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 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. Plant and soil samples can be taken and analyzed to identify the cause of the problem. Don't 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.

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

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. Length of rotation (the longer the better) and 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 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.

[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.*
2. Plow or disc-out stubble the same day that stalks are cut, pulling roots completely out of the soil.
3. Re-disc 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 (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 (140^0F to 175^0F for 30 minutes) to minimize *Rhizoctonia* damping-off and sore shin. Dry trays should be loosely stacked no more than 5 ft 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.

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 potential splashing of 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. High vacuum mowers should be used 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 use of a pesticide to control black shank or Granville wilt.*

Black shank is caused by a fungus-like pathogen that lives in soil and attacks tobacco roots and stalks. Tables 3 and 4 present black shank resistance ratings for flue-cured tobacco varieties. *Virginia tobacco producers who have used varieties possessing the Php gene should assume their fields contain race 1 of the black shank pathogen.* Growers planting black shank problem fields in 2011 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 use of resistant varieties is ESSENTIAL for Granville wilt control.* Including soybeans as a rotation crop helps reduce 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 5, 6 and 7).

Table 3. Reactions of Flue-Cured Tobacco Varieties to Black Shank.

	% Survival (Race 1)[2]		2008-2010 Yield Index	
	2010	2008-2010	Black Shank (Race 1)	No Black Shank
Varieties with the Php gene[1]				
SP 225	92	89	78	87
NC 606	67	74	71	97
SP 227	71	71	69	97
NC 471	80	73	66	90
NC 196	45	53	57	107
CC 67	70	57	57	100
PVH 1452	60	57	56	99
SP 220	49	58	55	96
PVH 1118	61	52	54	105
SP 168	62	58	54	92
NC 71	44	47	49	106
CC 37	41	47	49	105
NC 299	39	47	48	102
CC 700	51	44	46	105
NC 291	28	38	41	107
CC 27	40	35	38	107
NC 72	40	34	36	106
RG H51	35	35	35	101
NC 102	41	31	32	101
NC 297	30	29	31	105
Varieties without the *Php* gene[1]				
SP 236	90	88	77	88
K 346	79	80	74	92
K 394	63	72	74	103
CC 35	31	51	58	113
CC 33	59	56	58	103
K 149	54	55	55	100
CC 13	45	51	53	104
PVH 2110	44	48	51	105
K 326	25	31	33	108

[1] Varieties with the *Php* gene possess high to very high resistance to race 0 of the black shank pathogen. Resistance to race 0 in varieties without the *Php* gene is similar to or higher than that to race 1.

[2] Average % Survival near 2nd harvest without a soil fungicide. Results are averages from 2008-2010 field experiments conducted by Clemson and North Carolina State Universities as part of the Regional Flue-Cured Tobacco Variety Evaluation Program.

[3] Relative Yield Index = yield of each cultivar relative to the yield of all other cultivars in the experiment(s). Yield indexes for "No Black Shank" = average relative yield from the 2010 Virginia OVT test conducted at the Southern Piedmont AREC, Blackstone. Yield indexes for "Black Shank (race 1)" = yield index without black shank multiplied by the average estimated plant stand during harvest (% Survival/100).
[4] Based upon the more limited data available.

Table 4. Results from 2010 On-Farm Black Shank resistance tests (race 1) [1].

	Surry Co., NC Trial[1]		Mecklenburg Co., VA Trial	
Varieties with the *Php* gene	% Survival	Black Shank-Yield Index	% Survival	Black Shank-Yield Index
SP 225	.	.	91	83
PVH 1452	87	82	66	62
NC 196	85	89	37	39
CC 700	78	81	.	.
NC 299	77	77	.	.
PVH 1118	76	81	.	.
CC 67	73	69	59	56
NC 102	69	70	.	.
CC 37	57	55	50	49
CC 27			24	23
Varieties without the *Php* gene				
CC 35	92	109	100	118
K 346	90	84	88	82
SP 236	95	83	.	.
CC 13	62	68	.	.
CC 33	62	63	75	76
PVH 2110	59	64	40	43
K 326	44	48	30	33

[1] Disease data courtesy Dr. Mina Mila, Dept of Plant Pathology, NCSU.

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, CC 67, 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 to avoid significant plant injury.

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.

Table 5. Reactions of Flue-Cured Tobacco Varieties to Granville Wilt.

Varieties with the *Php* gene[1]	% Survival[2]		2008-2010 Yield Index	
	2010	2008-2010	With Granville Wilt	No Granville Wilt
CC 27	95	87	94	107
CC 37	96	88	92	105
SP 227	97	93	90	97
SP 220	98	93	89	96
PVH 1452	98	86	85	99
NC 196	85	77	83	107
NC 471	97	89	80	90
NC 606	92	82	80	97
NC 72	88	73	77	106
CC 67	100	77	77	100
NC 299	93	74	76	102
SP 225	98	86	75	87
SP 168	93	81	74	92
CC 700	80	71	74	105
NC 297	79	70	73	105
NC 71	82	68	72	106
PVH 1118	80	69	72	105
NC 291	79	65	70	107
NC 102	87	69	70	101
RG H51	80	66	66	101
Varieties without the *Php* gene[1]				
K 149	75	81	81	100
K 346	93	82	75	92
CC 33	85	72	74	103
CC 13	90	70	73	104
SP 236	89	81	71	88
PVH 2110	91	67	71	105
K 326	46	58	63	108
CC 35	43	38	43	113
K 394	50	31	32	103

[1] The *Php* gene provides high to very high resistance to race 0 of the black shank pathogen, but no resistance to Granville Wilt.

[2] Average % Survival near 2nd harvest without a soil fumigant. Results are averages from 2008-2010 field experiments conducted by Clemson University as part of the Regional Flue-Cured Tobacco Variety Evaluation Program.

[3] Relative Yield Index = yield of each cultivar relative to the yield of all other cultivars in the experiment(s). Yield indexes for "No Granville Wilt" = average relative yield from the 2010 Virginia OVT test conducted at the Southern Piedmont AREC, Blackstone. Yield indexes "With Granville Wilt" = yield index without

disease multiplied by the average estimated plant stand during harvest (% Survival/100).
[4] Based upon the more limited data available.

Table 6. Results from 2010 On-Farm Granville Wilt resistance tests [1].

	Average: 5 NCSU Trials[1]		Brunswick Co., VA Trial	
Varieties with the *Php* gene[1]	% Survival	Granville Wilt-Yield Index	% Survival	Granville Wilt-Yield Index
CC 67	81	77	99	99
CC 37	73	71	100	105
SP 225	.	.	99	87
PVH 1452	70	66	94	93
SP 227	.	.	95	92
SP 236	61	53	.	.
NC 196	56	59	86	92
NC 299	54	54	83	84
NC 102	40	42	.	.
CC 700	38	40	.	.
PVH 1118	24	26	.	.
			.	.
CC 27	.	.	92	99
Varieties without the *Php* gene				
CC 33	50	50	83	85
PVH 2110	44	47	.	.
CC 13	37	40	.	.
CC 35	14	17	.	.
K 326	.	.	30	33

[1] Disease data courtesy Dr. Mina Mila, Dept of Plant Pathology, NCSU.

Table 7. Reactions of Selected Flue-Cured Tobacco Varieties to Granville Wilt in Brunswick County, VA in 2009.

		Relative Yield Index[2]	
Cultivar	% Survival[1]	No Granville Wilt	With Granville Wilt
CC 37	96	109	105
NC 196	89	109	97
PVH 1452	92	104[3]	96[3]
CC 27	85	112	95
NC 299	90	105	94
SP 236	79	88[3]	70[3]
NC 71	66	104	69

[1]Average % survival near 2nd harvest (31 August) without a soil fumigant (0 = worst, 100 = best).
[2]Relative Yield Index = yield of each cultivar relative to the yield of all cultivars tested in the experiment(s). Yield indexes presented for "No Granville Wilt" = average relative yield for each cultivar from disease-free experiments conducted at the Southern Piedmont AREC, 2006-2009. Yield indexes for "With Granville Wilt" = yield index without Granville Wilt adjusted (multiplied by) the average plant population surviving to harvest in this Granville Wilt field test (% Survival/100).
[3]Based upon the more limited data available.

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 K 394*. 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, CC 33, CC 67, 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 care should be taken to plant nematode resistant cultivars of some rotation crops (Table 1). Forage legumes are often good hosts for root-knot nematodes. Crop rotation may not reduce lesion nematode populations as effectively as it does for tobacco cyst or root-knot nematodes. However, a single year of forage or grain pearl millet can reduce lesion nematode numbers similarly to soil fumigation. *Nematicide use may be profitable when a soil assay detects 50-100 lesion nematodes/500cc of soil.* Preplant nematicide use may be necessary when root-knot nematode populations are high, as indicated in the following table:

INTERPRETING ROOT-KNOT INFESTATION LEVELS

Risk of Crop Loss	% Roots Galled	Nematodes/500 cc of soil: Fall Sample	Nematodes/500 cc of soil: Spring Sample	Control Options
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'

Varieties with the Php 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 also increase disease losses in fields infested with black shank and Granville wilt.

Contact nematicides (such as Temik) are no longer registered for use in tobacco fields. If a susceptible variety will be grown in a field where populations of lesion, root-knot, or tobacco cyst nematodes are high, the field should be fumigated with an effective nematicide at least 3 weeks before transplanting.

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 5-7 day intervals up to transplanting. Use flat-fan, extended range tips at approximately 40 psi to maximize results. **Field sprays** targeting the soil surface should be applied using flat-fan spray tips and spray volumes between 25 and 40 gallons per acre. Field sprays for leaf diseases should generally be performed using hollow cone tips to apply a fine spray of 20-100 gallons per acre to maximize coverage as plants increase in size. Spray pressures should generally range between 40-100 psi. Both the tops and bottoms of leaves need to be covered. 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 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.

PRODUCT LABELS FOR SOIL FUMIGANTS ARE CHANGING SIGNIFICANTLY IN 2011 AND 2012. You must read and understand these labels well before you plan to fumigate in order to comply with the new requirements. Look particularly for changes regarding personal protective equipment and a "fumigant management plan" to be written before fumigating is allowed. Extension meetings are planned for early 2011 to more fully describe these new requirements.

After fumigation, leave soil undisturbed for an "exposure period" of 7-14 days. Cold, wet soil slows diffusion of fumigants, so wait longer before working soil under such conditions. Transplants will be injured if 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.

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 8. DISEASES OF TOBACCO SEEDLINGS

Disease	Material	Rate
Angular Leaf Spot or Wildfire *(Pseudomonas)*	Agri-mycin 17, Firewall, Fire-wall 17WP, etc	100-200 ppm (2-4 tsp/3gal)
Remarks: Foliar Spray: 100 ppm = 4 oz/50 gal or ½ lb/100 gal; preventative use. 200 ppm = ½ lb/50 gal or 1 lb/ 100 gal; curative use.		
Anthracnose *(Colletotrichum gloeosporoides)*	Dithane DF Rainshield	0.5 lb/100 gal (1 level tsp/gal)
Blue Mold *(Peronospora tabacina)*; **Target Spot** *(Thanatephorus cucumeris)*	Manzate ProStick Penncozeb 75DF	
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 gal /1000 sq. ft. when the canopy has closed and plants are close to ready for transplanting. Repeat applications on a 5-7 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: 1 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	1-2 pt	Preplant	F	---	---
MetaStar 2E AG or Ultra Flourish	1-2 qt	Preplant	F	---	---
Ridomil Gold EC	1.0 pt + 1.0 pt	Preplant + layby	VG	---	---
MetaStar 2E AG or Ultra Flourish	2 qt + 2 qt	Preplant + layby	VG	---	---
Ridomil Gold	1.0 pt + 1.0 pt	1st cultivation + layby	VG	---	---
MetaStar 2E AG or Ultra Flourish	2 qt + 2 qt	1st cultivation + layby	VG	---	---
Ridomil Gold	1 pt + 1.0 pt + 1.0 pt	Preplant + 1st cultivation + layby	VG	---	---
MetaStar 2E AG or 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 fungicide, but may improve control from a single fungicide application versus two.

FIELD DISEASES OF TOBACCO (Cont'd)

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 MetaStar 2E AG Ultra Flourish	0.5-1 pt + 0.5 pt/A 2-4 pt + 2pt 1-2 pt + 1 pt/A	Preplant + Layby
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 50WP + Dithane DF Rainshield, Manzate ProStick, or Penncozeb 75 DF	7.0 oz/100 gal water + 2.0 lb/100 gal water	Foliar Spray
	Forum + Dithane DF Rainshield Manzate ProStick, or Penncozeb 75 DF	7.0 fl 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 5-7 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.			

FIELD DISEASES OF TOBACCO (Cont'd)

Foliar Diseases

Disease	Material	Rate[1]	Application Method[2]
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; tankmixing 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	Nematodes [1] 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

[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] Row=inject 8 inches deep in row with single shank - 21-day waiting period before planting.

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 thunderstorms and/or air pollution. Hot humid days followed by heavy rains increase severity of problem.