturers will now require that tobacco be separated into four grades. Frequently, there will be no leaves in a crop short enough to grade in the tip (T) group. Buyers complained about a shortage of tip grades available from recently marketed crops. Generally there will be enough difference in color and body in upstalk tobacco to warrant a separation into bright leaf and red leaf, especially if tobacco is topped at 22-24 leaves. For pictures of burley grades and more information on grading burley tobacco go to the Southern Piedmont website:

<http://www.arec.vaes.vt.edu/southern-piedmont>

Tobacco should not be stripped or baled in too high or too low moisture content. Dry leaf lamina is easily shattered and ruins the usability of the leaf. High moisture tobacco will easily over-heat and mold and will

damage in handling. It has also been proven that tobacco stored at a high Moisture level results in higher levels of tobacco specific nitrosamines (TSNA's). Moisture content should be between 18 and 22% for proper handling and storage. Many tobacco manufactures and leaf dealers will reject tobacco if above a moisture content of 23.9 percent.

### Large Bales

Most buyers have shown a preference for tobacco to be marketed in large flue-cured type bales. These bales range in weight from 550-650 pounds. By requiring the handling of burley tobacco in bulk and by allowing "tangled leaf" baling compared to the oriented-leaf method used in traditional burley bales large growers can save a significant amount of labor. However, the labor savings must be balanced between the increased equipment and facility costs to operate the large bale system. Growers that continue to market burley tobacco in traditional small bales are usually penalized in price for their tobacco. Small bales may soon be unacceptable for marketing burley tobacco.



Figure 3. Example of a large baler and bales of burley tobacco.

### Tobacco Specific Nitrosamines (TSNA)

Nitrosamines are nitrogenous compounds, some of which are carcinogenic. They are found in a wide range of food and cosmetic products, as well as in tobacco. TSNA's, tobacco specific nitrosamines, are so called because they are formed only from tobacco alkaloids and found only in tobacco leaf and in the particulate phase of tobacco smoke. With the current emphasis on the health risks of tobacco, TSNA reduction has become a major issue for the tobacco industry.

Several tobacco-specific nitrosamines have been identified, but interest has focused on the four most important: NNK, NNN, NAT and NAB. Of these, NNN is the most important in burley and dark tobacco.

### How Are TSNAs Formed?

Negligible amounts of TSNAs are present in freshly harvested green tobacco. They are mainly formed during curing, specifically during the late yellowing to early browning stage. This is usually in the two-week period from three weeks to five weeks after harvest.

TSNAs are formed by the nitrosation of tobacco alkaloids (addition of a nitrogen and an oxygen atom to the alkaloid molecule). NNN is formed by the nitrosation of the alkaloid nornicotine. The nitrosating agent in air-cured tobacco is usually nitrite, derived from the reduction of leaf nitrate by the action of microbes during curing. Both the alkaloid and the nitrosating agent are necessary for the formation of TSNAs. Any practices or conditions which increase the accumulation of either of these groups of compounds would be expected to increase TSNAs.

### Best management practices for minimizing TSNAs

TSNA formation is a very complex process, and one cannot consider any of the factors contributing to it in isolation. All of these factors interact, and that is why different treatments sometimes result in TSNA differences and sometimes do not. The following is a list of practices that will contribute to lowering TSNAs.

- Use LC or screened seed
- Choose the most suitable variety, with the appropriate disease resistance package
- Use no more nitrogen than necessary to optimize yield
- Avoid spring applications of muriate fertilizers
- If sidedressing, apply sidedressing at the recommended 4-5 weeks after transplanting.
- Harvest at correct maturity, ideally 4 weeks after topping
- Avoid overpacking the barn and space sticks and plants on sticks evenly
- Manage air-curing carefully, ensuring adequate but not excessive ventilation, and avoid houseburn
- Allow burley tobacco to come into case naturally and use minimal artificial casing for dark tobacco, ideally misting systems instead of steam
- Do not leave tobacco in storage longer than necessary; strip, bale and deliver tobacco as soon as possible
- Keep moisture in the leaf as low as possible; do not put high moisture tobacco into storage, and do not deliver tobacco with moisture higher than that specified in the contract.