

Topping and Sucker Control

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Introduction

The emergence of the flower buds in a tobacco crop signals a shift from a vegetative growth stage to a reproductive growth stage. Flower buds must be removed and suckers controlled to allow the crop to reach its full yield and quality potential at harvest. Timely topping and sucker control practices allow more efficient harvest when the crop reaches maturity.

Topping

Topping refers to the removal of the flower bud along with some of the uppermost leaves in order to stimulate growth and development of the remaining leaves. When left untopped or topped late, tobacco plants put energy into flower and seed production rather than leaf production, resulting in substantial yield losses. Topping removes the dominant influence of the terminal bud over lateral buds or “suckers,” stimulating vigorous sucker growth that must be controlled. Topping also stimulates root growth, which increases nicotine production in the roots and translocation to the leaves. Secondary plant products that accumulate in the leaves and improve quality and smoking characteristics also increase after topping. Topped tobacco is much less prone to being blown over, since the plant is less top-heavy and root growth is enhanced.

Early topping reduces the populations of insects, such as aphids and budworms that are attracted to the terminal bud and flower. Early topping is also easier than later topping, since stalk tissue is softer and much easier to break. Later topping takes more time, in the removal of both the flower and suckers. Unless knives or clippers are used, tobacco topped late usually results in bruised, ragged stalks that are more susceptible to diseases such as bacterial soft rot (hollow stalk).

Most importantly, tobacco should be topped at a stage and height that will maximize yield and quality and satisfy the preferences of the buyer.

Topping Burley Tobacco

Bloom Stage

Research has shown that topping burley tobacco at 10 to 25% bloom generally provides the best yield and quality. This means that 10 to 25% of the plants in a field will have at least one open flower. Bloom stage at topping may also depend on the length of time the tobacco will remain in the field before harvest. Yields of burley tobacco topped at 75% bloom may be similar or better than tobacco topped at 10 to 25% bloom if harvested at three weeks after topping, whereas tobacco topped at 10 to 25% bloom and harvested six weeks after topping may have improved yield but lower quality.

Later-maturing varieties, such as KT 206, KT 209, N7371, and HB3307, may respond well to bud topping while bud topping may reduce yields in other varieties. NC 7 and KT 210 are extremely late-maturing varieties that require bud topping and may also require several leaves to be removed with the bud to prevent the plant from getting too tall in some seasons. Specific varieties may need early topping to produce their best quality. Early-maturing varieties such as KY14xL8 or KT212 that have more potential for high sucker pressure will also benefit from early bud topping to improve quality and improve management of suckers. Early topping will not affect yields if other factors, such as harvest time after topping, remain constant.

Leaf Number

Optimum leaf number for burley tobacco topping is generally 22 to 24 harvestable leaves. Some marketing contracts now encourage a true tip grade (T), and topping to this number of leaves allows the plant a better opportunity to produce a true tip. Yield effects of topping height are also dependent on timing of harvest. Tobacco topped to 24 leaves tends to yield slightly more than tobacco topped to 20 leaves and is more likely to have true tips. Too many extra leaves increase stripping labor and may increase the incidence of houseburn in older barns that have less space between tiers. Extra leaves beyond 24 do not necessarily mean extra yield. Root development dictates leaf production potential; therefore, extra leaves usually mean smaller leaves. Topping to the right number of leaves may require a slightly later topping time in order to produce tips. However, delays beyond 75% bloom will be counterproductive. A balance must be found between extra labor required to produce those leaves, the yield per acre, and premium for tips at the market.

Topping Dark Tobacco

Bloom Stage

Dark tobacco can generally be topped anytime between the elongated bud stage and 50% bloom without causing a significant impact on yield. Dark tobacco crops are usually more irregular than burley crops, with wide variations in bloom stage at the time of topping. It is not uncommon for some plants to have open flowers while other plants are at the early bud or even pre-bud stage. For this reason, it may be advisable to make two toppings. Attempting to make one topping on irregular crops lowers the yield potential of smaller plants. Increased yield incurred by allowing smaller plants to catch up usually compensates for extra labor required in making two toppings.

Leaf Number

Dark tobacco should be topped to 16 to 18 harvestable leaves. Topping to this height maximizes yield potential and allows a distinct characterization of lug, second, and leaf grades that are desired by the industry. Lower topping to 12 to 14 leaves does make tobacco easier to handle on the stick during housing and may cure better in older barns with narrow tier spacing, but also results in mostly lug and leaf with little or no true seconds. Plants topped to 12 to 14 leaves do compensate somewhat by producing larger leaves, but yield is still reduced by 200 pounds per acre or more compared to tobacco topped to 16 to 18 leaves.

Sucker Control for Burley and Dark Tobacco

Many of the benefits in topping at the appropriate bloom stage and leaf number are lost if suckers are not controlled. Suckers grow vigorously immediately after topping and can severely reduce yield and quality if not effectively controlled. Some varieties, such as KY 14xL8 and Narrowleaf Madole, are known to have more rapid sucker growth than other varieties and may require more aggressive sucker control strategies. Three types of chemicals are available for controlling sucker growth on tobacco:

- **Contacts.** These chemicals are not absorbed by plants and must have direct contact with suckers and leaf axils, where they physically burn tender suckers.
- **Local systemics.** These chemicals must also have direct contact with leaf axils, but are absorbed into the plant at the leaf axil area and retard sucker growth by inhibiting cell division.
- **Systemics.** These chemicals do not have to come into direct contact with suckers. They are absorbed by the plant and move internally to leaf axil areas, where they retard sucker growth by inhibiting cell division.

In addition, some products (FST-7, Leven-38, Plucker Plus, and others) are mixtures of two of these chemical types.

Contacts

Contact chemicals contain fatty alcohols as the active ingredient and form a milky-white emulsion when mixed with water at the proper dilution. Contact chemicals are available under many trade names, such as Off-Shoot-T, Royaltac, Royaltac-M, Fair-Tac, Fair 85, Sucker-Plucker, Antak, and others. In university trials, all of these products have performed similarly when used under the same conditions. Fatty alcohols burn suckers that are shorter than 1 inch on contact, and sucker buds should turn brown or black within one to two hours after application. Fatty alcohols are rainfast at one hour after application and can be applied 24 hours before topping or within one day after topping. Contact chemicals will control suckers for five to 10 days. Any suckers longer than 1 inch will not be fully controlled and should be removed prior to applying fatty alcohols. Contacts should be applied so that the materials run down the stalk and come into direct contact with all leaf axils. Missed suckers are common with contacts applied to crooked or leaning tobacco, so it is a good practice to straighten crooked tobacco before application, if possible. The proportion of fatty alcohol to water is critical to the effectiveness of these chemicals. If the concentration is too weak, suckers will not be controlled, and if it is too strong, the suckers, leaves, and leaf axil will be burned and leaf loss could occur. A 3 to 5% solution is suggested on labels for contact chemicals. General recommendations are 3 to 4% solution for burley tobacco and 4 to 5% solution for dark tobacco, with the lower concentration used in initial applications and the higher concentration used in follow-up applications. For powered spray equipment, use 1.5 to 2.5 gal of contact chemical in 50 gal of total spray solution per acre (3 to 5% solution). For stalk-rundown applications with backpack or hand sprayers, a 3 to 5% solution is 12 to 19 fl oz of contact chemical per 3 gal of total spray solution. Use of agitation is recommended, since the fatty alcohols are lighter than water and will float on the water in the spray tank. Fatty alcohols should be added to the spray

tank while adding water to promote dispersal. Avoid using cold water when mixing, as these products may not totally disperse.

Most contact products used in tobacco have been blends of 3 different fatty alcohols. Chemically, fatty alcohols are long, straight-chain alcohols that are referred to by the number of carbon molecules present. Examples of blended fatty alcohols include Off-Shoot-T, Royaltac-M, Fair 85 and Sucker Plucker. These products are blends of C₈, C₁₀, and C₁₂ fatty alcohols. Since 2015, contact manufacturers have begun to market products, such as Royaltac and Antak, that only contain the C₁₀ fatty alcohol. Research in 2015 and 2016 has shown that C₁₀ fatty alcohol products provide sucker control that is equivalent to control from blended fatty alcohol products, and may be used at slightly lower rates than blended products (3 to 4% solution for burley and dark tobacco).

Local Systemics

Butralin, Prime+, Flupro, and Drexalin Plus are the local systemic products currently available. Butralin and flumetralin (Prime+, Flupro, and Drexalin Plus) are the active ingredients in these products. All belong to a family of chemicals called dinitroanilines and have similar use recommendations. When properly mixed with water, Butralin makes an orange emulsion, while flumetralin products make a yellow emulsion. Local systemics should be applied in a manner similar to application of contacts, so that the chemical runs down the stalk and contacts every leaf axil. Suckers longer than 1 inch should be removed prior to application. Local systemics do not burn suckers like contacts but rather stop sucker growth, with suckers remaining as a pale greenish-yellow tissue for several weeks after application. Applications of local systemics can be made with powered spray equipment or with backpack or hand sprayers.

Local systemics generally require three hours without rain after application to be effective. The activity of local systemics in stopping cell division can also cause distortion of small, upper leaves that come into contact with the chemical. For this reason, applications of local systemics should be delayed until upper leaves are at least 8 inches long. If upper leaves are less than 8 inches long and manual stalk rundown applications are made, direct the spray below these smaller leaves. If a local systemic is being applied alone, a rate of 1 gal/A should be used (1 gal/50 gal total spray solution or 8 fl oz (0.5 pt) per 3-gal spray solution). Local systemics, particularly those that contain flumetralin, are much more persistent in the soil than other sucker control chemicals, and severe damage can occur to subsequent crops, particularly grasses. For this reason, care should be taken not to use excessive amounts of these products. If manual stalk rundown applications are made with drop lines, backpack, or hand sprayers, care should be taken to prevent pooling of the solution at the base of the stalk. Use only enough solution to wet the stalk and suckers on each plant; 0.5 to 0.75 fl oz of spray solution per plant is sufficient. Reduced rates of local systemics can be used if tank-mixed with contacts or systemic products. Use 3 qt local systemic per acre when tank-mixing with contacts and 2 qt/A when tank-mixing with systemic sucker control products. Butralin and Flupro may only be applied once per season. Drexalin Plus may be applied twice per season, but at rates of no more than 0.5 gal/A per application. In North Carolina only, Prime+ may be applied twice per season at up to 0.5 gal/A per application.

Systemics

Maleic hydrazide (MH) is the only true systemic product available for sucker control in tobacco. Since it is absorbed through the leaves and moves to actively growing sucker buds, it does not have to directly contact leaf axils to be effective. However, good soil moisture at the time of application is required to allow adequate absorption by leaves. Similar to other types of chemicals, MH does not control larger suckers, and these should be removed before application. MH should be applied as a foliar spray with powered equipment, since plant-to-plant stalk rundown applications do not allow enough leaf contact for adequate absorption into the plant. Absorption into the plant is also enhanced by using nozzles that produce coarse spray droplets as opposed to fine mist nozzles. Similar to local systemics, MH retards the growth of small upper leaves, and plants should be topped to a leaf no smaller than 8 inches long before MH is applied. MH products are available in three formulations: a regular liquid concentrate containing 1.5 lb MH/gal (Royal MH-30, Super Sucker-Stuff, Fair Plus), a higher concentrate liquid containing 2.25 lb MH/gal (Royal MH-30 Xtra, Sucker-Stuff, Fair 30), and a dry formulation (Royal MH-30 SG or Fair 80SP) that contains 60% MH by weight. Regardless of the formulation, the recommended rate of MH if used alone should be equivalent to 2.25 to 3 lb of active ingredient (MH) per acre (1.5 to 2 gal product per acre) and 1.5 lb to 2.25 lb ai per acre (1 to 1.5 gal product per acre) when used in combination with a local systemic. Product formulations and concentrations of all available MH formulations are shown in Table 1. Refer to product labels for specific use rates and other recommendations for each product.

The regular liquid concentrate (1.5 lb active ingredient/gal) is the most widely used form of MH in Kentucky, Tennessee, and Virginia and is the formulation discussed in this article unless otherwise noted. Regular-concentrate MH used alone can be applied at a rate of 1.5 to 2 gal/A. Recommended use rate for high-concentrate MH is 1 gal/A, which is equivalent to 1.5 gal/A of the regular concentrate. All MH formulations should be applied at a spray volume of 50 gal/A. MH is most effective if no rain occurs within 12 hours after application. If significant rainfall occurs within three hours after application, reapply at the full application rate. If rainfall occurs between three and six hours after application, reapply at one half the full application rate on the following day. If no rainfall occurs within six hours of application, MH does not need to be reapplied. There is an increased chance of leaf burning from MH if applied on bright, sunny days where the temperature is above 90°F. The optimum time to apply MH is on overcast or hazy days or in the morning during hot, clear weather. MH is more active in controlling sucker growth than other chemicals, and the most consistently effective sucker control programs include an MH application. In the past, it was

Table 1. MH product formulations currently available.

MH product	Lb MH per gal liquid or % MH dry
Regular concentrate MH products	
Royal MH-30	1.5
Super Sucker Stuff	1.5
Fair Plus	1.5
High concentrate MH products	
Royal MH-30 Xtra	2.25
Sucker Stuff	2.25
Fair 30	2.25
Dry MH products	
Royal MH-30 SG	60
Fair 80SP	60

Table 2. Sucker control, yield, quality grade index, and MH residue in tips of burley tobacco treated with recommended and reduced rates of MH—MSU West Farm, Murray KY, 2011

At topping	7 days after topping	% Sucker control (0-100%)	Sucker wt (lbs) per 30 plants	Total burley yield (lb/A)	Quality grade index (1-100)	MH residue in tips (ppm)
OST (2 gal/A)	RMH (1.5 gal/A) + Flupro (0.5 gal/A)	98	3.4	2620	57.4	89.8
OST (2 gal/A)	RMH (1 gal/A) + Flupro (0.5 gal/A)	93	5.2	2548	56.6	49.5

Abbreviations: OST = Off-Shoot-T, RMH = Royal MH 30 (1.5 lb/gal ai formulation). All treatments were applied using 60 gal/A of solution with TG-5 nozzles in 3-nozzles/row arrangement. Burley variety was NC 7. Tobacco was harvested approximately 5 weeks after topping (4 weeks after MH application).

common to use MH alone at the highest rate allowed for burley sucker control. However, there have been concerns in the industry about excessive MH residue on cured leaf, and major efforts have been made to reduce or even eliminate MH residues on burley tobacco. A mixture of MH at a reduced rate in combination with a local systemic is generally a better choice than MH alone. In addition, research has shown that MH applications made in the morning may result in lower MH residues on cured leaf than applications made later in the day.

MH and Local Systemic Combinations

An effective way to reduce MH residues without compromising sucker control is to use lower rates of 1 to 1.5 gal/A of regular-concentrate MH in combination with 2 qt/A of a local systemic applied with coarse nozzles. The combination with 1.5 gal/A MH consistently controls suckers as well as the full 2 gal/A MH rate and reduces MH residues. MH residue testing on cured leaf samples has shown that MH residues vary considerably from year to year and from one location to another (Table 2). The MH residue level of a particular cured leaf sample is influenced by the rate of MH applied, the amount and intensity of rainfall received after application, and the amount of time elapsed between application and harvest. To avoid high residue levels in cured leaf use the lowest rate of MH that will provide acceptable sucker

control, and allow at least 3 to 4 weeks between application and harvest. The lower 1 gal/A rate (regular concentrate) will reduce residues, and has often provided sucker control that was equivalent to the 1.5 gal/A rate in research trials (Table 2, Table 3, and Table 4). However, the 1 gal/A rate can be less consistent and give less than desired sucker control if the material is not properly applied or if applied during unfavorable conditions. Consistent success with reduced MH rates in combination with a local systemic requires application to tobacco which is straight, not under extreme drought stress, and in evenly spaced rows, using properly calibrated equipment and nozzles properly positioned above the row to give good stalk rundown.

Premixed Combinations

FST-7 and Leven-38 are prepackaged mixtures of MH and the contact n-decanol. Since both contain less MH (0.66 lb/gal) than other MH products, the maximum application rate is 3 gal/A. Reduced rates can be used if these products are tank-mixed with local systemics. They should be applied as a coarse spray with powered spray equipment in a spray volume of 50 gal/A to cover the top third to top half of the plant, allowing the solution to run down the stalk to the bottom of each plant. Since the active ingredients in both products tend to separate in the container, make sure the container is well mixed and shaken before its

Table 3. Impact of MH rate on cured-leaf MH residues by year and location for selected treatments from the regional burley sucker control trials

MH rate lb ai/A (gal/A)	TN ¹	VA	NC-LS	NC-R	KY
	Parts per million MH residue on cured leaves (average of all stalk positions)				
2010					
3.00 (2.0) ²	75	34	48	129	123
2.25 (1.5)	45	18	25	56	105
1.50 (1.0)	23	10	11	35	42
2011					
3.00 (2.0)	76	26	48	118	--
2.25 (1.5)	56	14	17	64	--
1.50 (1.0)	23	10	15	54	--
2012					
3.00 (2.0)	24	18	40	66	108
2.25 (1.5)	15	14	16	57	50
1.50 (1.0)	10	11	13	20	26

¹ Locations for the regional sucker control trial include Greenville, TN; Glade Spring, VA; Laurel Springs, NC; Reidsville, NC, and Lexington, KY. Application methods differed by location but all were targeted to deliver 50 gallons per acre of sucker control solution.

² 3.00 lbs ai/A = 2 gallons per acre regular concentrate; 2.25 lbs ai/A = 1.5 gallons per acre regular concentrate; 1.5 lbs. ai/A = 1 gallon per acre regular concentrate.

Table 4. Impact of MH rate alone or in combination with a local systemic on sucker control and yield in burley tobacco averaged across four locations

Sucker control treatment	% Sucker control	Cured leaf yield (lb/A)
2011		
Check Topped No Sucker Control	0.0	2434
MH 3.00 lbs ai/A (2.0 Gal/A)	98.9	2813
MH 2.25 lbs ai/A (1.5 Gal/A)	99.0	2904
MH 2.25 lbs ai/A (1.5 Gal/A) + 1% FluPro (0.5 Gal/A)	99.2	2826
MH 1.50 lbs ai /A (1.0 Gal/A) +1% Flupro (0.5 Gal/A)	98.9	2733
2012		
Check topped no sucker control	0.0	2559
MH 3.00 lb ai/A (2.0 Gal/A)	95.0	2970
MH 2.25 lb ai/A (1.5 Gal/A)	93.7	2992
MH 2.25 lb ai/A (1.5 Gal/A) + 1% Prime+ (0.5 Gal/A)	98.4	2983
MH 1.50 lb ai /A (1.0 Gal/A) +1% Prime+ (0.5 Gal/A)	89.3	2836

contents are added to the spray tank. Constant agitation in the spray tank should be used with FST-7, Leven-38, and all other sucker control products. Plucker Plus is a fairly new prepackaged mixture of flumetralin and a blend of three contact fatty alcohols that has recently been registered for use on tobacco. Plucker Plus contains less flumetralin (0.24 lb/gal) than other flumetralin products, so the maximum application rate is 2.5 gal/A. Up to two applications of Plucker Plus can be made per season, at 1.25 to 2.5 gal/A per application. Plucker Plus must be applied in a manner to achieve stalk run down of the material.

Application Methods for Sucker Control Chemicals

Four methods of application are currently being used to apply sucker control products to tobacco: powered spray equipment, drop lines, backpack or hand sprayers, and jugs.

Powered Spray Equipment for High Clearance, Over-the-Top Application

Use of powered spray equipment is the most labor-efficient method of applying sucker control products, as this method typically requires only one person and many acres can be covered in a day. Any type of sucker control product can be applied through powered spray equipment, although adequate coverage to achieve the best control generally requires high-volume spray output and straight, uniform tobacco. Coverage is the key to success with any sucker control application, particularly applications of contact chemicals and local systemics that must cover every leaf axil to be effective. Thorough coverage of all leaf axils requires a minimum of 50 gal/A spray volume, and coverage may improve on many crops as spray volume is increased to 60 or 70 gal/A. Pressure should be 20 to 30 psi.

Nozzle Arrangement

Broadcast applications and applications directed to the tobacco row are two types of nozzle arrangements that can be used. Broadcast or "straight-boom" arrangements using 20-inch nozzle spacing (for 40-inch rows) provide even coverage over the row and the row middle. Applications directed to the tobacco row involve multiple (three or more) nozzles per row. This method usually involves a nozzle placed directly over the row and two nozzles placed on either side of the row and directed at a slight angle into it. Broadcast applications usually provide the best coverage if tobacco is leaning or if row spacing is inconsistent, while directed applications may be preferred if tobacco is straight and row spacing is consistent. Even a slight misalignment of nozzles over each tobacco row with the directed method can result in poor sucker control on those plants. Spraying only two or four rows at a time instead of using the entire boom can improve alignment with the tobacco. This is especially important if using reduced MH rates or no MH where stalk rundown is required. If no MH is used, directed applications with the 3-nozzle system may provide better sucker control than broadcast applications, provided tobacco is straight and row spacing is consistent. "Conveyor hoods" are funnel-type devices that can be attached to the spray boom over a 3-nozzle arrangement to "funnel" the spray solution through an opening aligned over the row in order to concentrate the solution down the stalk of plants. Field trials in Kentucky in recent years comparing sucker control and MH

residue with conveyor hoods and standard 3-nozzle/row applications have shown no consistent benefits of conveyor hood applications, and reduced sucker control if tobacco is crooked.

Nozzle Selection

Nozzles that allow high output and produce coarse spray droplets are preferred for all sucker control applications. Coarse droplets tend to penetrate through the leaf canopy and reach all leaf axils down the stalk better than fine droplets. Full-cone nozzles such as TeeJet's TG-3, TG-4, TG-5, and TG-6, or their equivalents, are commonly used with powered spray equipment for over-the-top applications. The three-nozzle arrangement used for directed applications may be a TG-5 over the row and TG-3's on each side directed toward the row. Other combinations may also be effective. Broadcast applications can be made with all TG-3's or all TG-5's. Use TG-3's for more hilly terrain where traveling speeds are in the 2.5- to 3.5-mph range. For flatter ground where speed can be increased to 4 to 5 mph, use TG-5's or their equivalent to achieve the desired spray output.

Drop Line Applications

Drop line applications involve a high-clearance sprayer with hoses for each row attached to the boom. A spray trigger is attached to the end of each hose for operation by a worker walking behind the sprayer. Drop lines are used with plant-to-plant stalk rundown applications of contacts and local systemics. This method provides more direct sucker contact and generally provides better control than over-the-top applications but is labor intensive and requires a slower pace to accommodate workers. The speed of the sprayer can only be as fast as the slowest worker. Practice may be required for workers to become accustomed to the appropriate rate of application, particularly on crooked tobacco that may require directing the application to several areas on the stalk. On tall tobacco, missed suckers can be common in the top of the plant, but misses are less common than with other methods. Apply 0.5 to 0.75 fl oz of spray solution to each plant, with care taken to avoid applying excessive amounts that will pool on the ground at the bottom of the plant. Product rates per acre are the same as with any application method, although volume of spray solution required for drop line applications will be 20 to 40 gal/A depending on plant population and how straight the crop is, significantly less than the volume used in over-the-top applications. Drop lines work well for local systemic applications to plants with upper leaves smaller than 8 inches, since the applicator can direct the spray below these smaller upper leaves. Where applications are directed below small upper leaves, a second sucker control application should be made to those plants within seven days to cover leaf axils of upper leaves. Although slow and labor intensive, drop line methods are very effective in sucker control programs that do not include MH. Personal protective equipment (PPE) must be employed when using this application method. See **WORKER PROTECTION STANDARD UPDATES** on page 72 for more information.

Backpack and Hand Sprayer Applications

Backpack and hand sprayer applications are similar to drop line application methods, in that each worker applies 0.5 to 0.75 fl oz of spray solution to the top of each plant to run down the stalk. The backpack or hand sprayer consists of a small, 2 to 3

gal spray tank and a wand attachment that can be fitted with a coarse spray nozzle. This method may have an advantage over the drop line method in that each worker is independent of others and speed is not dictated by the slowest worker. Small-acreage growers using plant-to-plant stalk rundown applications prefer this method. See WORKER PROTECTION STANDARD UPDATES on page 72 for PPE requirements.

Jug Applications

Jug applications involve adding the chemical to a gallon jug with water and pouring 0.5 to 0.75 fl oz of solution down the stalk of each plant. One gallon of spray solution should treat 170 to 256 plants. Although the jug method is the simplest of all methods, it is more difficult to apply consistent amounts to each plant. Some small-acreage growers may still prefer the jug method. See Table 5 for conversion of product rates from gallons of product per 50 gallons of spray solution to ounces of product per gallon of spray solution. See WORKER PROTECTION STANDARD UPDATES on page 72 for PPE requirements.

Chemical Topping of Burley Tobacco

“Chemical topping” refers to the concept of making a suckercide application to untopped burley tobacco that will effectively stop growth of the terminal bud and control axillary sucker growth without manual topping. If successful, this practice of chemical topping could save five man-hours per acre or more in manual topping costs. A three-year study has just been completed on the feasibility of chemical topping of burley tobacco. This research showed that chemical topping was effective in eliminating the need for manual topping, without sacrificing yield (Table 6) or leaf quality, provided the following guidelines are used:

- Use a late-maturing variety such as KT 210 (which was used in this research), NC 7, HB4488, or KT 215. Timing of the suckercide application at the appropriate bloom stage is critical to success with chemical topping, and later maturing varieties such as these take more time to progress through the bloom stages, allowing more time to make the application at the appropriate time. Early-maturing varieties such as KY 14xL8 and KT212 should be avoided for chemical topping.
- Make an application of MH (2.25 to 3 lbs ai/A, 1.5 to 2 gal/A regular concentrate MH) tank-mixed with local systemic

such as Butralin or a flumetralin products (Prime+, Flupro, or Drexalin Plus) at 0.5 gal/A using standard application techniques when 10 to 50% of the plants in the field are at a pre-button stage when only the top of the flower head is showing between the leaf sheath of the bud. Tobacco may only be 4 to 5 ft. tall at this stage. This application timing will be approximately one week prior to when the tobacco would normally be manually topped at 10 to 25% bloom. Making the chemical topping application at timings later than 50% pre-button will likely allow continued elongation of the terminal bud, resulting in plants that are too tall to be manageable for harvest and housing.

- Tobacco will need to stand 4 to 5 weeks between the chemical topping application and harvest, which may be a few days longer than it would stand following manual topping.

Sucker Control Strategies for Burley Tobacco

Uniform Crops

For most crops that are uniform and can be topped one time, use 1 to 1.5 gal/A MH (regular 1.5 lb/gal formulation) with 2 qt/A of a local systemic as an over-the-top application with powered spray equipment. Top tobacco at 10 to 25% bloom, and remove all suckers longer than 1 inch. Spray applications can be made within one day before or after topping. If upper leaves will be less than 8 inches long at topping, apply a contact at topping and then follow with 1 to 1.5 gal/A MH (regular 1.5 lb/gal formulation) plus 2 qt/A of a local systemic seven days later. Research has demonstrated that sucker control from contact applications can be more effective when applications begin just before topping.

Uneven Crops

The most common cause of sucker escapes is a delay in topping until suckers have reached a size that is difficult to control. Tobacco topped later than 50% bloom can have suckers near the top of the plant that are more than 1 inch long. These suckers will escape control if not removed by hand at topping, and a second application to these suckers will also result in poor control. This situation commonly occurs in uneven crops. One solution is to make two toppings. However, the best solution may depend on the degree of unevenness. Three strategies for uneven crops are:

- If the crop is not drastically uneven, the best approach may be to top all plants, leaving a small leaf (approximately 6 to 8

Table 5. Conversion chart for gallons product per 50 gallon spray solution to fluid ounces product per gallon solution

Gallons product per 50 gal/A solution	Fluid ounces product per 1 gallon solution
0.5	1.3
0.75	1.9
1.0	2.6
1.25	3.2
1.5	3.8
1.75	4.5
2.0	5.1
2.25	5.8
2.5	6.4
2.75	7.0
3.0	7.7

Table 6. Burley total yield (lbs/A) from chemically topped treatments compared to manually topped tobacco. Data averaged over location (Princeton and Lexington KY) and year (2016 and 2017).

Treatment	Burley Tobacco Yield (lbs/a)	
	Medium Maturity (TN 90)	Late Maturity (KT 210)
Untreated*	2050	2232
Manually topped at 10% bloom**	2629	2890
Chemically topped at 10% pre-button**	2589	2789
Chemically topped at 50% pre-button**	2618	2602

*Untreated was topped but no sucker control treatment applied.

**Manually topped and chemically topped treatments received Royal MH-30 (1.5 gal/A) plus Butralin (0.5 gal/A).

inches) at the top of plants that have not bloomed. Treat the entire crop with 1 to 1.5 gal/A of MH (regular 1.5 lb/gal formulation) and 2 qt/A of a local systemic. Use coarse nozzles only. To reduce labor, some producers may elect to top only those plants with a bud or bloom and spray the entire crop with the combination above, allowing the spray material to chemically top those plants in the pre-bud stage.

- In uneven crops that will require two topplings seven days apart, top plants that reach the elongated bud to early flower stage and apply a contact over the top to the entire field using powered spray equipment. Apply 1 to 1.5 gal/A MH (1.5 lb/gal formulation) plus 2 qt/A of a local systemic after the second and final topping.
- In extremely uneven crops that will require more than two topplings or two topplings more than seven days apart, top plants that are ready and apply contacts every five to seven days or at each topping using powered spray equipment over the top, or apply a local systemic at 0.75 with a contact or 1 gal/A alone as a manual plant-to-plant stalk rundown application only to topped plants at each topping. Flumetralin products (Prime+, Flupro, or Drexalin Plus) are the local systemics of choice in this situation, as they generally provide slightly longer control than Butralin. If a local systemic is used, do not retreat plants that have already been treated at a previous topping. At the final topping, apply 1.5 gal/A MH (1.5 lb/gal formulation) over the top using powered spray equipment.

Strategies for MH-free Burley Tobacco

Certain buying companies have offered price incentives in the past for burley tobacco that is not treated with MH. These incentives may be offered again, and some companies may only accept MH-free burley tobacco in the future. Although burley tobacco can be grown without MH, labor requirements may be greater and sucker control may be reduced in programs that do not include MH. If sucker control is adequate, some improvement in yield and cured leaf color can be seen in MH-free crops. Crops that have not received MH may also stay in the field longer before harvest. Alternative management and application techniques may need to be employed with MH-free tobacco. The most consistent method for producing MH-free tobacco is to use contacts and local systemics in plant-to-plant stalk rundown applications with drop lines or backpack/hand sprayers. As discussed previously, this method requires much more labor and time, and multiple applications are usually needed. Good yields and sucker control can be achieved in MH-free tobacco using over-the-top applications with powered spray equipment, but achieving adequate coverage on all leaf axils can be difficult. For the best chance of success, use multiple contact applications (at least two) every seven days beginning before topping, followed by a single local systemic application at 1 gal/A either alone or preferably tank-mixed with a contact. Do not allow suckers to grow longer than one inch before treating.

Sucker Control Strategies for Dark Tobacco

Although sucker control strategies for dark tobacco are similar to those for burley, achieving effective sucker control is usually more difficult in dark tobacco. Sucker growth after topping is generally more vigorous than in burley, and ground suckers are

more common. Dark tobacco is much more prone to blowing over and becoming crooked than burley. Also, dark tobacco typically stays in the field for a longer period between topping and harvest, requiring extended sucker control. The prostrate structure and leaf arrangement of dark tobacco is also not as conducive to achieving good coverage on all leaf axils. Some buyers of dark tobacco have discouraged the use of MH in the past except in situations of blow-over where stalk rundown is nearly impossible. MH used at topping or at high rates can cause severe upper leaf discoloration and distortion. For these reasons, plant-to-plant stalk rundown applications of contacts and local systemics with drop lines or backpack/hand sprayers are much more common in dark tobacco. Research has demonstrated that contact applications can be more effective when applications begin just before topping. As discussed previously, dark tobacco crops are rarely uniform enough to allow one topping over the entire field.

Plant-to-Plant Stalk Rundown Applications

A typical sucker control strategy for dark tobacco is to top plants that are ready (elongated bud to early bloom) and apply a contact at 4% solution (2 gal/50 gal total solution) to the entire field as a plant-to-plant stalk rundown application. Top the rest of the crop within seven days if possible and apply either a tank-mix of a contact at 4 to 5% solution (2 to 2.5 gal/50 gal total solution) with a local systemic at 3 qt/50 gal or a local systemic alone at 1 gal/50 gal. The contact/local systemic tank-mix allows a slightly lower rate of the local systemic to be used and may also increase sucker control compared to applying the local systemic alone at the full use rate. If more than two topplings are required, plan on applying a contact every seven days and follow with a local systemic or contact/local systemic tank-mix application at the final topping. If a local systemic is applied to plants that have not been topped nor have upper leaves less than 8 inches long, direct the application below these smaller leaves. Another strategy is to apply a local systemic at 1 gal/A alone or at 0.75 gal/A as a tank mix with a contact at each topping. With this strategy, treat only plants that have just been topped and do not retreat plants at later topplings.

Over-the-Top Applications with Powered Spray Equipment

Although plant-to-plant stalk rundown applications are more common in dark tobacco, success can be achieved with over-the-top applications. Coverage on all leaf axils will be more difficult on dark tobacco, and slightly higher spray volumes can improve coverage. Spray volumes of 60 to 70 gal/A are recommended for contact and local systemic applications. Dark tobacco that is straight is rare, and crooked tobacco is usually the cause of missed suckers with over-the-top or plant-to-plant applications. If tobacco leans due to wind, try to straighten the tobacco before it grows crooked if possible, as this will improve coverage in over-the-top applications. If tobacco is relatively straight, directed applications with three nozzles per row will provide better coverage than broadcast, straight-boom applications. A good strategy for over-the-top applications is to apply a contact as a 4% solution at the first topping and again seven days later. Follow with a local systemic at 1 gal/A or contact/local systemic tank-mix as described previously. Since more suckers will escape

Table 7. Sucker control and yield from selected MH and MH-free spray programs in Dark Tobacco—MSU West Farm, Murray KY, 2013

At 1st topping	At 2nd (Final) topping	7 days after 2nd topping	% Sucker control	Sucker Wt (lbs) per 10 plants	Total dark-fired yield (lbs/A)
OST (2 gal/A)	-	-	12	45.7	2080
OST (2 gal/A)	OST (2.5 gal/A)	OST (2 gal/A) + Butralin (0.75 gal/A)	74	27.9	2834
OST (2 gal/A)	OST (2.5 gal/A)	RMH (1 gal/A) + Butralin (0.75 gal/A)	88	13.7	2854
OST (2 gal/A)	OST (2.5 gal/A)	RMH (1.25 gal/A) + Butralin (0.5 gal/A)	92	14.6	2920
OST (2 gal/A)	OST (2.5 gal/A)	RMH (1.5 gal/A)	95	11.5	2903

Abbreviations: OST = Off-Shoot-T, RMH = Royal MH 30 (1.5 lb/gal ai formulation). All treatments were applied using 60 gal/A of solution with TG-5 nozzles in 3-nozzles/row arrangement. Dark variety was PD7309LC.

control with over-the-top applications to dark tobacco, including an MH application is recommended (Table 7).

Use of MH in Dark Tobacco

Although MH use in dark tobacco has been discouraged in the past, buying companies have become more lenient in its use in recent years. The key to avoiding discoloration and distortion of upper leaves is to not apply MH at topping as is commonly done in burley. Allow at least five to seven days after the final topping before applying MH. Application rate is also important. Five to 6 qt/A (1.25 to 1.5 gal/A of the regular 1.5 lb/gal formulation) is recommended. Rates lower than 5 qt/A will

provide marginal sucker control, and rates higher than 6 qt/A may cause some upper leaf discoloration, even when applied seven days after final topping. Recommended MH programs for over-the-top applications to dark tobacco are to apply a contact at the first topping and every five to seven days through the last topping. Five to seven days after the final topping, apply 5 to 6 qt/A regular concentrate MH alone or tank-mixed with 2 qt/A of a local systemic (Table 7). Tank-mixing of MH with a local systemic is recommended for improved and extended sucker control. If one topping can be made, apply a contact and follow with MH or MH/local systemic tank-mix five to seven days later. Be sure to top down to at least an 8-inch leaf.