FLUE-CURED TOBACCO DISEASE CONTROL

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

ACCURATE DIAGNOSES OF DISEASE PROBLEMS is the first step in controlling flue-cured tobacco diseases. Note any signs of disease during the growing season. Take plant and soil samples for analysis to identify the cause of the problem. Keep a record of 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.

DISEASE-RESISTANT VARIETIES may be the most cost-effective way to control disease. Flue-cured tobacco varieties with resistance to black shank, Granville wilt, and mosaic, as well as cyst and root-knot nematodes, are available to Virginia growers.

CROP ROTATION is particularly effective in helping to control black shank, Granville wilt, most nematodes, and tobacco mosaic. Crop rotation 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.

EARLY DESTRUCTION OF ROOTS AND STALKS reduces overwintering populations of nematodes and disease-causing organisms by destroying the tobacco debris that pathogens rely on for food and shelter during the fall and winter. *The earlier and more complete the destruction of tobacco debris, the better the disease control*. The objective of early root and stalk destruction is to pull the roots out of the ground, dry them out, break them up, and get them decayed as soon as possible. Table 2 lists the steps involved.

Table 1. Usefulness of various rotation crops for tobacco disease control[1]

			Nematodes			
Rotation Crop	Black Shank	Granville Wilt	Root-Knot	Tobacco Cyst	Tobacco Mosaic Virus	Black Root Rot
Fescue	H	H	H	H	H	H
Small grain	H	H	H	H	H	H
Lespedeza 'Rowan'	H	H	H	-	H	L
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

[1]Adapted from Flue-cured Tobacco Information, North Carolina Cooperative Extension. 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.

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

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

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

Table 2. Steps in early stalk and root destruction

1. Cut stalks into small pieces with a bush-hog or similar equipment *immediately after final harvest if possible*.
2. Plow or disc-out stubble the same day that stalks are cut. Be sure to pull roots completely out of the soil.
3. Redisc the field *2 weeks after the first operation*.
4. Plant a cover crop when root systems are completely dried-out and dead.

Disease Control in Tobacco Greenhouses

Avoid seeding tobacco greenhouses any earlier than necessary. Eliminate any volunteer tobacco plants. Plants closely related to tobacco (tomatoes, peppers, etc.) should not be grown in greenhouses used for transplant production.

Disease-causing organisms can enter a greenhouse in soil or plant debris, so entrances should be covered with asphalt, concrete, gravel, or rock dust. Footwear should be cleaned or disinfected before entering a greenhouse. Float bays should be re-lined with fresh plastic each year and should be free of soil and plant debris.

If tobacco mosaic virus (TMV) may have occurred in the previous year, greenhouse surfaces such as side-curtains, center walkways, and the 2x6 boards that support the float bays should be disinfected. A 1:10 solution of household bleach and water is sufficient for these purposes, as are most disinfectants. There is no need to spray the purline supports or the plastic covers over the greenhouse. Float trays used when TMV may have been present should be washed and cleaned thoroughly before being fumigated. Mosaic has a number of weed hosts (horsenettle, ground cherry) which should be removed from the vicinity of tobacco greenhouses.

Float trays should be cleaned and then fumigated with methyl bromide or aerated steam (140° to 175ºF for 30 minutes) to minimize *Rhizoctonia* damping-off and sore shin. Dry trays should be loosely stacked no more than 5-foot high and completely enclosed in plastic. Use one pound of methyl bromide per 330 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.

Don't 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.

Weekly application of 0.5 pound of Dithane DF per 100 gallons of water (1 level tsp/gal) should start approximately one week after seedlings are big enough to cover the tray cells. Spray volume should increase from 3 to 6 gal/1,000 square feet as plants grow. Fungicide application should continue until seedlings are transplanted.

Condensation in the greenhouse favors disease. Temporarily lowering the side-curtains near dusk and ventilating the greenhouse with horizontal airflow fans will help reduce condensation. Minimize overhead watering and the potential for splashing media from one tray cell to another. Correcting drainage problems in and around the greenhouse will also help avoid excess humidity.

To avoid spreading TMV, mower blades and decks should be sanitized 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. Clippings, unused plants, and used media should be dumped 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

Diseases like **black shank** and **Granville wilt** are caused by microscopic organisms that live in the soil. Any activity that moves soil from one place to another can spread these diseases. *Crop rotation, early root and stalk destruction, and a resistant variety should all be used before considering the use of a pesticide to control black shank or Granville wilt*.

Table 3. Reactions of flue-cured tobacco varieties to black shank.

	% Survival only[1]		Black Shank Yield Index[2]	
	Race 1	Race 0	Race 1	Race 0
Varieties with the *Ph* gene:				
SP 225	78	97	74	92
SP 168	54	99	55	101
SP 227	55	99	55	99
NC 810	51	85	52	87
SP NF3	54	63	51	59
SP 220	52	99	51	98
NC 471	55	99	50	89
NC 196	44	97	48	107
SP 234	46	*nt*[3]	47	*nt*
SP H20	43	98	40	93
PVH 1118	36	*nt*	37	*nt*
NC 291	32	99	34	106
NC 71	31	97	33	101
RG H51	31	92	32	96
CC 27	26	100	30	114
NC 297	29	95	30	98
NC 299	25	97	26	104
NC 72	24	97	26	106
CC 37	23	*nt*	25	*nt*
NC 102	16	96	16	103
Varieties without the *Ph* gene:				
K 346	61	79	60	78
NC 606	44	64	41	61
SP 210	41	75	39	72
K 149	41	57	39	54
CC 13	23	*nt*	38	*nt*
K 326	24	44	26	47

[1]Average % survival calculated from % disease near 2nd harvest in 10 field experiments, 2004-2007, under heavy black shank disease pressure without a soil fungicide; 0 = worst, 100 = best.

[2]Black Shank Yield Index = relative yield index from 2006 and 2007 Virginia OVT tests adjusted for % survival in black shank resistance tests, 2004-2007. A value of 100 reflects the average yield among varieties in the OVT experiments at 100% stand.

[3]*nt* = "not tested"; no data available from land-grant university tests in tobacco states.

Table 4. Reactions of flue-cured tobacco varieties to Granville wilt.

Varieties:	% Survival only[1]	Granville Wilt Yield Index[2]
SP 227	92	92
NC 810	87	88
SP 220	88	87
K 346	86	86
CC 37	78	86
SP 225	90	86
CC 27	75	85
NC 299	79	85
SP 168	81	83
SP 234	81	82
NC 72	73	81
CC 13	76	81
K 149	84	80
SP 210	82	78
NC 196	71	78
SP H20	78	74
SP NF3	79	74
NC 297	72	74
NC 102	68	73
NC 606	76	72
NC 471	80	72
K 358	72	69
NC 71	67	69
NC 291	63	67
RG H51	62	65
PVH 1118	62	64
K 326	57	61

[1]Average % survival calculated from % disease near 2nd harvest in 10 field experiments in North and South Carolina, 2004-2007, under heavy disease pressure without soil fumigation; 0 = worst, 100 = best.

[2]Granville Wilt Yield Index = relative yield index from 2006 and 2007 Virginia OVT tests adjusted for % survival in Granville wilt resistance tests, 2004-2007. A value of 100 reflects the average yield among varieties in the OVT experiments at 100% stand.

Table 5. Granville-wilt resistance ratings and on-farm test results for selected flue-cured tobacco cultivars.

		% Survival at End of Season (6-7 September)[2]		
Variety	2008 Granville Wilt Yield Index[1]	2005 10.5 gpa Telone C17	2005 Untreated Soil	2006 Untreated Soil
NC 810	88	71	62	nt
Speight 220	87	75	53	nt
K 346	86	nt	nt	78
CC 27	85	nt	nt	75
Speight 168	83	68	63	73
Speight 234	82	nt	nt	72
K 149	80	54	40	nt
Speight H20	74	37	30	nt
NC 471	72	nt	nt	81
NC 606	72	64	37	62
NC 71	69	39	32	35
NC 291	67	nt	nt	25
PVH 1118	**64**	**nt**	**nt**	**36**

[1]Granville Wilt Yield Index = relative yield index from 2006 and 2007 Virginia OVT tests adjusted for % survival in Granville wilt resistance tests, 2004-2007. A value of 100 reflects the average yield among varieties in the OVT experiments at 100% stand.

[2]nt = not tested. Test results from on-farm trials in Brunswick County, Virginia.

Black shank is caused by a fungus-like pathogen that lives in soil and attacks tobacco roots and stalks. Table 3 presents black-shank resistance ratings for flue-cured tobacco varieties. *Virginia tobacco producers who have used varieties possessing the Ph gene should assume their fields contain race 1 of the black shank pathogen*. Growers planting black-shank problem fields in 2008 should seriously consider preventative soil fungicide use in addition to planting the highest black-shank resistance available. Remember that while soil fumigants provide good to excellent control of Granville wilt and nematodes, they are generally not effective for black-shank control.

Granville (Bacterial) Wilt is caused by a soil-inhabiting bacterium that invades tobacco plants through roots and often kills the entire plant. The pathogen can also invade tobacco plants through wounds, so early and shallow cultivation and topping by hand can help reduce the spread in infested fields. Although symptoms are somewhat similar to those for black shank, intermediate symptoms of Granville wilt involve wilting on only one side, and wilted leaves may retain their normal green color rather than yellowing. *Crop rotation and the use of resistant varieties are ESSENTIAL for Granville wilt control*. Including soybeans as a rotation crop has proven particularly beneficial in reducing losses to this disease (Table 1). Disease reduction and yield increases are generally much larger from use of resistant varieties compared to soil fumigation (Tables 4 and 5).

Tomato spotted wilt virus (TSWV) is spread by various species of thrips, usually within the first few weeks after transplanting. Greenhouse application of an appropriate systemic insecticide can significantly reduce damage caused by TSWV.

Tobacco mosaic virus (TMV) can be spread by contaminated clipping mowers in the greenhouse, from tobacco roots and stalks remaining in soil from previous crops, from weed hosts such as horsenettle and ground cherry, from contaminated objects and surfaces (trays, sheets, etc.), and from manufactured tobacco products. Workers should wash their hands regularly during planting. Rogueing infected plants before layby will reduce virus spread within a field. However, tobacco mosaic can't be eliminated from infested fields without crop rotation and early destruction of roots and stalks. Mosaic resistant varieties can reduce damage and may help eliminate residual virus in infested fields. *Varieties such as CC 27, CC 37, NC 102, NC 297, NC 471, and Speight H20 may be appropriate for fields with a history of 30 to 50 percent of the plants infected with mosaic before topping*. If a TMV-resistant variety is planted, the entire field should be planted to the resistant variety.

Blue mold and target spot can be significant problems for Virginia tobacco producers. The fungicide Quadris is registered for target spot control, but target spot often occurs early in the harvest period, and timely harvest of leaf at lower stalk positions often reduces disease to insignificant levels.

Tobacco Cyst (TCN), Root-knot, and Lesion 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 southern root-knot nematode (*Meloidogyne incognita*) is the most common species of root-knot nematode in Virginia, but other types of root-knot can also be present in damaging numbers. Most flue-cured tobacco varieties currently grown are resistant to the southern root-knot nematodes, with the exception of Coke 371-Gold. Root galling on other tobacco varieties indicates the presence other species or races of root-knot nematode. Rotation intervals should be increased as long as possible and nematicides should be used when galling has been observed on root-knot resistant varieties. Flue-cured tobacco varieties CC 13 and CC 37 claim some resistance against these other species of root-knot. Rotating tobacco with grasses or small grains reduces populations of tobacco cyst and root-knot nematodes, but take care to plant nematode resistant cultivars of some rotation crops (Table 1). Forage legumes are often good hosts for root-knot nematodes. Lesion nematode populations often may not be as reduced by crop rotation as are tobacco cyst or root-knot nematodes. However, a single year of forage or grain pearl millet can cause a reduction in lesion nematode numbers similar to that of soil fumigation. Nematicide use may be profitable when a soil assay detects 50 to 100 lesion nematodes/500cc of soil. Preplant nematicide use may be necessary when root-knot nematode populations are high, as indicated in the table below.

Varieties with the Ph gene reduce TCN populations dramatically, although a recommended nematicide will be necessary to produce acceptable yield and quality when TCN populations are high (Table 3).

Nematicides should always be used in conjunction with resistance, rotation, and early root and stalk destruction. Poor control of nematodes and soil insects can increase disease losses in fields infested with black shank and Granville wilt.

Application Methods

The performance and safety of a chemical is dependent on the use of proper application methods. Improper pesticide use 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, proper calibration of application equipment, and strict adherence to label directions and all federal, state, and local pesticide laws and regulations.

Preplant Incorporated (Preplant) – 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** for leaf diseases should generally be performed using hollow-cone tips to apply a fine spray of 20 to 100 gal/A to maximize coverage as plants increase in size. Spray pressures should generally range between 40 to 100 psi. Both the tops and bottoms of leaves need to be covered. The use of 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 fumigant 6 to 8 inches deep with one chisel-type applicator in the center of the row. Soil should be sealed in the same operation by bedding the fumigated row area with enough soil to

Interpreting root-knot infestation levels

Risk of Crop Loss	% Roots Galled	Nematodes/500 cc of soil		Control Options
		Fall Sample	Spring Sample	
Very Low	1 to 10	1 to 200	1 to 20	Practice crop rotation and/or plant a resistant variety.
Low	11 to 25	201 to 1,000	21 to 100	Use crop rotation in combination with a resistant variety and/or a nematicide.
Moderate	26 to 50	1,001 to 3,000	101 to 300	Increase rotation interval. Also use a resistant variety and a nematicide rated 'G' or higher.
High	Over 50	Over 3,000	Over 300	Increase rotation interval if at all possible. Use a resistant variety with a nematicide rated 'E'.

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. Soil should be sealed immediately with a roller, drag, or similar piece of equipment.

After fumigation, leave soil undisturbed for an "exposure period" of seven to 14 days. Cold, wet soil slows the diffusion of fumigants, so wait longer before working soil under such conditions. Transplants will be injured if the fumigant is still present at transplanting, so soil should be aerated after the exposure period. Planting should be safe when the fumigant can no longer be smelled in the soil root zone. This condition is usually reached (depending upon temperature and moisture) within three weeks after fumigations. To hasten aeration (especially after cold, wet weather): 1) **Row** – use a chisel in the bed without turning the soil; 2) **Broadcast** – plow or cultivate above the depth of the treatment zone; **Caution**: avoid contaminating fumigated soil with untreated soil.

Band-row (B-row) – Refer to nematicide table for instructions for the application of granular formulations of pesticides.

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

Table 6. Diseases of tobacco seedlings

Disease	Material	Rate
Angular Leaf Spot or **Wildfire** (Pseudomonas)	Agrimycin 17, Streptrol, etc	100-200 ppm (2-4 tsp/3gal)
Remarks: Foliar Spray: 100 ppm = 4 oz/50 gal or ½ lb/100 gal 200 ppm = ½ lb/50 gal or 1 lb/ 100 gal		
Anthracnose (Colletotrichum gloeosporoides) **Blue Mold** (Peronospora tabacina) **Target Spot** (Thanatephorus cucumeris)	Dithane DF Rainshield	0.5 lb/100 gal (1 level tsp/gal)
Remarks: Apply as a fine foliar 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. when plants are about the size of a dime. Use 6-12 gal/1000 sq. ft. when the canopy has closed and plants are close to ready for transplanting. Repeat applications on a 5- to 7-day interval to protect new growth.		
Blue mold (Peronospora tabacina)	Aliette	0.5 lb/50 gal
Remarks: Foliar spray; apply no more than 0.6 lb/1,000 sq.ft; CAN BURN PLANTS IF WASHED INTO MEDIA OR FLOAT WATER; no more than 2 sprays/greenhouse season.		
Pythium Root Rot (Pythium spp.)	Terramaster 35WP	2 oz/100 gal of 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.
Remarks: 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 diluted emulsion evenly and thoroughly in float-bed water.		
Tomato Spotted Wilt Virus (TSWV)	Actigard 50WG	1-2 oz/100,000 plants (~350- 288-cell trays)
Remarks: *Must submit liability waiver to receive a copy of the label, which is required for use.* **One** foliar application in the greenhouse 5-7 days prior to transplanting in sufficient water to ensure good coverage (~6 gal/1,000 sq. ft.); **use of accurate rate is *critical* to avoid crop injury. In general**, a 10%-15% stand loss due to TSWV should be expected before considering application of Actigard to tobacco seedlings. Use of systemic insecticides such as imidacloprid or thiamethoxam as well as Actigard will significantly improve control of TSWV. Tank mixtures are not recommended, but product may be left on foliage or washed off into the root ball.		

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 or SL	1-2 pt	Preplant	F	—	—
Ultra Flourish	1-2 qt	Preplant	F	—	—
Ridomil Gold EC	1.0 pt + 1.0 pt	Preplant + layby	VG	—	—
Ultra Flourish	2 qt + 2 qt	Preplant + layby	VG	—	—
Ridomil Gold EC or SL	1.0 pt + 1.0 pt	1st cultivation + layby	VG	—	—
Ultra Flourish	2 qt + 2 qt	1st cultivation + layby	VG	—	—
Ridomil Gold EC or SL	1 pt + 1.0 pt + 1.0 pt	Preplant + 1st cultivation + layby	VG	—	—
Ultra Flourish	1 qt + 2 qt + 2 qt	Preplant + 1st cultivation + layby	VG	—	—
Telone C 17	10.5 gal	F-Row	P-F[3]	F	G
Chlor-O-Pic	3 gal	F-Row	P-F	F	G
Chloropicrin 100	3 gal	F-Row	P-F	F	G
Pic Plus	4 gal	F-Row	P-F	F	G

[1] **Preplant** – broadcast, preplant incorporated spray; 1st cultivation – broadcast spray just before 1st cultivation ; **layby** - broadcast spray just before layby; **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 or 3 pt of Ridomil Gold per acre.

[2] Control rating - F=fair; G=good; VG=very good. (-) - No disease control or not labeled for this disease.

[3] Fumigants will not control black shank without use of a soil fumigants, but may improve control from a single fungicide application versus two.

Foliar diseases

Disease	Material	Rate[1]	Application Method[2]
Blue mold *(Peronospora tabacina)*; **Tomato Spotted Wilt Virus** (TSWV)	Actigard 50WP	0.5 oz/20 gal/A	Foliar
Remarks: Begin applications when blue mold disease threatens and plants are 12 inches tall. Up to 3 sprays may be applied on a 10-day schedule. Treated plants require 3-5 days to fully respond to each application. TSWV sprays beginning within 7 days of transplanting or whenever plants have recovered from transplant shock may also be used to follow-up on greenhouse application of Actigard for TSWV control.			
Blue mold *(Peronospora tabacina)*	Aliette	2.5-4.0 lb/A	Foliar
Remarks: No more than 5 sprays allowed, 3 day pre-harvest interval; don't tankmix.			
Blue mold *(Peronospora tabacina)*	Ridomil Gold EC	0.5-1 pt + 0.5 pt/A	Preplant + Layby
	Ultra Flourish	1-2 pt + 1 pt/A	
Remarks: Strains of the blue mold pathogen are often insensitive to mefenoxam, but mefenoxam may control sensitive strains early in the season, as well as Pythium damping-off. Read precautionary and rotation crop restrictions.			
Blue mold *(Peronospora tabacina)*	Acrobat MZ	2.5 lbs/100 gal of water	Foliar Spray
	Acrobat 50WP + Dithane DF Rainshield	7.0 oz/100 gal water + 2.0 lb/100 gal water	
	Forum + Dithane DF Rainshield	7.0 oz/100 gal water + 2.0 lb/100 gal water	
Remarks: 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 or 10 lb/A per season. Do not apply after the early button stage or within 21 days of the first harvest.			
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 injury.			

[1]Use higher rates of protectant fungicides for mature plants.

[2]**Foliar 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.

Tobacco nematodes

Product	Rate/A, Application Method[2]	Nematodes [1]	
		Root-Knot and Others	Tobacco Cyst
Fumigants			
Chlor-O-Pic	3- 4 gal, Row	E	G
Metam CLR	25 gal, Row	—	G
Pic Plus	4.2 gal, Row	E	G
Telone II	9-10 gal, Row	E	G
Telone C-17	10.5 gal, Row	E	G
Granular or Liquid Non-Fumigants			
Nemacur 3SC[3]	1.3-2 gal, PPI	G	—
Temik 15G	20 lbs, Band	G	G

[1]Control ratings: E=Excellent; G=Good; F=Fair; P=Poor; (—)=no control or not labeled. Use higher rates for higher nematode populations or for heavier soils.

[2]**PPI**=Sprayed broadcast, preplant incorporated; **Row**=inject 8 inches deep in row with single shank - 21-day waiting period before planting; **Band**= apply granules in a 14-inch band, then incorporate. Granules should be covered with 2-6 inches of soil when forming beds. **Do not** apply Temik more than one week before transplanting. Be aware that adequate soil moisture is required before the product is activated.

[3]Alternate use of Nemacur with other nematicides. Nemacur will not be commercially available after 2007.

Diseases of Tobacco

There Are No Chemical Controls For the Following Diseases

Disease	Remarks
Botrytis Blight (*Botrytis cinerea*)	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. Reducing surface moisture on leaves and stems by correct watering and improved ventilation, and collecting and removing loose leaf material from clipping will help reduce damage.
Brown Spot (*Alternaria alternata*)	Can be severe on mature tobacco, especially during periods of high humidity. Avoid leaving mature leaves in the field. Good sucker control also helps reduce disease incidence.
Collar Rot (*Sclerotinia sclerotiorum*)	Symptoms resemble damping-off. Small groups of plants have brown, wet lesions near the base of stems. Leaf rot may appear 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. Infected plants, as well as plants immediately adjacent to diseased areas, should be discarded as soon as possible. Improving ventilation and reducing excess moisture may help reduce spread. Proper clipping procedures may also help.
Frenching (nonpathogenic causal agent)	This disorder has been associated with toxins produced by a nonpathogenic bacterium, *Bacillus cereus*, 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.