

TOBACCO DISEASE MANAGEMENT

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General Information

Endemic diseases such as bacterial wilt, black shank and root-knot nematodes always cause significant disease losses in South Carolina. Tomato spotted wilt, target spot, and blue mold also have the potential of causing disease problems in SC as well. These important and potentially devastating diseases of tobacco can best be managed through a combination of control methods. It is urged that growers identify disease problems in their fields and follow disease management suggestions based on rotation, variety selection, sanitation and chemical treatments. A sound disease management strategy cannot be developed without the proper identification of the disease problems in your fields. Disease development is a dynamic process and can change over time. A low disease loss in your fields in the recent past does not assure disease losses will remain low!

Disease Management Strategy

Disease losses affect tobacco yields, quality and profitability. Disease control options can be expensive to use and costly especially if the wrong control option is chosen. Great care needs to be exercised to assure a return on your control investment.

Rotation: The best defense against most diseases and the least expensive is a good, well-planned rotation. However, the diseases must be correctly identified within particular fields to develop a sound rotation plan. Any rotation is better than no rotation, but certain crops will do a better job of suppressing certain diseases. While some growers take a chance and do not rotate, sooner or later they will get caught with unexpected losses. Some diseases, such as bacterial wilt or black shank, may destroy entire fields! Also, some diseases such as mosaic and nematodes may be causing more damage than realized through observation because the plant may not completely die. Losses to these diseases are easily masked in a year in which rainfall was plentiful. Although difficult to see, these losses substantially reduce farm income! Losses to the three major diseases in South Carolina, that consistently reduce yields from year to year, can be reduced through a planned rotation program.

Host Resistance: Selection of resistant varieties provides a highly effective and inexpensive method of reducing losses to disease. Varieties differ in resistance to black shank, bacterial wilt, tobacco mosaic, Fusarium wilt and root-knot nematodes, so any one variety will not be the best choice in all fields. Study the disease ratings within the tobacco production guide to select appropriate varieties for your farm.

Chemical Treatments: Selection of chemical treatments should be your LAST CONSIDERATION in a disease control strategy. Rotation, variety selection and proper sanitation reduce populations of pathogenic organisms to levels that can be controlled by chemical applications. Choose your chemicals to match the disease pressure in your fields.

Bacterial Wilt Control

Bacterial wilt is the most serious of the soil-borne diseases of tobacco in South Carolina. It is very difficult to manage. The disease is concentrated in the eastern-most counties in the Pee Dee Region, but is present and increasing in severity in other important tobacco-producing counties.

Symptoms of bacterial wilt appear first as a wilt of leaves on one side of the plant. Eventually, the entire plant wilts, and infected plants usually die. Stalks appear dark brown or black at the ground level and look very much like black shank. However, bacterial wilt-infected plants have black streaks in the tissue just under the outer bark. Portions of lower stalk tissue will ooze milky strands of bacteria when placed in a clear container of water.

Bacterial wilt is a disease that is caused by a bacterium (*Ralstonia solanacearum*), which lives in the soil. These bacteria cause disease when they infect the roots through wounds. Any type of root wounding provides an entry point for infection. Therefore, shallow cultivation will help to avoid wounding roots, which provide points for infection. Natural wounds occur in the root system as a result of root growth through the soil; therefore, a certain amount of natural infection can take place, if the bacterial population is high enough in the soil around the root system.

The bacterium that causes bacterial wilt also infects a number of other crop plants, such as tomatoes, potatoes, peppers, eggplant and peanuts. Ragweed is a very common weed that is a host for the bacterium. Therefore, it is very important to recognize and control this weed thoroughly in areas planned for tobacco. The bacteria are very persistent in soil, and long rotations (three years or longer) may be necessary in some fields to assist in managing the disease. Rotation is imperative for management. Multipurpose chemicals (Telone C-17 and Chlor-O-Pic) also assist in control. Bacterial wilt **MUST** be managed by a combination of rotation, variety selection, and possible use of multipurpose chemicals. Other helpful practices include root and stalk destruction, enhanced soil drainage (utilize a high wide bed) and early shallow cultivation to avoid root wounding. It is also **VERY IMPORTANT** to avoid spread of bacterial wilt by movement of infested soil on farm equipment or by other means.

Mechanical Spread of Bacterial Wilt

Infection of tobacco in the field occurs typically through the root system. However, mechanical transmission of the bacterium during topping and harvesting also plays a significant role in the spread and severity of the disease.

BEST MANAGEMENT SYSTEM FOR CONTROL OF BACTERIAL WILT

The following points should be considered to help control bacterial wilt:

1. Crop rotation to include soybeans
2. Use of host resistance
3. Multipurpose soil fumigation
4. Hand topping or prioritize order of topping, and harvesting (**healthy tobacco first**). Consider using the redesigned topper blade which applies Clorox as a disinfectant.
5. Eliminate or reduce stalk wounding at harvest. Keep harvesters clean and properly adjusted to **avoid stem injury**
6. Use Roundup to kill stalks or immediate stalk destruction following last harvest
7. Maintain proper drainage in field
8. Use of a winter cover crop

MULTI-PURPOSE CHEMICALS FOR BACTERIAL WILT AND NEMATODE CONTROL.

MATERIAL	RATE/A	REMARKS	REI
Telone C17	10.5 gal	CAUTION: 3-week waiting period between Application and Transplanting.	5 days
Chlor-O-Pic	3.0 gal	Same as above.	48 hr and gas conc. less than 0.1 ppm
Remarks: Multi-purpose fumigants require waiting periods of up to 3 weeks before tobacco can be safely transplanted into fumigated soils. Good disease control by fumigation is possible whenever soil moisture and soil temperature conditions (55° F at 6 inches is best) are favorable. Cold, wet soils will not allow fumigants to work to the best of their capability. In-row multipurpose fumigation can be applied during the subsoiling operation. Placement of fumigant below the clay subsoil should be avoided. Soil moisture should not be excessive at the point of injection or poor control will be achieved.			

Black Shank Control

Black shank can cause significant losses in South Carolina tobacco. Black shank is caused by a fungus (*Phytophthora parasitica* var. *nicotianae*), which lives in the soil and attacks the plant primarily through the roots. Wounds are not required for infection by the black shank fungus. High soil moisture favors root colonization by the black shank fungus, although effects of early season infections become most apparent when soil moisture becomes limited. Sustaining high disease losses from black shank is tragic, because we know that rotation is very effective in reducing levels of the fungus in the soil. Any rotation is effective to some degree, because tobacco is the only host of the black shank fungus. The longer the rotation, the more effective the control. Therefore, rotation is the backbone of a successful control strategy, which also should utilize resistant varieties, chemicals and cultural practices.

FIELD INFESTATION LEVEL	ROTATION	VARIETAL RESISTANCE OPTIONS	CHEMICAL CONTROL
High (More than 6% disease)	1) 4 years	Moderate to high	Nematicide
	2) 3 years	High only	Multipurpose <u>or</u> Fungicide + Nematicide
	3) 2 years	High only	Fungicide + Nematicide
Moderate (1% - 6% disease)	1) 3 years	Low to High	Nematicide
	2) 2 years	High only	Multipurpose <u>or</u> Fungicide + Nematicide
	3) None*	High only	Fungicide + Nematicide
Low (Less than 1% disease)	1) 2 years	Low to high	Nematicide
	2) None*	High only	Multipurpose <u>or</u> Fungicide + Nematicide

Remarks: Continuous culture (tobacco following tobacco) is not recommended. However, if this cropping system is chosen, use only varieties with high resistance and a black shank control chemical. Do NOT consider continuous culture if the infestation level is greater than 6% of the plants having black shank.

Continuous use of new varieties with high resistance and the ph gene without crop rotation may lead to the development of new strains of the pathogen reducing the effectiveness of the newer resistant cultivars. Numerous fields have been observed with race 1 of black shank, which can cause disease on varieties with the ph gene. Producers should consider rotating tobacco varieties to include lines with and without the ph gene (see tobacco variety table in South Carolina Tobacco Growers Guide). If race 1 occurs within your field (disease observed in a variety with the ph gene which imparts immunity to race 0) consider using a variety with high resistance that does not contain the ph gene. In addition, continuous use of new varieties with high resistance to black shank without crop rotation may lead to losses from other diseases such as fusarium wilt (see disease resistance ratings in SC Tobacco Growers Guide).

Ridomil Gold and two new fungicides, Orondis Gold 200 and Presidio, are labelled for use on tobacco in 2017. Please see tables and information below for application recommendations, **BUT ALWAYS CONSULT THE INDIVIDUAL PRODUCT LABEL FOR COMPLETE USE DIRECTIONS AND APPLICATION INFORMATION.**

RIDOMIL GOLD FOR BLACK SHANK CONTROL

ROTATION	RIDOMIL GOLD SL APPLICATION	REI
None (Continuous tobacco is NOT recommended)	1 qt/A preplant broadcast <u>OR</u> 1 pt/A preplant broadcast + 1 pt /A layby* <u>OR</u> 1 pt/A preplant + 1 pt/A first cultivation + 1 pt/A layby*	48 hr
2 year (Tobacco in alternate years)	1.5 pt /A preplant broadcast <u>OR</u> 1 pt/A preplant broadcast + 0.5 pt /A layby*	48 hr
3 year or more (Tobacco every third year or more)	1 pt /A preplant <u>OR</u> 1 pt/A preplant broadcast + 0.5 pt/A layby*	48 hr
Remarks: *Apply Ridomil at layby cultivation using two drop nozzles per row directed to the sides of the bed. REI = reentry interval		

RIDOMIL GOLD FOR PRE-PLANT & POST-PLANT CONTROL OF BLACK SHANK

Application site	RIDOMIL GOLD SL APPLICATION	REI
Transplant water 24-C label or post-plant soil applications	Apply in transplant furrow while planting tobacco seedlings. Apply in 4-8 oz/A (0.25-0.5 pt/A) in at least 200 gallons of transplant water per acre. Additional soil applications (1st cultivation and/or layby) may be needed if disease pressure is high. <u>Do Not Exceed</u> label rate for the season. Consult label for potential of crop injury and application directions! 24-C Label should be in your possession at the time of application.	48 hr.

PRESIDIO FOR POST-PLANT CONTROL OF BLACK SHANK

Application Rates		Minimum Time from Last Application to Harvest (PHI)	Specific Use Instructions
fl oz/A	GPA Spray Mixture		
4 (0.125 lb ai/A)	Ground: Minimum 20	N/A	Post-transplant program: one application of <i>Presidio</i> fungicide can be made at either first cultivation or layby (last cultivation). Direct nozzles to cover soil beneath lower leaves incorporate immediately with cultivator.

*For best control of black shank with *Presidio* Fungicide, use with tobacco varieties that have moderate-to-high resistance to the black shank pathogen. Consult your local Cooperative Extension Service office or university specialist for information on variety selection.

ORONDIS GOLD 200 FOR PRE-PLANT & POST PLANT CONTROL OF BLACK SHANK

Rate (fl oz/A)	Application Timing
4.8 - 19.2	Apply at planting in furrow or in transplant water.
	Apply soil-directed or banded applications at 1st cultivation and layby.
Resistance Management:	
<ul style="list-style-type: none"> • Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. • Do not follow soil applications of Orondis Gold 200 with foliar applications of Orondis Opti A or Orondis Ultra A. 	
USE RESTRICTIONS	
<ol style="list-style-type: none"> 1) Maximum Single Application Rate: Do not exceed 19.2 fl oz per acre per application. 2) Maximum Annual Rate: Do not exceed 38.6 fl oz per acre per year. 3) Maximum Number of Applications: Do not make more than four applications per crop. 4) Minimum Application Interval: 7 days 5) Pre-harvest Interval (PHI): 7 days 	

ORONDIS + RIDOMIL GOLD CO-PACK FOR PRE-PLANT & POST PLANT CONTROL OF BLACK SHANK

Rate Orondis Gold 200 + Ridomil Gold SL	Use rate per 2 (ee) Recommendation
Maximum amount per season Orondis Gold 200 + Ridomil Gold SL	Do not exceed 38.6 fl. Oz. of Orondis Gold 200 soil use per acre per season Do not exceed the equivalent of 1.5 lbs. a.i. per acre of mefenoxam-containing products
Minimum gallons per acre (GPA)	Transplant (setter) water drench: 200 GPA 1 st Cultivation: 20 GPA Layby: 40 GPA
Preharvest Interval (PHI)	7 days
Adjuvants	Do not combine with adjuvants, surfactants or fertilizers, unless prior use has shown the combination physically compatible, effective and non-injurious under your conditions of use
Crop Rotation Intervals	0 days to crops on label 30 days to cereals and grass animal feeds 180 days to all other crops

Recommended Black Shank Fungicide Programs for 2017

The opportunity to use the Orondis Gold 200 + Ridomil Gold SL co-pack in a transplant-water application in 2017 offers new options for improved black shank control. Orondis Gold 200 needs to reach plant roots early to be effective, but when it does, it has shown excellent results in longer-term control. Its low water solubility also makes it less mobile in the soil, which is facilitated by application in the transplant water. The addition of Ridomil Gold in the co-pack also provides improved Pythium control. The following two program recommendations, **A & B**, take into consideration field sites with moderate or high history of disease. Because Ridomil Gold is water soluble, it may leach out of the root zone if a heavy rainfall event occurs after transplanting. In this case, consider an additional Ridomil application to maintain both black shank and Pythium control. Do not exceed label rate for the season, however.

Fungicide Program – Plan A

Two Applications – Moderate Disease Pressure

1. In Transplant Water
 - Orondis/Ridomil Co-Pack
2. At Layby
 - Ridomil Gold
 - Or
 - Presidio

Fungicide Program – Plan B

Three Applications – High Disease Pressure

1. In Transplant Water
 - Orondis/Ridomil Co-Pack
2. At 1st Cultivation
 - Presidio
3. At Layby
 - Ridomil

****Always Consult the Individual Product Label for Complete Use and Application Information***

Tomato Spotted Wilt Control

TSW infections occur through wounds in epidermal cells caused by tobacco thrips. Generally insecticides have been ineffective in reducing virus transmission because very little time is required to transmit the virus. The insecticide may kill the insect but only after the plant has already acquired the virus. Thrips population's peak in April and May and then decline in June. This approximates the timing of TSW seen in South Carolina.

The following points should be considered to help control Tomato Spotted Wilt:

1. Avoid early planting
2. Apply Admire (Imidacloprid) as a tray drench (refer to product label for application instructions)
3. Use healthy disease free seedlings to reduce stand loss to other pathogens
4. Follow fertility recommendations - avoid excessive nitrogen application
5. Irrigate if possible to assure sustained crop growth
6. Consider use of Actigard if expectation of disease loss is high or if severe losses to TSW were experienced in previous years (refer to product label for application instructions)

Target Spot Control

Target spot is endemic to South Carolina tobacco fields and is caused by a fungus (*Thanatephorus cucumeris*). Disease development is more severe during wet weather. The symptoms appear similar to brown spot and are easy to confuse. Necrotic tissue can become brittle, fall out, and leave a shot hole appearance. Under high relative humidity lesions can increase rapidly blighting large portions of the leaf.

FOLIAR TREATMENTS*	RATE	REMARKS
Quadris Flowable	6.0-12.0 oz/A	Apply on a 7-14-day interval with shorter intervals under conditions conducive to disease development. For ground application apply Quadris in sufficient water volume for adequate coverage and canopy penetration. Do not tank mix with Thiodan Quadris should be applied as a component in an Integrated Pest Management strategy . Check label for application information and potential crop injury. REI = 4 hours
Remarks: REI = reentry interval.		

Blue Mold Control

Blue mold occurs in Florida and Georgia almost every year and has the potential to cause severe losses in South Carolina. Ridomil resistant strains have been observed in other states and pose a possible threat to the tobacco crop in South Carolina. Blue mold is potentially one of the most destructive diseases of tobacco. It is caused by a fungus (*Peronospora tabacina*) that is airborne, and disease can spread very quickly, leading to epidemics if not properly managed. Acrobat has received a label for blue mold control but should be used in combination with another fungicide. Presidio received a label for blue mold control in 2015.

FIELD BLUE MOLD CONTROL

SOIL TREATMENTS	RATE	REMARKS
Ridomil Gold	0.5-1 pt/A	Broadcast and incorporate 2-4 inches at or before transplanting. An additional 0.5 pt/A may be used at layby if no more than 1 pt/A was applied at planting. REI = 48 hr.
FOLIAR TREATMENTS*	RATE	REMARKS
Forum (formerly Acrobat)	2-8 fl oz	Forum must be tank mixed with a product registered for control of blue mold, such as mancozeb, for resistance management. Neither Ridomil Gold nor Actigard are recommended as a tank-mix with Forum. Consult label before tank mixing with any product. Do not exceed 30 oz/season. REI = 0 days. Tobacco may be harvested the day of the last application, after the spray has dried.
Actigard 50 WG	0.5 oz/A	Begin application after plants reach a height of 12 inches. Apply on a preventative schedule when blue mold threatens. Another registered blue mold product should be used prior to 12 inches for early season control and after the final application if conditions are conducive for disease. Make up to 3 applications on a 10-day schedule. Apply in a minimum of 20 gals. /A. Application of Actigard may result in leaf yellowing. This cosmetic yellowing normally disappears after final application. REI = 12 hr.

FOLIAR TREATMENTS*	RATE	REMARKS
Quadris Flowable	6.0-12.0 oz/A	<p>Quadris application should begin prior to disease development or at first indication that blue mold is in the area. Do Not apply Quadris as a curative application. If blue mold is present in the field, initiate application with Acrobat MZ prior to Quadris application. Apply on a 7-14-day interval with shorter intervals under conditions conducive to disease development. For ground application apply Quadris in sufficient water volume for adequate coverage and canopy penetration. Do not tank mix with Thiodan. Check label for potential crop injury.</p> <p>REI = 4 hours</p>
Presidio	4 (0.125) lb ai/A	<p>For resistance management, Presidio Fungicide must be tank mixed with a labeled rate of another fungicide active against the target pathogen, but with a different mode of action. Apply as a foliar spray prior to disease onset or at first indication that blue mold is in the area. A second foliar application may be made, with a minimum treatment interval of 7 days between foliar applications. Make no more than 2 foliar applications per season.</p> <p>REI = 12 hours</p>
Orondis Ultra A	2.0 – 4.8 oz/A	<p>Begin applications prior to disease development and continue on a 7- to 10-day interval.</p> <p>Use the higher rates when disease is present, for longer application intervals, or for susceptible varieties.</p> <p>For conventional ground application, apply at least 15 gallons per acre, increasing the spray volume as the plants mature to ensure thorough coverage of the foliage.</p> <p>For air-assisted ground application, apply at least 10 gallons per acre.</p> <p>For aerial application, apply at least 2 gallons per acre.</p> <p>Maximum Single Application Rate: Do not exceed 4.8 fl oz per acre per application.</p> <p>Maximum Annual Rate: Do not exceed 19.2 fl oz per acre per year.</p> <p>Maximum Number of Applications: Do not exceed six foliar applications per acre per year for the same crop.</p> <p>Do not use for more than 33% of the total foliar fungicide applications.</p> <p>Minimum Application Interval: 7 days</p> <p>Pre-harvest Interval (PHI): 7 days</p> <p>Resistance Management:</p> <p>Make no more that 2 sequential applications before rotating to a fungicide with a different mode of action.</p> <p>Do not follow soil applications of Orondis with foliar applications of Orondis Ultra A. Use either soil applications or foliar applications but not both for disease control.</p>

REI = reentry interval

TOBACCO GREENHOUSE DISEASE CONTROL

There are several potentially important disease problems that may occur in greenhouse transplant production systems. These include target spot (*Rhizoctonia solani*), white mold or stem rot (*Sclerotinia spp.*), damping-off caused by *Pythium* spp. or *Rhizoctonia spp.*, blue mold (*Peronospora tabacina*), gray mold (*Botrytis cinerea*), soft rot (*Erwinia spp.*) and tobacco mosaic virus. The potential also exists for diseases most often associated with field-grown tobacco to occur and include bacterial wilt (*Ralstonia solanacearum*) and black shank (*Phytophthora parasitica var. nicotianae*).

It is imperative that producers take extra precautions to prevent pathogens from entering the greenhouse and to minimize environmental conditions within the greenhouse that might encourage disease development. Thus, ventilation, sanitation, monitoring, and use of good production practices are important disease management factors.

DISEASE	CHEMICAL	RATE/50 GAL WATER	REMARKS*
Target Spot Blue Mold	Quadris Flowable 24-C Label	6 oz/A or 0.14 oz (4 ml)/1000 ft ² in enough water for thorough coverage (recommended 5 gal/1000 ft ²)	Make only one application prior to transplanting. Follow up applications can be made in the field according to the Quadris federal label. Greenhouse 24-C Label should be in your possession at the time of application. REI = 4 hours
	Terramaster 4EC	1.4 oz/100 gal water	Do not apply as a drench or in irrigation water. Apply this product only to tobacco float-bed water. Consult the label for mixing directions. Crop injury can occur with improper mixing. Terramaster 4EC used as a preventative treatment before symptoms occur, mix 1.4 fl. oz of Terramaster /100 gal of water no sooner than three weeks after seeding. A sequential preventative application of 1.4 fl oz/100 gal of water can be made 3 weeks after the first application. Do not apply Terramaster 4EC later than 8 weeks after seeding. REI = 12 hr.
	Terramaster 4EC	1.4 oz/100 gal water	Terramaster 4EC used as a curative treatment when symptoms first appear, mix 1.4 fl oz of Terramaster /100 gal of water no sooner than three weeks after seeding and when leaves are at least 1 in. in diameter. If <i>Pythium</i> symptoms recur after the first application, a second application of 1-1.4 fl oz/100 gal of water can be made. Allow at least a 3-week interval between the first and second application. Do not apply Terramaster 4EC later than 8 weeks after seeding. No more than 2.8 fl. oz. of Terramaster 4EC /100 gal of water may be applied to each crop of transplants. REI = 12 hr.
Remarks: The potential for phytotoxicity exists when Dithane DF or Manzate Pro-stick fungicide is used on tobacco seedlings. To minimize potential for damage, 72 hours prior to large scale application, user should test for potential phytotoxicity by applying the fungicide to a small sample area growing under similar conditions. In general, injury is greater in greenhouse systems. Ridomil Gold, or Acrobat are not labeled for use in greenhouses, or floatbed plant production systems. REI = reentry interval.			