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 rot them away 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 can be 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 10% solution of household bleach in 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. Table 3 presents black shank resistance ratings for flue-cured tobacco varieties. *Because varieties possessing the Php gene have been planted so often, for so long, Virginia tobacco producers should assume their fields contain race 1 of the black shank pathogen.* Growers planting black shank problem fields in 2014 should seriously consider applying a soil fungicide in addition to planting a variety with high resistance to race 1 of the black shank pathogen. 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 one or more 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 4, 5, and 6).

Table 3. Reactions of flue-cured tobacco varieties to black shank, 2009-2013.

Varieties with the *Php* gene[1]:	% Survival (Race 1)[2]	Disease - Yield Index[3]	
		Black Shank (Race 1)	No Black Shank
SP 225	86	73	85
SP 227	76	70	92
PVH 1452	67	67	99
NC 196	62	65	106
SP 168	66	61	93
CC 67	60	60	99
SP 220	62	58	95
PVH 1118	56	55	99
GL 939	56	53	95
CC 700	48	50	103
NC 71	46	50	108
CC 37	48	49	102
NC 299	42	43	103
GF 318	39	41	105
NC 291	36	39	106
NC 72	32	33	103
CC 27	30	32	106
NC 297	30	31	104
NC 92	24	23	100
PVH 2275[4]	10	10	99
Varieties without the *Php* gene[1]			
CC 143[4]	**77**	**81**	**106**
NC 925[4]	**80**	**80**	**100**
SP 236	88	75	86
K 346	81	75	93
NC 606	68	67	99
CC 65	58	65	112
CC 33	60	61	102
GL 395[4]	**65**	**60**	**93**
CC 13	46	47	104
CC 35	40	46	114
PVH 2110	41	44	107
K 326	31	33	108

[1] Varieties with the *Php* gene possess 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 9 field experiments conducted in 2009-2013 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 2009-2013 Virginia OVT tests conducted at the Southern Piedmont AREC, Blackstone. Yield indexes for "Black Shank (race 1)" = yield index without black shank multiplied by the average proportional survival near 2nd harvest.

[4] *Ratings based on limited data available.* **Varieties in bold are new for 2014 growing season.**

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, CC 304, NC 102, NC 297, or PVH 2275 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 tobacco producers in Virginia. The fungicide Quadris is now registered for target spot control in both the greenhouse and field. Only one application is allowed in the greenhouse, but if applied shortly after the 1st clipping, this spray should provide good foliar disease control for 3 to 4 weeks or more. Target spot also often occurs in the field as topping time nears through early in the harvest period. Timely harvest of lower leaves usually reduces disease to insignificant levels by increasing air flow in fields, allowing upper leaves to dry-out. However, preventative fungicide applications can minimize leaf spots even when wet weather conditions continue over prolonged periods of time.

Table 4. Reactions of flue-cured tobacco varieties to Granville wilt 2009-2013.

		Disease - Yield Index[3]	
Varieties with the *Php* gene[1]:	% Survival[2]	With Granville Wilt	No Granville Wilt
SP 227	93	86	92
CC 37	83	85	102
CC 27	80	85	106
SP 220	88	83	95
PVH 1452	83	83	99
CC 67	82	82	99
SP 168	83	77	93
NC 72	73	75	103
NC 196	71	75	106
GF 318	70	74	105
SP 225	86	73	85
NC 299	71	73	103
NC 92	72	72	100
CC 700	68	70	103
NC 297	67	70	104
NC 71	61	67	108
NC 291	61	64	106
PVH 2275[4]	62	61	99
PVH 1118	60	60	99
Varieties without the *Php* gene[1]			
CC 143[4]	**79**	**83**	**106**
NC 606	81	81	99
CC 33	75	76	102
K 346	78	73	93
GL 939	76	72	95
PVH 2110	67	72	107
GL 395[4]	**73**	**68**	**93**
CC 13	65	67	104
SP 236	77	66	86
NC 925[4]	**63**	**63**	**100**
K 326	54	58	108
CC 65	41	46	112
CC 35	40	45	114

[1] Varieties with the *Php* gene possess 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 soil fumigation. Results are averages from 4 field experiments conducted in 2008-2010 and 2012 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 2009-2013 Virginia OVT tests at the Southern Piedmont AREC, Blackstone. Yield indexes for "with Granville Wilt" = yield index without black shank multiplied by average % Survival.
[4] *Ratings based on limited data available.* ***Varieties in bold are new for 2014 growing season.***

Table 5. Performance of selected flue-cured tobacco varieties in 2013 Virginia Tech on-farm tests of resistance to Granville Wilt in Brunswick and Mecklenburg Counties.

		% Plants Surviving in Non-Fumigated Soil at 4 locations:					Yield Index with
Variety	Ph_p gene[1]	Basker ville	Rawlins	Dolphin	Union Level	Avg	Granville Wilt[2]
NC 299	+	99	96	45	94	84	90
NC 196	+	99	96	33	95	81	86
CC 37	+	97	98	49	95	85	83
PVH 1425	+	99	96	56	95	86	82
CC 67	+	98	96	34	99	82	81
CC 143	**-**	**97**	**89**	**21**	**96**	**76**	**80**
CC 700	+	99	94	21	94	77	77
CC 33	-	100	91	23	95	77	76
GF 318	+	95	91	11	90	72	74
GL 395	**-**	**98**	**98**	**20**	**92**	**77**	**73**
NC 925	**-**	**100**	**88**	**12**	**89**	**72**	**70**

[1]The Ph_p gene provides very high resistance to race 0 of the black shank pathogen, but no resistance to Granville wilt.
[2] Yield Index with Granville Wilt = proportion of plants surviving for each variety multiplied by the 2013 relative yield for that cultivar in the 2013 Virginia OVT test conducted at the Southern Piedmont AREC, Blackstone.

Table 6. Tobacco disease resistance possessed by selected flue-cured tobacco varieties available in 2014.

	Black Shank			Root-Knot[3]			
Variety	Ph_p gene (race 0 only)[2]	Race 1	Granville Wilt	*M. incognita*	Other species	TCN[3]	TMV[5]
CC 13	-	46	65	+	+	-	-
CC 27	+	30	80	+	-	+	+
CC 33	-	60	75	+	+	-	-
CC 35	-	40	40	+	+	-	-
CC 37	+	48	83	+	+	+	+
CC65	-	58	41	+	+	-	-
CC 67	+	60	82	+	-	+	+
CC 143[4]	-	***76***	***79***	+	-	-	-
CC 700	+	48	68	+	-	+	-
GF 318	+	39	70	+	-	+	-
GL 395[4]	-	***64***	***73***	+	-	-	-
GL 939	-	56	76	+	-	-	-
K 326	-	30	54	+	-	-	-
K 346	-	81	78	+	-	-	-
NC 71	+	46	61	+	-	+	-
NC 72	+	32	73	+	-	+	-
NC 92	+	24	72	+	-	+	-
NC 196	+	62	71	+	-	+	-
NC 291	+	36	61	+	-	+	-
NC 297	+	30	67	+	-	+	+
NC 299	+	42	71	+	-	+	-
NC 606	-	68	81	+	-	-	-
NC 925[4]	-	***80***	***63***	+	-	-	-
PVH 1118	+	56	60	+	-	+	-
PVH 1452	+	67	83	+	-	+	-
PVH 2110	-	41	67	+	-	-	-
PVH 2275	+	10	62	+	+	+	+
SP 168	+	66	83	+	-	+	-
SP 220	+	62	88	+	-	+	-
SP 225	+	86	86	+	-	+	-
SP 227	+	76	93	+	-	+	-
SP 236	-	88	77	+	-	-	-

[1] Resistance rating = average % plants still alive near 2nd harvest, without a soil fungicide or fumigant. See Tables 3 and 4 for more detailed information.
[2] Varieties with the *Php* gene are almost immune to race 0 of the black shank pathogen; resistance to race 0 without the *Php* gene is at least as high as resistance to race 1.
[3] "Other species" of root-knot nematode include *Meloidogyne arenaria* (peanut root-knot nematode) or *M. javanica* (Javanese root-knot nematode. These other species are now common in Virginia. TCN= Tobacco Cyst Nematode.
[4] *Ratings based on limited data available.* **Varieties in bold are new for 2014 growing season.**
[5] TMV = Tobacco Mosaic Virus.

Tobacco Cyst (TCN), Root-Knot, and Lesion Nematodes are microscopic worms that live in the soil and feed on tobacco roots. *Fields continuously planted with tobacco will develop significant nematode*

problems. In addition to stunting tobacco and reducing yield and quality on their own, tobacco nematodes also significantly increase levels of black shank, Fusarium wilt, and Granville wilt. Destruction of tobacco roots as soon as possible after harvest is a critical first step toward reliably acceptable nematode control in the future. Nematicides should always be used in conjunction with production practices such as early root and stalk destruction, crop rotation, and planting resistant varieties.

Although TCN was a widespread problem for tobacco producers in Virginia for 40 years, frequent use of varieties with the Ph_p gene over the last 20 years has dramatically reduced TCN populations in most fields. Nematicide use should no longer be necessary for TCN control in these cases, but may be advisable when the number of TCN juveniles and eggs exceeds 1,000 per 500 cc of soil (Table 6). Planting a variety without the Ph_p gene for 1-2 consecutive years may allow TCN to increase to such damaging levels. Field histories and nematode assay results can be used to decide if nematicide use would be prudent for the 2014 crop.

Several species of root-knot nematodes are now common in Virginia tobacco fields, and can be present in damaging numbers. All flue-cured tobacco cultivars currently being grown (except K 394) are resistant to races 1 and 3 of the southern root-knot nematode (*Meloidogyne incognita*), but other types of root-knot are often present. These other types of root-knot include the peanut root-knot nematode (*M. arenaria*), races 2 and 4 of the southern root-knot nematode, and the Javanese root-knot nematode (*M. javanica*). Any galling on a "root-knot resistant" cultivar indicates the presence of these other types of root-knot. Flue-cured tobacco cultivars CC 13, CC 33, CC 35, CC 37, CC 65,and PVH 2275 claim resistance to most or all types of root-knot, and should significantly improve control of all of these root-knot nematodes. Rotating tobacco with some other crops will also reduce root-knot nematode populations (see Table 1), but forage legumes, such as clover, are often good hosts for root-knot. Rotation intervals should be increased as long as possible. Using an effective soil nematicide may be advisable when crop rotation and resistant varieties aren't practical and preplant root-knot 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'

Significant crop stunting and relatively high populations of lesion or meadow nematodes (*Pratylenchus* species) seem increasingly common in flue-cured tobacco fields in Virginia. However, not all lesion nematode species damage tobacco, and nematode assay results aren't currently able to differentiate those species from others that don't parasitize tobacco. Rotation crops that reduce root-knot and tobacco cyst nematodes aren't necessarily effective for lesion nematodes, although a single year of forage or grain pearl millet can be highly effective. No resistance is available in tobacco varieties. Applying a tobacco nematicide for lesion nematode control may be profitable when: 1- significant stunting or crop weakness has already been observed, and 2- a soil nematode assay detects as few as 50-100 lesion nematodes/500 cc of soil.

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 if repeated, should be applied 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 spray tips that evenly distribute the spray solution at spray volumes between 25 and 40 gallons per acre. **Field sprays for leaf diseases** should generally be applied using tips that apply a fine spray of 20-100 gallons per acre at 40-100 psi to maximize coverage as plants increase in size. 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: - Fumigant Management Plans (FMPs) are required for use of tobacco soil fumigants containing chloropicrin (Pic+ and Telone C-17, for example) or metam sodium (Sectagon, for example). Tobacco producers who plan to fumigate soil need to familiarize themselves with all documentation, applicator safety, Good Agricultural Practices (GAPs), posting, buffer zone, re-entry, and other requirements involved with use of the specific fumigant product they plan to use. These requirements are detailed in the extensive label for all soil fumigants.

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 7. 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.		

Table 7. DISEASES OF TOBACCO SEEDLINGS (Cont'd)

Disease	Material	Rate
Target Spot (Thanatephorus cucumeris)	Quadris	0.14 fl oz (4 ml)/1,000 sq.ft. (6.0 fl oz/A)
Remarks: Apply in enough water for thorough coverage (5 gal/1,000 sq. ft.). The Special Local Need (24[c]) label allows only 1 application before transplanting, and requires the label be in the possession of the user at the time of application. Follow-up sprays are allowed in the field according to the Quadris federal label.		
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	Disease[2] Granville wilt
Ridomil Gold SL	1-3 pt	Preplant	F	---
Ultra Flourish	2-6 pt	Preplant	F	---
MetaStar 2E AG	4-12 pt	Preplant	F	---
Ridomil Gold SL	1 pt + 1 pt	Preplant + layby	VG	---
Ultra Flourish	2 pt + 2 pt	Preplant + layby	VG	---
MetaStar 2E AG	4 pt + 4 pt	Preplant + layby	VG	---
Ridomil Gold SL	4-8 fl oz + 1.0 pt	TPW[3] + 1st cultivation and/or layby	VG	---
Ridomil Gold SL	1 pt + 1 pt	1st cultivation + layby	VG	---
Ultra Flourish	2 pt + 2 pt	1st cultivation + layby	VG	---
MetaStar 2E AG	4 pt + 4 pt	1st cultivation + layby	VG	---
Ridomil Gold SL	1 pt + 1 pt + 1 pt	Preplant + 1st cultivation + layby	VG	---
Ultra Flourish	2 pt + 2 pt + 2 pt	Preplant + 1st cultivation + layby	VG	---
MetaStar 2E AG	4 pt + 4 pt + 4 pt	Preplant + 1st cultivation + layby	VG	---
Telone C-17	10.5 gal	F-Row	P-F[4]	G
Chlor-O-Pic	3 gal	F-Row	P-F[4]	G
Chloropicrin 100	3 gal	F-Row	P-F[4]	G
Pic Plus	4 gal	F-Row	P-F[4]	G

[1]Preplant – broadcast, preplant-incorporated spray; Transplant water – addition of fungicide to water applied to furrow during transplanting; 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 apply more than 3 pt of Ridomil Gold, 6 pt of Ultra Flourish, or 12 pt of Meta Star 2E AG per acre.

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

[3]Apply in at least 100-200 gallons of transplant water (TPW) per acre, followed by at least 1 subsequent fungicide application for black shank control. There is a risk of temporary plant injury from TPW application at lower rates of water per acre. Pre-mixing Ridomil Gold in a tank from the TPW nurse or source tank also reduces risk of plant injury.

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

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 Ultra Flourish MetaStar 2E AG	0.5-1 pt + 0.5 pt/A 1-2 pt + 1 pt/A 2-4 pt + 2pt	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; but residues are a concern of the tobacco industry; 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
Non-Fumigants			
Vydate CLV	68 fl. oz., PPI	G	---
Vydate L	1 gal, PPI	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= before planting, apply broadcasst in 40 gal/A, use at least 20 gal/A if applied in an 18-24 inch-wide band; incorporate 4-6 inches deep as soonas possible; 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*)	A wet rot is often first observed on stems or leaves. A gray, downy material may be present on the surface of diseased areas. In the greenhouse, 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. "Greenhouse management practices effective for collar rot and target spot also help reduce incidence and severity of Botrytis blight. Occurrence of this disease is extremely rare in the field, but when observed, was associated with topping plants very late in very wet weather."
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, reducing excess moisture, proper clipping procedures, and controlling target spot may help reduce disease.
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.