

DISEASE CONTROL FOR BURLEY TOBACCO

Charles S. Johnson, Extension Plant Pathologist, Tobacco

Good disease control results from accurate diagnosis of disease problems, careful consideration of disease severity in each field, and prudent use of disease control practices. Crop rotation, early root destruction, and resistant varieties should always be used in conjunction with disease control chemicals because consistent disease control depends on the use of several control practices together.

Accurate Diagnosis of Disease Problems is the first step in controlling burley tobacco diseases. Note any signs of disease during the growing season. Take plant and soil samples and have them analyzed to identify the cause of the problem. Do not forget to record what the problem was determined to be, where and when it occurred, and how bad it eventually became, so that you can plan appropriate control practices for the future.

Crop Rotation is particularly effective in helping to control tobacco diseases and also provides many agronomic benefits. The length of rotation (the longer the better) and the types of alternate crops are among the most important rotation considerations. Table 1 lists some possible rotation crops.

Table 1. Usefulness of Various Rotation Crops for Tobacco Disease Control¹

Rotation Crop	Black Shank	Granville Wilt	Root-Knot Nematodes	Tobacco Cyst Nematodes	Tobacco Mosaic Virus	Black Root Rot
Fescue	H	H	H	H	H	H
Small grain	H	H	H	H	H	H
Lespedeza	H	H	H	-	H	L
'Rowan'						
Soybean	H	H	L ³	H	H	L
Corn	H	M	L	H	H	H
Sweet potato	H	M	L ⁴	-	H	H
Cotton	H	M	N	-	H	L
Milo	H	M	L	H	H	H
Peanuts	H	L	N	H	H	L
Pepper	H	N	N ²	L	N	H
Potato, Irish	H	N	L	L	H	H
Tomato	H	N	N ³	N	N	M

¹Adapted from Table 9-2, Flue-Cured Tobacco Information 2006, North Carolina Cooperative Extension Service. Ratings indicate the value of each rotation crop for reducing damage caused by each disease in the subsequent tobacco crop and assume excellent weed control in each rotation crop; H = highly valuable, M = moderately valuable, L = Little value, N = no value – may be worse than continuous tobacco, - = unknown.

²May be highly valuable for some species or races of root-knot nematodes

³However, root-knot resistant cultivars are highly effective rotation crops for tobacco.

⁴Root-knot resistant sweet potato cultivars are moderately effective rotation crops for tobacco.

Early Destruction of Roots also reduces overwintering populations of nematodes and disease-causing organisms, as well as many insects, grasses, and weeds. The earlier and more complete the destruction of tobacco debris, the better the disease control. Table 2 lists the steps involved in this important tobacco disease control practice.

Table 2. Steps in Early Stalk and Root Destruction

1)	Plow or disc-out stubble as soon after harvest as possible. Be sure to pull roots completely out of the soil.
2)	Re-disc the field two weeks after the first operation.
3)	Plant a cover crop when root systems are completely dried-out and dead.

Disease-resistant Varieties may be the most cost-effective way to control disease, but significant losses can still occur under heavy disease pressure. Crop rotation and early root destruction should be used along with resistance. Fungicide use is often necessary when susceptible varieties are planted frequently in fields with a history of black shank.

DISEASE CONTROL IN TOBACCO GREENHOUSES

Disease-causing organisms can enter a greenhouse in soil or plant debris. Entrances should be covered with asphalt, concrete, gravel, or rock dust, and footwear should be cleaned or disinfected before entering a greenhouse. New float-bay liners should be used each year and should be free of soil and plant debris. Greenhouse equipment should also be sanitized periodically. A 1:10 solution of household bleach and water is sufficient for these purposes, as are most disinfectants.

Not seeding tobacco greenhouses and float beds until March, and eliminating any volunteer tobacco plants within these structures, should be an essential component of each grower's disease control plan. As a general rule, plants closely related to tobacco (tomatoes, peppers, etc.) should not be grown in greenhouses used for transplant production.

Float trays should be cleaned and then fumigated with methyl bromide or aerated steam (140°F to 175°F for 30 minutes) to minimize *Rhizoctonia* damping-off and sore shin. Dry trays should be loosely stacked no more than 5 feet high and completely enclosed in plastic. One pound of methyl bromide will fumigate 300 cubic feet (400 trays). Trays should be fumigated 24 to 48 hours, then aerated for at least 48 hours before use. Be sure to read the label for space fumigation and follow it exactly.

Do not fill float bays with water from surface water sources like streams or ponds, as water from these sources may be contaminated. Avoid introducing disinfestants into water intended for plant uptake. Moving water from one bay to another can increase spread of water-borne pathogens. Filling bays with water long before floating the trays can make Pythium disease problems worse.

Start a weekly application of 0.5 pound of Dithane DF per 100 gallons of water (1 level teaspoon per gallon) approximately one week after seedlings are big enough to cover the tray cells. Increase the spray volume from 3 to 6 gallons per 1,000 square feet as plants grow. Continue fungicide applications until seedlings are transplanted.

Minimize overhead watering and potential splashing of the media from one tray cell to another. Correcting drainage problems in and around the greenhouse will also help avoid excess humidity. Running horizontal airflow fans and lowering side curtains near sunset will help equalize air temperatures between the inside and outside your greenhouse and reduce condensation in the greenhouse, making conditions less favorable for disease.

Sanitize mower blades and decks with a 1:1 bleach:water solution between greenhouses and after each clipping. Plant debris left on trays after clipping is one of the primary causes of collar rot problems. Use high vacuum mowers to clip tobacco seedlings. Dump clippings, unused plants, and used media at least 100 yards from the greenhouse.

Bacterial soft rot causes a slimy, watery rot of leaves and stems and can easily be confused with damage from collar rot. Greenhouse management practices that help minimize collar rot will also help prevent bacterial soft rot. Management practices for angular leaf spot and wildfire (two other diseases caused by bacteria) can also help reduce bacterial soft rot as a side effect.

SPECIFIC DISEASES IMPORTANT IN VIRGINIA

Black Root Rot causes roots of infected plants are usually black in color and decayed, causing plants to grow poorly early in the growing season. Plants may appear to recover as temperatures increase. Black root rot may be controlled by keeping soil pH between 5 and 6, planting a resistant variety, avoiding early planting into cold soils (65°F), promoting good soil drainage, and using a three-year rotation with small grains or corn. Red clover, soybeans, or other legumes should not be planted in black root rot-infested fields.

Black Shank is caused by a fungus-like pathogen that lives in soil and attacks tobacco roots and stalks. Disease losses usually can be avoided by planting highly resistant cultivars in fields that have been rotated in and out of tobacco production. The longer the interval between tobacco crops, the less black shank to be expected. **Burley tobacco cultivars possessing the L8 and Ph genes are highly resistant to race 0 of the black shank pathogen, but susceptible or much less resistant to race 1.**

The following table presents recent Virginia on-farm test results comparing survival of burley tobacco varieties in black shank-infested fields with high disease pressure (without a soil fungicide).

Variety	Race 1		Race 0		
	KY-TN	% Survival	KY-TN	% Survival	
	Rating (0-10)	2007	Rating (0-10)	2005	2007
KT 206	7	29.3	10	not tested	99.7
KT 204	7	25.6	7	24.7	98.1
KT 200	6	30.3	6	20.1	<i>not tested</i>
TN 90	4	3.6	4	16.9	82
NC 5	4	2.2	10	74.5	<i>not tested</i>
NC 7	7	1.0	10	53.0	<i>not tested</i>
KY14xL8	0	0.4	10	55.4	<i>not tested</i>
NC 2000	0	not tested	0	6.4	<i>not tested</i>
NCBH 129	1	0.1	1	0.1	34.2

Using a soil fungicide cannot guarantee adequate black shank control in fields planted with tobacco every year (no crop rotation). Soil fumigation is not as effective against black shank as it is when used to manage Granville wilt or nematodes.

Nematodes are microscopic worms that live in the soil and feed on tobacco roots. *Significant nematode problems are usually found in fields continuously planted with tobacco.* The selection of rotation crops is very important. Legumes such as red clover, vetch, and soybeans are as susceptible to root-knot and lesion nematodes as is tobacco. NC 5, NC 6, NC 7, and Clay's Hybrid 402 are resistant to common root-knot nematodes (*M. incognita* races 1 and 3). Burley tobacco is generally resistant to tobacco cyst nematodes.

Blue Mold can be reduced by obtaining transplants locally rather than production areas outside Virginia. Apply blue mold fungicides as soon as the Blue Mold Forecast System (on the Internet at www.ces.ncsu.edu/depts/pp/bluemold/) predicts a moderate to high risk of blue mold in your area. Dithane, Forum tank-mixed with Dithane, and Aliette should be applied to maximize coverage of all leaves.

The following table illustrates the spray volumes required.

Crop Stage	Gallons of Spray Mixture/Acre	
	Air blast Sprayer	Hydraulic Sprayer
Before layby	10	20
Near layby	20	40
Waist-high plants	30	60
Chest-high plants	40	80
Near topping	50	100

Use hollow-cone type nozzles to ensure thorough coverage of all leaves. You can use air blast sprayers for small plantings. Mix fungicides at twice the normal concentration when using an air blast sprayer. However, cut the spray volumes in half when using an air blast sprayer.

Complete coverage is not required when using Actigard for blue mold control. However, tobacco plants need four to five days after an application of Actigard before they are fully protected from disease. Initial use of Actigard should occur within three days of any previous fungicide application. If this is not possible, tank mixing the first Actigard spray with a fungicide will also help protect your crop while the plants are developing “systemic acquired resistance” to blue mold. Burley tobacco is sensitive to Actigard. Follow the Actigard label very closely to minimize potential yellowing or stunting of the crop.

Products such as bleach and household cleaners may appear to control the disease at first, but in university tests, have actually made blue mold problems worse.

APPLICATION METHODS

The performance and safety of a chemical depends on proper application methods. Improper use of agricultural chemicals can reduce yields as severely as any pest and will not provide satisfactory disease control. Proper pesticide use depends upon correct diagnosis of the problem, a clear understanding of the label for

each chemical being applied, adequate calibration of application equipment, and strict adherence to label directions and all federal, state, and local pesticide laws and regulations.

Preplant Incorporated (PPI) – Refer to section under weed control.

Foliar Spray (FS) – Greenhouse applications should not begin until seedlings are at least the size of a dime, but should be repeated at five- to seven-day intervals up to transplanting. Use flat-fan, extended-range tips at approximately 40 psi to maximize results. Field sprays should generally be performed using hollow-cone tips to apply a fine spray of 20 to 100 gallons per acre to maximize coverage as plants increase in size. Spray pressures should generally range between 40 and 100 psi. Using drop nozzles will significantly improve disease control after layby by improving spray coverage on bottom leaves, where foliar diseases are usually concentrated.

Fumigation: F-Row – Inject the fumigant 6 to 8 inches deep with one chisel-type applicator in the center of the row. Seal the soil in the same operation by bedding the fumigated row area with enough soil to bring the soil surface 14 to 16 inches above the point of injection. **F-Broadcast** - Space chisels 8 inches apart and inject fumigant 10 to 12 inches below the soil surface. Seal the soil immediately with a roller, drag, or similar piece of equipment.

Precautionary and Restriction Statements - *Take labels seriously. Read and follow all directions, cautions, precautions, restrictions, and special precautions on each product label. This publication must not be used as the only source of precautionary and restriction statements.*

DISEASE RESISTANCE LEVELS OF SELECTED BURLEY VARIETIES¹

Variety	Black Shank		Rating for Race 1		Black Root Rot	Fusarium Wilt	Tobacco Mosaic Virus	Wildfire	Brown Spot	Blue Mold	Aphid Transmitted Viruses
	Rating for Race 0		Rating for Race 1								
	Verbal	KY/TN ²	Verbal	KY/TN ²							
KT 206	H	10	MH	7	H	--	H	H	--	4	H/M ⁴
NC 7 ³	H	10	L-M	3-4	H	H	H	H	--	0	H/M ⁴
KY 910	H	10	M	4	H	L	H	H	--	0	H/M ⁴
NC 5 ³	H	10	M	4	H	S	H	H	--	0	M
NC 6 ³	H	10	L	2	H	S	H	H	--	0	M
KY 14xL8	H	10	S	0	M	M	H	H	T	0	S
KT 204 LC	MH	7	MH	7	H	L	H	H	--	0	H/M ⁴
KT 200 LC	M	6	M	6	M	S	H	H	--	0	H/M ⁴
TN 97 LC	M	5	M	5	H	S	H	--	--	0	H/M ⁴
VA 509	M	5	M	5	L	L	S	H	VS	0	S
TN 86 LC	M	4	M	4	H	S	S	H	--	0	H/M ⁴
TN 90 LC	M	4	M	4	H	S	H	H	--	2	M
R-630	M	3	M	3	M	L	H	H	--	0	H/M ⁴
KY 907 LC	L	2	L	2	H	M	H	H	--	0	H/M ⁴
NBH 98	L	2	L	2	M	L5	H	H	--	0	S
NC BH-129	S	1	S	1	H	S	H	H	--	0	S
Clay's 403	S	0	S	0	M	M	H	H	--	0	S
HB 04P	S	0	S	0	H	--	H	H	--	0	S
NC 2000	S	0	S	0	L	VS	H	H	S	7	M
NC 2002	S	0	S	0	L	VS	H	H	S	7	S
R-711	S	0	S	0	M	L	H	H	--	0	S
R-712	S	0	S	0	H	S	H	H	--	0	S

¹ VS=very susceptible; S=susceptible; L=low resistance; M=moderate resistance; H=high resistance; T=tolerant.

²Rating on a 0-10 scale where 10=most resistant; Developed by the University of Kentucky-University of Tennessee Tobacco Task Force.

³Resistant to races 1 and 3 of the common root-knot nematode (*Meloidogyne incognita*).

⁴Highly resistant to Tobacco Vein Mottling Virus (TVMV) but moderately resistant to Tobacco Etch Virus; TVMV is the most commonly occurring of the aphid-transmitted viruses on burley tobacco.

DISEASES OF TOBACCO SEEDLINGS

Disease	Material	Rate	Remarks
Angular Leaf Spot or Wildfire (Pseudomonas)	Agrimycin 17, Bac-master, Firewall, Farmsaver, Streptomycin, Streptrol, etc.	100-200 ppm (2-4 tsp/3gal)	100 ppm = 4 oz/50 gal or 0.5 lb/100 gal for preventative sprays. 200 ppm = 0.5 lb/50 gal or 1 lb/100 gal after disease occurs.
Anthracnose (Colletotrichum gloeosporoides) Blue Mold (Peronospora tabacina) Target Spot (Thanatephorus cucumeris)	Dithane DF	0.5 lb/100 gal (1 level tsp/gal)	Apply as a fine spray to the point of run-off to ensure thorough coverage. Begin applications before disease has been observed, but not before seedlings are the size of a dime. Use 3 gal of spray mixture /1000 sq. ft. (or 100 sq. yd.) when plants are about the size of a dime. Use 6 to 12 gal /1000 sq. ft. (or 100 sq. yd.) when the canopy has closed and plants are close to ready for transplanting. Repeat applications on a 7-day interval to protect new growth.
Blue mold (Peronospora tabacina)	Aliette WDG	0.5 lb/50 gal water	For preventative control of blue mold. Can cause leaf burn if washed into greenhouse media or float water. Only 2 applications allowed. Do not exceed 0.6 lb product/1,000 sq. ft. per application.
Pythium Root Rot (Pythium spp.)	Terramaster 35WP	2 oz/100 gal of float bed water	Can be used before or after symptoms appear, but no earlier than 2 weeks after seeding. If symptoms reappear, a second application can be made no later than 8 weeks after seeding. MUST BE EVENLY DISTRIBUTED; when mixing, first form dilute slurry, then distribute slurry evenly and thoroughly in float-bed water.
	Terramaster 4EC	Preventative: 1 fl oz/100 gal Sequential: 0.9 fl oz/100 gal Curative: 1.4 fl oz/100 gal 2nd Curative: 1-1.4 fl oz/100 gal	Can be used before or after symptoms appear, but no earlier than 2 weeks after seeding. If symptoms reappear, a second application can be made no later than 8 weeks after seeding. No more than 2.8 fl. oz./100 gallons of water may be applied to any crop of transplants, regardless of the number of applications. MUST BE EVENLY DISTRIBUTED. When mixing, first form dilute emulsion, then distribute emulsion evenly and thoroughly in float bed water.

FIELD DISEASES OF TOBACCO

Root and Stem Diseases

Product	Rate/A	Application Method ¹	Disease ²		
			Black Shank	Black Root Rot	Granville Wilt
Ridomil Gold EC	1-2 pt	Preplant	F	—	—
Ultra Flourish	1-2 qt	Preplant	F	—	—
Ridomil Gold EC	1.0 pt + 1.0 pt	Preplant + layby	G	—	—
Ultra Flourish	2 qt + 2 qt	Preplant + layby	G	—	—
Ridomil Gold EC	1.0 pt + 1.0 pt	1st cultivation + layby	G	—	—
Ultra Flourish	2 qt + 2 qt	1st cultivation + layby	G	—	—
Ridomil Gold EC	1 pt + 0.5 - 1.0 pt + 0.5 - 1.0 pt	Preplant + 1st cultivation + layby	VG	—	—
Ultra Flourish	1 qt + 1-2 qt + 1-2 qt	Preplant + 1st cultivation + layby	VG	—	—
Telone C 17	10.5 gal	F-Row	P-F	F	G
Chlor-O-Pic	3 gal	F-Row	P-F	F	G
Chloropicrin 100 Pic Plus	3 gal	F-Row	P-F	F	G
	4 gal	F-Row	P-F	F	G

¹ F-Row – inject 8 inches deep in row with single shank in center of row. Do not use more than a total of 3 qt. of Ultra Flourish, 3 pt. of Ridomil Gold EC, or 3 lb. of Ridomil Gold WSP per acre. Drop nozzles should be used to apply these fungicides at layby.

² Control rating - F=fair; G=good; VG=very good; (X)=Will reduce disease losses but no current information on disease control performance; — =No disease control or not labeled for this disease.

FIELD DISEASES OF TOBACCO (Cont'd)**Foliar Diseases – Blue Mold**

Chemical	Material	Rate¹	Application Method²	Comments
Systemic Fungicides Acibenzolar-S-methyl	Actigard 50WP	0.5 oz/20 gal/A	Foliar	Begin application when blue mold threatens and plants are 18 inches tall. Up to 3 sprays are allowed, no more than 10 days apart. Treated plants require 4 to 5 days to fully respond to each application.
Mefenoxam	Ridomil Gold EC	0.5-1 pt + 0.5 pt/A	Preplant + Layby	Strains of the blue mold pathogen are often insensitive to mefenoxam. However, mefenoxam will control sensitive strains early in the season, as well as Pythium damping-off. Read precautionary and rotation crop restrictions.
	Ultra Flourish	1-2 pt + 1 pt/A	Preplant + Layby	
<u>Protectant Fungicides</u>	Acrobat MZ	2.5 lb/100 gal of water	Foliar Spray	Begin sprays when the Blue Mold Advisory predicts conditions favorable for disease. Continue applications on a 5- to 7-day interval until the threat of disease subsides. Apply 20 to 30 gal/A of spray solution during the first several weeks after transplanting and gradually increase spray volume as the crop grows. Spray volumes should reach 40 gal/A by layby and should range between 80 and 100 gal/A on tobacco ready to be topped. Do not exceed 2.5 lb/A of Acrobat per application (10 lb/A per season). Do not apply after the early button stage or within 21 days of the first harvest.
Dimethomorph and Mancozeb	Acrobat 50WP	7.0 oz/100 gal water		
	+ Dithane DF Rainshield	+ 2.0 lb/100 gal water		
	Forum	7.0 fl oz/100 gal water		
	+ Dithane DF Rainshield	+ 2.0 lb/100 gal water		
Fosetyl-aluminum	Aliette WDG	2.5-4.0 lb/A	Foliar Spray	Do not apply Aliette within 3 days of harvest or 4 lb/A of Aliette per application (20 lb/A per season). Do no tank mix Aliette with copper compounds, foliar fertilizers, surfactants, or adjuvants that increase pesticide penetration.

FIELD DISEASES OF TOBACCO (Cont'd)

Foliar Diseases - Target Spot, Frogeye, and Blue Mold

Chemical	Material	Rate ¹	Application Method ²	Comment
Blue mold (Peronospora tabacina); Frogeye (Cercospora nicotianae); Target Spot (Thanatephorus cucumeris)	Quadris	6-12 fl. oz.	Foliar Spray	Remarks: First application for blue mold should be made at first indication of disease in the area; for target spot, spray at or soon after layby; don't spray Quadris "back-to-back" for blue mold, but alternate with another fungicide; spray sufficient water volume for complete coverage and canopy penetration; may enhance weather flecking, but this shouldn't affect yield or quality; up to 4 applications/year allowed; may be applied up to the day of harvest; tank mixing with insecticides formulated as ECs or containing high amounts of solvents may cause some crop injur

¹Use higher rates of protectant fungicides for mature plants.

²Foliar spray - apply at 40-100 psi in 20 to 100 gal of water. The amount of water depends on size of plant. Use hollow-cone nozzles (TX12, etc.) Use drop nozzles to apply fungicide to both the top and bottom leaves. Preplant + layby - first application preplant followed by a second spray just before last cultivation.

FIELD DISEASES OF TOBACCO (Cont'd)

There Are No Chemical Controls for the Following Diseases

Disease	Comments
Botrytis Blight (<i>Botrytis cinerea</i>)	This disease is restricted to tobacco greenhouses. A wet rot is often first observed on stems or leaves. A gray, downy material may be present on the surface of diseased areas. The only control methods available involve reducing surface moisture on leaves and stems (by correct watering and improving ventilation) and by the collection and removal of loose leaf material resulting from transplant clipping operations.
Brown Spot (<i>Alternaria alternata</i>)	Can be severe on mature tobacco, especially during periods of high humidity. Avoid practices that would leave mature leaves in the field or delay the maturity of the tobacco. Harvest early when lesions appear on dry leaves.
Collar Rot (<i>Sclerotinia sclerotiorum</i>)	Symptoms of this disease (occurring only in greenhouse and float bed systems) resemble damping-off. Small groups of plants have brown, wet lesions near the base of stems. Leaf rot may be seen that appears to progress from leaf margins or tips toward the stem. White, cottony, mold may be visible. Irregularly shaped, white to black objects (sclerotia) may also be found attached to severely infected plant parts. Sclerotia may be carried to the field by infected plants. Infected plants, as well as plants immediately adjacent to diseased areas, should be discarded as soon as possible. Improving ventilation and reducing excess moisture will help reduce spread of the causal organism. Proper clipping procedures may also help.
Frenching (nonpathogenic causal agent)	This disorder has been associated with toxins produced by a nonpathogenic bacterium, <i>Bacillus cereus</i> , and other nonpathogenic microorganisms. Frenching is more prevalent on wet, poorly aerated soils. This problem can be more severe on neutral or alkaline soils and is sometimes associated with lack of available nitrogen or other minerals. Proper drainage and fertilization can be beneficial. Do not plant in alkaline soils and avoid heavy applications of lime.
Weather Fleck (ozone)	This disorder appears as small brown to tan leaf spots in the plant bed and field. The major cause of this problem is ozone from car, industrial, and natural sources. Hot, humid days followed by heavy rains increase severity of problem.