Tobacco

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Reliable and efficient control of tobacco diseases and nematodes **depends** upon accurate identification of the problems in each field and the simultaneous use of multiple disease management approaches (crop rotation, resistant varieties, sanitation, early stalk and root destruction, etc.).

Disease Management Practices

Crop Rotation

The use of the proper rotation crop can be **critical** to avoid losing yield and quality to diseases and nematodes. Tobacco following tobacco should be avoided.

Table 3.21 - Usefulness of Various Rotation Crops for Tobacco Disease Control[1]

Rotation Crop	Black Shank	Granville Wilt	Root-Knot Nematodes	Tobacco Cyst Nematodes	Tobacco Mosaic Virus	Black Root Rot
Fescue	H	H	H	H	H	H
Small grain	H	H	H	H	H	H
Lespedeza 'Rowan'	H	H	H	-	H	L
Soybean	H	H	L[2]	H	H	L
Corn	H	M	L	H	H	H
Sweetpotato	H	M	L[3]	-	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[4]	L	N	H
Potato, irish	H	N	L	L	H	H
Tomato	H	N	N[2]	N	N	M

[1]Adapted from Table 9-2, Flue-Cured Tobacco Information 2005, 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]However, root-knot resistant cultivars are highly effective rotation crops for tobacco.

[3]Root-knot resistant sweetpotato cultivars are moderately effective rotation crops for tobacco.

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

Early Stalk and Root Destruction

Helps reduce disease, insect, and weed infestation levels that will carry over into future tobacco crops. *Most effective when tobacco stalks and roots are destroyed immediately after final harvest.*

The following steps should be completed to gain maximum benefit: 1) **flue-cured** - cut stalks into small pieces with bushhog or similar equipment the day that harvest is completed in each field; 2) **all types** - disc or plow-out roots the day harvest is completed. Roots must be exposed to air for about 2 weeks to obtain maximum drying of roots; 3) after 2 weeks, re-disc field to provide additional root kill and to bury crop refuse; 4) plant a cover crop when root systems are killed and plant debris is buried.

Disease-resistant Varieties

Offer good control of several of the major diseases of tobacco. However, growers should consider the major disease problems and the level of infestation when selecting a resistant variety. In severe disease situations, disease control chemicals may also

be required to obtain satisfactory results. The Virginia Cooperative Extension Tobacco Production Guides summarize the latest disease resistance information on the most current tobacco cultivars.

Disease Control in Tobacco Greenhouses

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

If tobacco mosaic (TMV) may have occurred in the previous year, greenhouse surfaces that may come in contact with plants should be disinfected. Such surfaces should include side-curtains, center walkways, and the 2x6 boards that form the float bays. However, there is no need to spray the purline supports or the plastic covers over the greenhouse. *Relatively new float trays that may have been used when TMV may have been present should be washed and rinsed thoroughly before being fumigated*. Older trays should be discarded and replaced with new trays. 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°F to 175°F for 30 minutes) to minimize *Rhizoctonia* damping-off and sore shin. Dry trays should be loosely stacked no more than 5 ft high and completely enclosed in plastic. Three pounds of methyl bromide will fumigate 1,000 cubic feet (1,200 trays). Trays should be fumigated 24 to 48 hours, then aerated for at least 48 hours before use. Be sure to read the label for space fumigation and follow it exactly.

Do not fill float bays with water from streams or ponds as these sources may be contaminated. To reduce the potential spread of water-borne pathogens, do not move water from one bay to another. Be careful to avoid introducing disinfectants into water intended for plant uptake.

To avoid spreading TMV, mower blades and decks should be sanitized with a 1:1 bleach and 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.

Condensation on the underside of the greenhouse top and on leaf surfaces create conditions that favor disease. This condensation results from a difference in temperature between the inside and outside of the greenhouse, particularly at sunset. **Increasing air exchange near dusk by temporarily lowering the side curtains will reduce such differences in air temperature. Ventilating the greenhouse with horizontal airflow fans will also help reduce potential 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.

A weekly application of 1/2 lb of Dithane DF, Manzate Pro-Stick, or Penncozeb 75 DF per 100 gal of water (1 level tsp/gal) should start approximately 1 week after seedlings are big enough to cover the tray cells. Spray volume should increase from 3 to 6 gal/1,000 sq. ft. as plants grow. Fungicide application should continue until seedlings are transplanted.

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.

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

Diseases

Blue Mold

Tobacco transplants should be destroyed as soon as possible after transplanting has been completed. If possible, fields that seem to favor blue mold development (shady areas with poor air drainage) should be avoided. Fields should be irrigated early enough in the day that leaves can dry before nightfall. Suspected blue mold should be reported to Virginia Cooperative Extension.

Black Shank and Granville Wilt

Calculating and recording the percentage of diseased plants in each field at the end of each season can enable growers to evaluate the cost-effectiveness of their disease control program.

Severity Level	Black Shank or Granville Wilt
Low	Less than 1%
Moderate	1-5%
High	More than 5%

Black Shank

Caused by a fungus-like pathogen that lives in the soil and attacks tobacco roots and stalks. Disease losses can be minimized in most black shank-infested tobacco fields by planting highly resistant cultivars in fields that have been rotated in and out of tobacco production. The longer the interval between tobacco crops, the less black shank to be expected. Levels of black shank resistance are generally much higher in flue-cured tobacco compared to burley and dark-fired tobacco. Consequently, black shank-infested fields used to produce burley or dark-fired tobacco should be rotated out of tobacco for longer periods of time than normally used with flue-cured tobacco. **Some burley and flue-cured tobacco cultivars are highly resistant to race 0 of the black shank pathogen, but are susceptible to other races. Because most tobacco fields in Virginia now contain mostly race 1 of the pathogen, tobacco cultivars selected for 2009 should be chosen for their resistance to race 1. Current tobacco varieties are always at least as resistant to race 0 as they are to race 1 of black shank, but many are much less resistant to race 1 than to race 0. If black shank is present in fields to be planted with tobacco in 2009, ALWAYS know the resistance to RACE 1 before planting a variety.** Maximum use of a soil fungicide will not necessarily protect a variety with low black shank resistance against significant damage, particularly in non-rotated fields. Soil fumigation is not as effective against black shank as it is for the management of Granville wilt or nematodes.

Granville (Bacterial) Wilt

Caused by a soil-inhabiting bacterium that invades tobacco plants through roots and subsequently kills the entire plant. The pathogen can also invade tobacco plants through wounds, such as those caused by cultivation, mechanical topping, and mechanical harvest. For this reason, early, shallow cultivation and topping by hand can help reduce this disease in infested fields. Although symptoms are somewhat similar to those associated with black shank, intermediate symptoms of Granville wilt involve wilting on only one side of affected plants, and wilted leaves may retain their normal green color rather than yellowing. Crop rotation (particularly with soybeans) and the use of resistant varieties is ***essential*** for Granville wilt control. Disease reduction and yield increases are generally much larger from the use of resistant varieties than from using soil fumigation. However, Granville wilt-resistant varieties are not available in burley and dark-fired tobacco. These types of tobacco generally should ***not*** be planted in fields infested by the Granville wilt pathogen.

Nematodes

Nematodes are microscopic roundworms. Many live in soil and parasitize plant roots. Root-knot, lesion, and tobacco-cyst nematodes are important pests of all tobacco types grown in Southside Virginia. Because symptoms of nematode injury are often confused with other problems, nematodes may go undetected for years. The specific pesticides, rotation crops, and resistant varieties vary among the different types of nematodes that damage tobacco. A Nematode Assay Clinic at Virginia Tech provides a *Diagnostic Nematode Assay* and a *Predictive Nematode Assay*. The *Diagnostic Nematode Assay* determines if plant-parasitic nematodes are the cause of stunted or unthrifty plants. Plant roots should always accompany soil samples submitted for the assay. When nematodes are found to be the cause of problems, it is usually impractical to initiate control measures until the year following the diagnosis. The *Predictive Nematode Assay* focuses on sampling for nematodes in the fall to identify fields with damaging nematode populations so that control measures can be initiated before or at the time of planting. Any soil samples submitted for this assay should be obtained by a systematic sampling procedure. Each soil sample should represent an area no larger than 2 acres and should consist of at least 25 cores or subsamples taken 6 to 8 inches deep. Predictive nematode assay samples must be received by Virginia Tech by November 30 for results to be available by planting. Assay results indicate the presence or absence of economically significant nematode populations. If damaging nematodes are not found, the producer can choose not to use a nematicide. In addition, the type and number of nematodes will influence the choice of nematicide if one is needed. Contact your local Cooperative Extension agent for information on methods of collecting samples and interpreting assay results.

Lesion Nematodes

Early root and stalk destruction and crop rotation can significantly reduce populations of these nematodes. Use of a nematicide rated good (G) or excellent (E) may be profitable when a soil assay detects 50-100 lesion nematodes/500 cc of soil. A combination of crop rotation and more effective nematicides should be used when populations of lesion nematodes are greater than 100 nematodes/500 cc of soil.

Root-knot Nematodes

Root-Knot Nematodes are common in Virginia tobacco fields, and several types of root-knot can be present in damaging numbers. Most "root-knot resistant" tobacco cultivars are only resistant to races 1 and 3 of the southern root-knot nematode (*Meloidogyne incognita*), but other types seem increasingly common. Any root galling on a "root-knot resistant" cultivar indicates the presence of these other types of root-knot. Rotating tobacco with pasture grasses and small grains is equally effective in reducing populations of all types of root-knot, but be careful to rotate tobacco with root-knot resistant cultivars for row crops such as soybean. Forage legumes can also increase root-knot nematode populations to damaging levels. Several new flue-cured tobacco cultivars claim resistance to more than one type of root-knot. Consult the flue-cured tobacco production guide for more information on these varieties. A preplant nematicide may be necessary when root-knot nematode populations are high, as indicated in the following table.

Table 3.22 - Interpreting Root-knot Nematode Infestation Levels

		Nematodes/500 cc of soil		
Risk of Crop Loss	**% Roots Galled**	**Fall Sample**	**Spring Sample**	**Control Options[1]**
Very Low	1-10	1-200	1-20	Practice crop rotation and/or plant a resistant variety.
Low	11-25	201-1,000	21-100	Use crop rotation in combination with a resistant variety or a nematicide rated 'G' or higher.
Moderate	26-50	1,001-3,000	101-300	Use crop rotation in combination with 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 and a nematicide rated 'E'.

[1]Be aware that most "root-knot resistant" tobacco varieties are only resistant to the most common types of root-knot nematodes. **Risks of crop loss are high if any evidence of galling is found on roots of root-knot resistant varieties**. Rotation intervals should be increased as long as possible and nematicides with a rating of excellent (E) should be used when galling has been observed on root-knot resistant varieties.

Tobacco-cyst Nematode (TCN)

Tobacco-cyst nematode (TCN) *(Globodera tabacum subsp. solanacearum)* is now present in most tobacco-producing counties in Southside Virginia and continues to spread to new fields and farms. Taking soil samples for a Predictive Nematode Assay of tobacco fields on a regular basis (before rotating a field to another crop) will help avoid detecting TCN populations "the hard way." **Varieties of flue-cured tobacco are now available that will reduce TCN populations to non-damaging levels.** Crop rotation with corn, sorghum, small grains, or pasture grasses will also significantly improve TCN control, particularly when used in addition to TCN-resistant varieties.

Tobacco Mosaic Virus (TMV)

Anything that moves sap from diseased to healthy plants will also move TMV. TMV can spread via contaminated clipping mowers in the greenhouse and from manufactured tobacco products, old tobacco sheets, tobacco roots and stalks left in the soil from previous crops, and from weed hosts such as horse-nettle and ground cherry. Washing hands regularly with detergent can help reduce TMV incidence early in the season. Rogueing infected plants before layby will reduce spread of the virus within a field. TMV cannot be eliminated without faithful use of crop rotation and early root and stalk destruction. All burley varieties are resistant to TMV except KY8959, TN86, VA509, and HY502. Flue-cured tobacco varieties CC27, CC37, NC102, NC297, NC471, and Speight H20 are also TMV-resistant, as is the dark-fired tobacco variety VA312. *TMV-resistant varieties should be planted in flue-cured tobacco fields with a history of 30 to 50 percent of the plants being infected with TMV by the topping stage. If a TMV-resistant variety is used in an infested field, the entire field should be planted with the resistant variety. Do not plant resistant and susceptible varieties together in TMV problem fields.*

Tomato Spotted Wilt Virus (TSWV)

Spread by various species of thrips from wild weed hosts to tobacco and other crops. Removing infected plants from a tobacco field will not reduce damage. Crop rotation does not reduce the incidence of TSWV. All commercial tobacco varieties are equally susceptible to the virus. Spraying foliar insecticides is also ineffective. However, application of imidacloprid or thiamethoxam prior to or at transplanting can significantly reduce the damage caused by TSWV to tobacco, as will preplant use of Actigard. Satisfactory control of TSWV can be achieved through application of Actigard and either imidacloprid or thiamethoram before transplanting. Be aware, however, that some risk of significant stunting has been associated with preplant use of Actigard. For this reason, do not apply TSWV control chemicals unless 10% to 15% of the tobacco crop is expected to become infected with TSWV. See the PMG section on tobacco insect control for more specific information on use of imidacloprid or thiamethoxam.

Other Viruses

Tobacco etch virus (TEV), Tobacco vein mottling virus (TVMV), Cucumber mosaic virus (CMV), Peanut stunt virus (PSV), Potato virus Y (PVY), Alfalfa mosaic virus (AMV) - TVMV and TEV are the most common viruses found in burley tobacco, frequently occur together, and are often referred to as a virus complex. Other less common viruses found in the burley virus complex are AMV, CMV, and PSV. All of these viruses are transmitted by aphids that feed on infected weeds and then move into tobacco. Overwintering hosts of these viruses include horsenettle, ground cherry, curly dock (for TVMV), alfalfa (for AMV), and clovers for CMV and PSV. Symptoms of virus infections vary greatly depending on the virus involved, time of infection, and variety. Virus infected plants may show mosaic, vein clearing, stunt, chlorosis, vein banding, etch, and death of veins. The earlier the plants become infected the more severe the stunting, chlorosis, and necrosis. There are no known methods to prevent infection, nor are chemicals available to cure a virus-infected plant. The following practices, however, may reduce the severity of losses caused by aphid-borne viruses: 1) Use resistant or tolerant varieties; 2) reduce overwintering hosts; and 3) timely planting. Consult the *Burley Tobacco Production Guide* (Virginia Cooperative Extension publication 436-050) for information on resistance to these viruses in currently-grown burley varieties.

Fusarium Wilt

Can become a serious problem when roots are injured, particularly by tobacco cyst or root-knot nematodes, so effective nematode control is critical to controlling this disease. Early destruction of tobacco stalks and roots and crop rotation (for as long as possible, but not with sweet potato) will also help reduce problems with Fusarium wilt. Use of multipurpose fumigant may be required when significant stand loss occurs.

Application Methods

The performance and safety of a chemical is dependent on following the proper application methods. Proper application procedures will avoid crop injury and poor disease control.

Preplant Incorporated (PPI)

Refer to section under weed control.

Foliar Spray (FS)

Greenhouse applications should not begin until seedlings are at least the size of a dime, but should be repeated at 5- to 7-day intervals up to transplanting. Use flat-fan, extended-range tips at approximately 40 psi to maximize results. **Field sprays** should generally be performed using tips to apply a fine spray of 20 to 100 gallons per acre to maximize coverage as plants increase in size. Spray pressures should generally range between 40 and 100 psi. 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. Fungicides applied using air-blast sprayers should be mixed at a two-times concentration but only half the spray volume (gal mix/acre) should be delivered compared to a hydraulic sprayer.

Fumigation

Field Procedures - Soil should be in good seed bed condition, free of clods and undecomposed plant material, and with soil moisture at about 1/2 of field capacity when fumigants are applied. If undecomposed plant material is present, plow down and allow to decompose before applying fumigant. Soil temperature should be 50° to 80° F at the depth of injection. Fumigants can be applied by the following procedure: 1) **Row treatment** - inject the fumigant 6-8 inches deep with one chisel-type applicator in center of the row. In the same operation as fumigant application, seal the soil by bedding the fumigated row area with enough soil to bring the soil surface 14-16 inches above the point of infection. 2) **Broadcast treatment** - Space chisels 8 inches apart and inject fumigant 10 to 12 inches below the soil surface. Immediately seal in the fumigant with a roller, drag, disc, or similar equipment.

After fumigation, leave soil undisturbed for an 'exposure period' of 7-14 days. Cold, wet soil retards diffusion of fumigants and requires a longer exposure period. Soil should be aerated at the end of the exposure period. Planting is generally considered safe when a residual odor of the fumigant is no longer detectable in the soil root zone. This condition is usually reached within 3 weeks after fumigation. *The following procedures can be used to hasten aeration, especially if rains or cold temperatures occur during the exposure period: 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****: In both types of treatment, avoid contamination of treated soil with untreated soil. Do not rehill row if there is a danger of contamination with untreated soil. Do not use tools, equipment, and/or residues that are contaminated with soil-borne pathogens. Remember, plant injury will occur if fumigant is still present in the soil at transplanting.*

Precautionary and Restriction Statements

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

Table 3.23 - Diseases of Tobacco Seedlings

Disease	Material	Rate	Remarks
Blue mold (*Peronospora tabacina*)	Aliette	0.5lb/50 gal	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.
Tomato Spotted Wilt Virus (TSWV)	Actigard 50WG	1.0-2.0 oz/100,000 plants (~347- 288-cell trays)	*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.** A 10% to 15% stand loss due to TSWV should be expected before considering use. 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.
		0.5 oz/A	Field application as a banded, foliar spray in sufficient water (at least 20 gal/A) to provide thorough coverage. The initial spray should be made within 7 days of transplanting or whenever plants have recovered from transplant shock, whichever comes first. A total of 3 such field applications may be made, 10 to 14 days apart.
Angular Leaf Spot or Wildfire *(Pseudomonas)*	Agrimycin 17, Streptrol, etc.	100-200 ppm (2-4 tsp/3 gal)	Foliar Spray; 100 ppm = 4.0 oz/50 gal or 0.5 lb/100 gal; 200 ppm = 0.5 lb/50 gal or 1.0 lb/100 gal
Anthracnose *(Colletotrichum gloeosporoides)* Blue Mold *(Peronospora tabacina)* Target Spot *(Thanatephorus cucumeris)*	Dithane DF Rainshield Manzate Pro-Stick Penncozeb 75DF	0.5 lb/100 gal (1 level tsp/gal)	Apply as a fine spray to the point of run-off to ensure thorough coverage. For best results, 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/1,000 sq ft. when the canopy has closed and plants are close to ready for transplanting. Repeat applications on a 5-day interval to protect new growth.
Pythium Root Rot *(Pythium spp.)*	Terramaster 35WP	2 oz/100 gal of float bed water	Can be used before or after symptoms appear, but no earlier than 2 weeks after seeding. If symptoms reappear, a second application can be made no later than 8 weeks after seeding. **Must be evenly distributed**; when mixing, first form dilute slurry, then distribute slurry evenly and thoroughly in float bed water.
	Terramaster 4EC	**Preventative:** 1 fl oz/100 gal **Sequential:** 0.9 fl oz/100 gal **Curative:** 1.4 fl oz/100 gal **2nd Curative:** 1-1.4 fl oz/100 gal	Can be used before or after symptoms appear, but no earlier than 2 weeks after seeding. If symptoms reappear, a second application can be made no later than 8 weeks after seeding. No more than 2.8 fl oz/100 gal 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 slurry, then distribute slurry evenly and thoroughly in float bed water.

Table 3.24 - Foliar Diseases in the Field

Disease	Material	Rate	Remarks
Angular Leaf Spot (*Pseudomonas angulata*)	Agrimycin 17, Streptrol (streptomycin sulfate), etc.	0.25-0.5 lb/A	Apply at 50 psi in 20-50 gal of water. The amount of chemical and water depends on size of plant. Use higher rates for mature plants. Cover both tops and bottoms of leaves. Drop nozzles increase plant coverage. Make field applications when disease is predicted or threatens and repeat at 7-day intervals. During active disease weather, spray at 3 to 4 day intervals. Repeat application immediately after a rain. Discontinue spray application when disease is no longer a threat. **Warning:** May fail to control disease if applied after infection and symptom formation.
Blue mold *(Peronospora tobacina)*	Actigard 50WG	0.5 oz/20 gal/A	Begin applications when blue mold threatens and plants are tall enough (12 inches for flue-cured and dark-fired tobacco, 18 inches for burley). Up to 3 sprays may be applied on a 10-day schedule. Spray weekly for complete coverage until blue mold no longer threatens. Increase spray volume as the crop grows. Spray volumes should range from 20 gal/A for 1- 3 weeks after transplanting to 40 gal/A for tobacco near layby, to 60 gal/A for waist- high tobacco, to 80-100 gal/A for tobacco near topping or thereafter. If using an air blast sprayer, mix fungicide at 2X concentration, but calibrate sprayer to apply 1/2 the spray volume (gal/acre) used with hydraulic sprayers. Do not spray within 21 days of harvest for flue-cured tobacco or within 30 days of cutting burley tobacco.
	Acrobat MZ	2.5 lb/100 gal	
	Acrobat 50WP + Dithane DF Rainshield or Manzate Pro-Stick or Penncozeb 75DF	7.0 oz/100 gal 2.0 lb/100 gal	
	Forum + Dithane DF Rainshield or Manzate Pro-Stick or Penncozeb 75DF	7.0 fl oz/100 gal 2.0 lb/100 gal	
	Aliette	2.5-4.0 lb/A	Foliar spray; no more than 5 sprays allowed, 3-day preharvest interval; don't tankmix.
	Carbamate (Ferbam);	2.0-3.0 lb/A	Make field applications when disease is predicted or threatens and repeat at 5-7 day intervals. During active blue mold weather, spray at 3-4 day intervals. Repeat application immediately after a rain. Discontinue spray application when disease is no longer a threat.
	Dithane DF Rainshield Manzate Pro-Stick Penncozeb 75DF	2.0 lb/100 gal	Spray weekly for complete coverage until blue mold no longer threatens. Gradually increase spray volume as the crop grows. Spray volumes should range between 80 and 100 gal/A on tobacco ready to be topped. If using an air blast sprayer, mix fungicide at 2X concentration, but calibrate sprayer to apply 1/2 the spray volume (gal/acre) used with hydraulic sprayers. Don't spray within 21 days of harvest for flue-cured tobacco, or within 30 days of cutting burley tobacco.

Table 3.24 - Foliar Diseases in the Field (cont.)

Disease	Material	Rate	Remarks
Blue mold *(Peronospora tabacina);* Frogeye *(Cercospora nicotianae):* Target Spot *(Thanatephorus cucumeris)*	Quadris	6.0-12.0 fl oz	First application should be made prior to disease development or at first indication of disease development in the area; sprays should be applied every 7-14 days, with shorter intervals when weather is conducive for disease, in sufficient water volume for complete coverage and canopy penetration; may enhance weather flecking, but this does not 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.
Blue mold *(Peronospora tobacina)*	Ridomil Gold EC Ultra Flourish	0.5-1.0 pt 1.0-2.0 pt	**Flue-Cured** - Apply 0.5 pt/A of Ridomil Gold EC for early season control. **Burley, dark-fired, and sun-cured** - Apply 1 pt/A of Ridomil Gold EC. **Note:** Apply broadcast and incorporate in top 2-4 inches of soil before transplanting. Do not use Ridomil in transplant water or apply to tobacco leaves in the field. Ridomil Gold should not be used in plant beds or float systems.
	Ridomil Gold EC Ultra Flourish	0.5 pt 1.0 pt	Apply to soil beneath plants just before layby cultivation. **Do not make this application if Ridomil-insensitive strains may be present.**

Table 3.25 - Root and Stem Diseases in the Field

Disease	Material	Rate/Acre	Remarks
Black Root Rot (*Thielaviopsis basicola*)	Chlor-O-Pic Chloropicrin 100 Pic+ Telone C17	3.0 gal 3.0 gal 4.2 gal 10.5 gal	Keep soil pH at 5.6 or between 5 and 6. Use a 2-4 year rotation with small grains or corn. Do not rotate with red clover, soybeans, or other legumes since the same pathogen that attacks tobacco infects these crops. Multipurpose chemicals applied before transplanting may aid in the reduction of symptoms caused by black root rot. Use higher rates for high infestation levels.
Black shank (*Phytophthora nicotianae*)	**Flue-Cured** Ridomil Gold EC Ultra Flourish	 1.0-2.0 pt 2.0-4.0 pt	Apply broadcast and incorporate in the top 2-4 inches of soil before trans-planting. Ridomil or Ultra Flourish should always be used in conjunction with crop rotation and resistant varieties.
	Burley and Dark Ridomil Gold EC Ultra Flourish	 2.0-3.0 pt 4.0-6.0 pt	Failure to control nematodes in treated fields may result in poor black shank control.
	Ridomil Gold EC Ultra Flourish	0.5-1.0 pt 1.0-2.0 pt	Apply to soil beneath plants at the last cultivation. Use with a preplant appli-cation. Do not exceed a total of 3.0 pt of Ridomil Gold/A or 6.0 pt of Ultra Flourish.
	Ridomil Gold EC Ultra Flourish	1.0 pt 2.0 pt	Apply to soil preplant and beneath plants at the first and last cultivations.
	Ridomil Gold EC Ultra Flourish	0.5 pt 1.0 pt	Before and 30-35 days after trans-planting in no-till tobacco. See com-ments in tobacco weed control section for directions in calculating rates for band applications.
	Chlor-O-Pic Chloropicrin 100 Pic+ Telone C-17	3.0 gal 3.0 gal 4.2 gal 10.5 gal	Inject 8 inches deep with one shank in center of row when soil temperatures are above 50° F. Wait 2-3 weeks after fumigation before planting. Fumigants should always be used in conjunction with host resistance and crop rotation. Soil fumigants should always be used with a soil fungicide if applied for black shank control.
Fusarium Wilt (*Fusarium oxysporum* f. sp. *nicotianae*)	Chlor-O-Pic Chloropicrin 100 Pic+	3.0 gal 3.0 gal 4.2 gal	In severe cases, use a multipurpose chemical and a 2-year rotation. Do not rotate with sweet potatoes, since the same fungus attacks both crops.
Granville Wilt (*Pseudomonas solanacearum*)	Chlor-O-Pic Chloropicrin 100 Pic+ Telone C-17	3.0 gal 3.0 gal 4.2 gal 10.5 gal	Fumigants should always be used in conjunction with host resistance and crop rotation.

Table 3.26 - Nematodes[1]

Material	Rate/A[2]	Application Method[3]	Root-Knot and Others	Tobacco-Cyst[4]	Remarks
Fumigants					
Chlor-O-Pic	3.0 gal	Row	E	G	
Metam CLR	20.0-25.0 gal	Row	—	G	
Pic+	4.2 gal	Row	E	G	
Telone II	9.0-10.0 gal	Row	E	G	
Telone C17	10.5 gal	Row	E	G	
Granular or Liquid Non-fumigants[5]					
Temik 15G	20.0 lb	Band	G	G	Flue-cured only. Do not apply more than one week before transplanting to obtain optimum control.

[1]Control rating - E = Excellent; G = Good; F = Fair; P = Poor, — = no control or not labeled for disease; nd = no data available.

[2]Use higher rates for heavy soil types and/or high nematode infestations.

[3]**PPI** - Applied broadcast, preplant incorporated. **Row** - Inject 8 inches deep in row with single shank - 21-day waiting period before planting. **Band** - Apply Temik granules in a 14 inch band; incorporate into or cover with soil to a depth of 2 to 6 inches when forming beds. Apply Vydate in a 18-24 inch band and incorporate 4-6 inches deep.

[4]Tobacco cyst (TCN) - *Globodera tabacum* subsp. *solanacearum.*

[5]Satisfactory nematode control from Temik is extremely dependent on proper application. Be aware that adequate soil moisture is required before the product is activated. Read precautionary and rotation crop restrictions.

Table 3.27 - No Chemical Available for the Following Diseases

Disease	Comments
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. The only control methods available involve reducing surface moisture on leaves and stems (by correct watering and improving ventilation) and by collection and removal of loose leaf material resulting from transplant clipping operations.
Collar Rot *(Sclerotinia sclerotiorum)*	Symptoms of this disease (occuring only in greenhouse and float bed systems) resemble damping-off. Small groups of plants have brown, wet lesions near the base of stems. Leaf rot may be seen that appears to progress from leaf margins or tips toward the stem. White, cottony, mold may be visible. Irregularly shaped, white to black objects (sclerotia) may also be found attached to severely infected plant parts. Sclerotia may be carried to the field by infected plants. Infected plants, as well as plants immediately adjacent to diseased areas, should be discarded as soon as possible. Proper clipping procedures, improving ventilation, and reducing excess moisture will help reduce spread of the causal organism.
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 soil drainage and fertilization can be beneficial. Do not plant in alkaline soils and avoid heavy application 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 increases severity of problem. Burley and flue-cured tobacco are more susceptible than dark-fired and sun-cured varieties. Certain varieties within tobacco types are less susceptible than oth ers. Refer to variety information.