CONTROLLING BLACK SHANK of TOBACCO in Kentucky

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Black shank of tobacco is one of the most destructive diseases of tobacco in the southern United States. The pathogen or disease-producing agent was first reported in 1915 and has since been reported throughout the southern tobacco-growing areas of the United States. Black shank was first observed in Kentucky in 1935, but it was not of much concern until about 1940.[2] By 1952 black shank had been reported in over 60 counties and by 1964, in over 75 counties and on many hundreds of farms (Fig. 1). Most of the infested fields are small plots along creek bottoms.

Crop rotation has been used with partial success to control the disease. By strict sanitation measures and careful planning, many growers have been able to eliminate black shank from their farms. However, where black shank has become well established and long crop rotations are not practical, the use of resistant varieties is the best control.

SYMPTOMS

Black shank is primarily a disease affecting roots and basal parts of the stem, hence the common name "black shank." Symptoms of the disease vary with the age of the plant and the degree of plant resistance.

In the tobacco field, black shank usually first appears in a low wet area affecting only a few plants. It is often mistaken for drowning, but when it appears the following year destroying plants over a large part of the field, the disease's true nature is recognized.

When vigorously growing plants a foot or more high become infected, the plants wilt during the day and recover at night. After a few days the leaves begin to turn yellow and hang down the stalk and the plant remains wilted. If you examine the roots in the early stage of wilting, you'll notice one or more of the larger lateral roots will be blackened and dead. At this early stage the stalk will be free

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[1] Agricultural Research Service, U.S. Department of Agriculture.

[2] E. M. Johnson and W. D. Valleau, Kentucky Agricultural Experiment Station Bulletin 615, *Disappearance of Black Shank from Kentucky Soils.* (University of Kentucky, Lexington, 1954), p. 3.

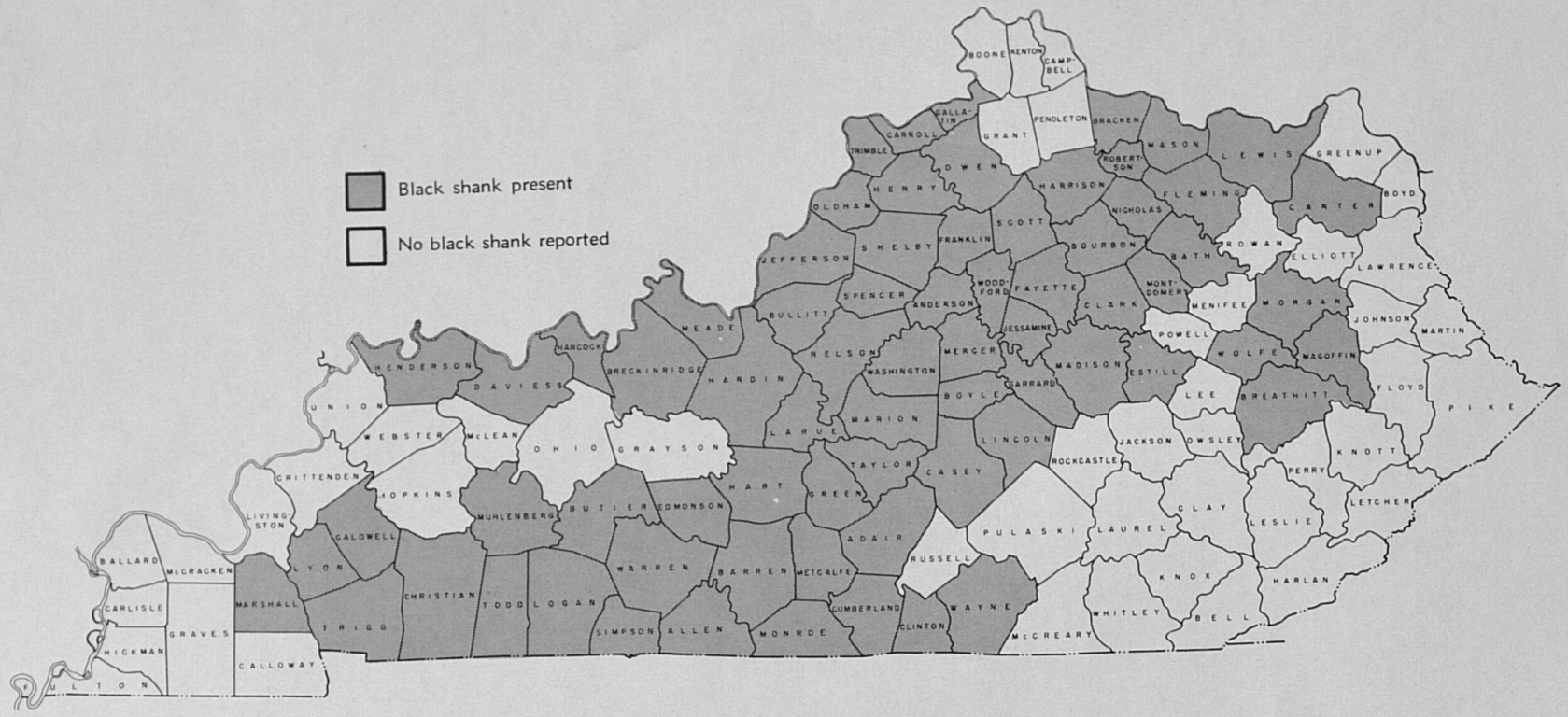

Fig. 1.— Map showing black shank distribution in 1964.

from decay or discoloration. As the disease progresses, the decay spreads up the stalk a few inches turning the bark black. Upon splitting the stalk, you'll see that the pith of some plants is separated in disks as far up the stalk as the discoloration of the bark extends (Fig. 2). This is one of the most characteristic symptoms of black shank. However, the only sure diagnosis must be made with a microscope.

Fig. 2.— Black shank in tobacco showing disk separation. The photograph at the left shows the plant blackened from the roots upward and the decayed roots. The photograph at the right shows the insides of two stalks split lengthwise. Note the blackening and disking of the pith. The stalk on the right had evidently been infected through two leaves. There is an area of normal pith between the infected area.

While susceptible plants will show these symptoms, moderately resistant plants such as Burley 37 may have no visible injury on the shank, and the plant may appear healthy. However, if you pull and examine these plants, the crown or other parts of the root system may show infection. Because above-ground symptoms may be absent on moderately resistant varieties, more plants in a field may be infected with black shank than you suspect. This situation allows a gradual buildup of black shank organisms to such an extent that an occasional plant may die.

Roots of highly resistant plants, where L8 is the source of resistance, are usually non-infected and white (Fig. 3).

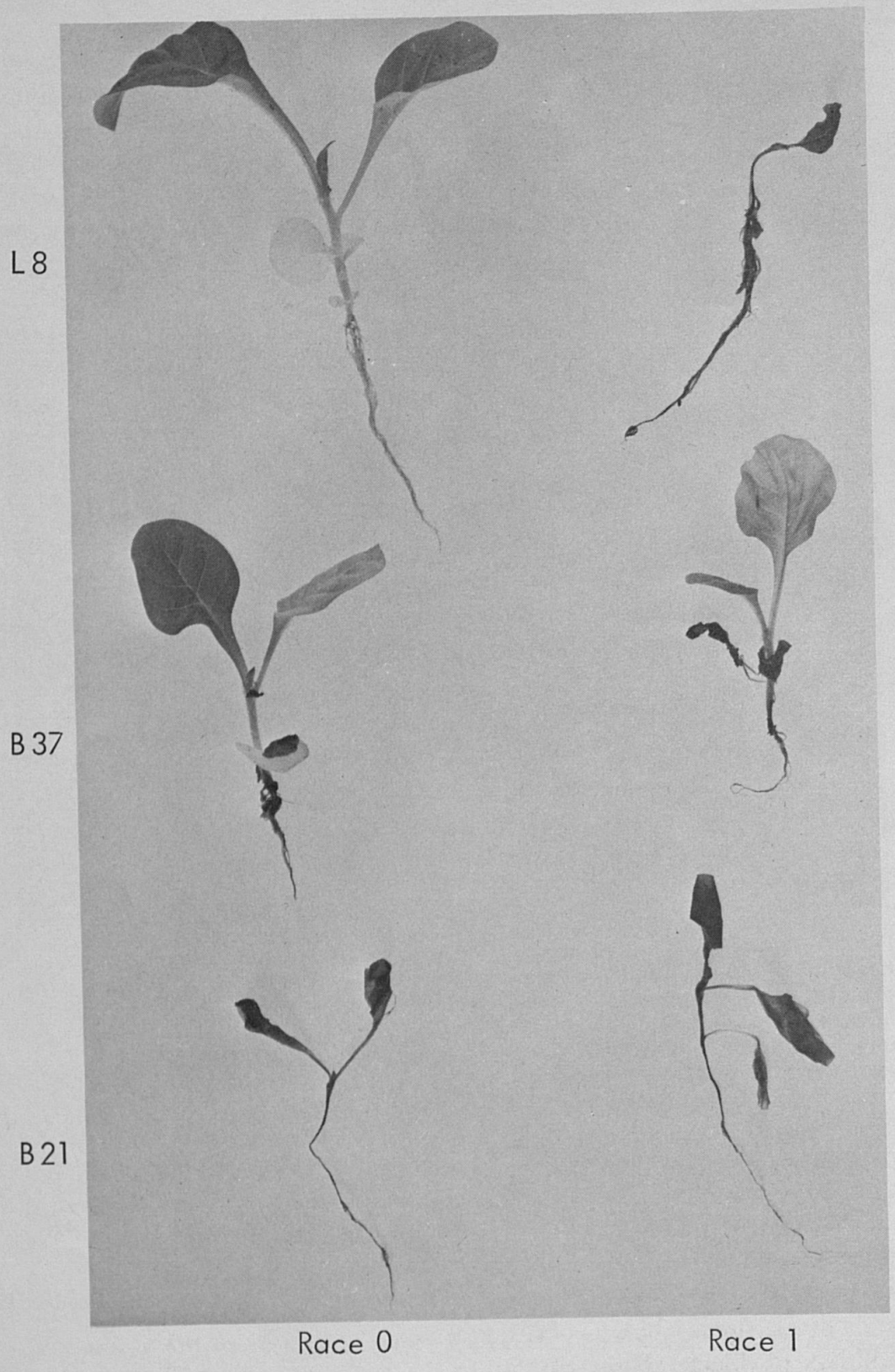

Fig. 3.— Plant resistance to black shank. The left-hand column of plants is infected with Race 0; the right-hand column with Race 1. The top row of plants is L8, the middle row is Burley 37, and the bottom row is Burley 21.

CAUSAL ORGANISM

Black shank is caused by a fungus (*Phytophthora parasitica* var. *nicotianae*). Tobacco is the only known natural host plant for the black shank fungus. However, in tests where stems or leaves of young seedlings of crops related to tobacco are placed in contact with the black shank fungus, infection may result. On the basis of present day experimental evidence, however, serious economic losses to crops other than tobacco are not likely.[3]

The black shank fungus reproduces by small, seed-like bodies called spores. It produces heavy-walled resting spores in the diseased tissue. It is not definitely known how the fungus survives the winter, but it probably is by means of the resting spores. Spores are carried by water in bits of dead tobacco plants and deposited on overflow land. When the black shank infected plants decompose, the resting spores in the diseased tissue are released into the soil where they germinate and cause infection early in the season. The black shank fungus produces zoospores in sporangia which can germinate and cause infection (Fig. 4). Both of the spore forms may be carried long distances by water and can germinate in water. The zoospores are produced in abundance during warm wet weather. Most of the secondary or later infection during the summer is caused by zoospores.

Fig. 4.— Zoospores being released from their sporangia, or sacks in which they develop. The zoospores then are carried, primarily by water, to other plants and cause new infection.

For many years, only one race, or type, of the black shank organism was known. Recently another race has been found making two

[3] G. B. Lucas, *Diseases of Tobacco* (New York: The Scarecrow Press, 1958), pp. 166-199.

races, designated 0 and 1. Race 0, the common race, is found on most farms where black shank is a problem.

MEANS OF SPREAD

Black shank spreads rapidly during wet weather to other plants in the field which, in turn, may become infected within a few days. Large dead spots may be found on the leaves during wet periods where the spores have been splashed onto them.

Setting tobacco plants from a black shank area is one of the main ways of infesting your fields. Always prepare enough plant bed area to set the crop. In case your plant bed fails, get your tobacco plants from a black shank free area. A good way to determine if a farm has black shank is to ask which variety is being grown. If a black shank resistant variety is being used, it is a good indication that black shank is present on the farm. The only reason for growing a black shank resistant variety is to control black shank. Therefore, don't buy or take black shank resistant tobacco plants from another farm to set on your farm.

The black shank fungus is carried by water and in and on anything that carries soil. Therefore, make every effort to see that all tools you use in setting are clean before beginning work; this is extremely important if you borrow tools which have been used on a black shank farm. A fungicide such as a 1-400 nabam solution is good to clean black shank from boots, tools, and other equipment.

You can also infest your fields by bringing in setting water from contaminated creeks or rivers. Pond water, if the pond receives no drainage from a black shank field, cistern water, spring water, and water from city water supplies are safe to use in all tobacco production practices. If you have a visitor from a black shank farm, be sure that his shoes are free from dirt and that clods of dirt are not on the floorboard ready to be kicked out when he gets out of the car. As an added precaution, visitors should stay entirely away from the tobacco field.

Manure contaminated with black shank fungus can also infest your farm. Don't use manure for tobacco if it is infested with black shank.

Tobacco stalks and barn sweepings from a black shank diseased crop should not be used as bedding and should not be put on the manure pile. They may be put on grassland which is not in the tobacco rotation and does not drain into a creek or river.

CONTROL

The best and most economical means of controlling black shank is through crop rotations. If sufficient land is not available for crop

rotations, then the only recommended control is the use of black shank resistant varieties.

Rotations for Controlling Black Shank

If you know that a tobacco field has black shank, sow it in a grass or a grass-legume mixture and don't use it, if possible, for tobacco for at least 3 years or longer (Table 1).

Table 1.— Some Suggested Grass and Grass Legume Mixtures for Seeding Black Shank Infested Fields.*

	Species	*Rate Lb/Acre*
I.	Tall fescue	12-15
	or	
	Orchardgrass	10-14
	or	
	Kentucky bluegrass	8-12
	or	
	Clair timothy	4-6
II.	Red clover and	6-10
	Tall fescue	12-15
	or	
	Orchardgrass	8-12
	or	
	Kentucky bluegrass	6-8
III.	Red clover,	4-6
	White clover (including ladino) and	1-2
	Tall fescue	12-15
	or	
	Orchardgrass	8-12
	or	
	Kentucky bluegrass	6-8
IV.	Use when pH is above 6	
	Alfalfa and	12-15
	Orchardgrass	4-6
	or	
	Tall fescue	4-6
	or	
	Kentucky bluegrass	6-8
	or	
	Clair timothy	6-8

* Table compiled by W. C. Thompson, Department of Agronomy.

You can sow and establish the field in grass without applying limestone as would probably be needed in establishing a legume. This is important because in limed soils the fungus is likely to live longer.

When a good ground cover is established, the field can be grazed without animals' feet carrying dirt, thus spreading black shank from one field to another.

After 3 years in sod and without lime, you may be relatively safe in planting tobacco again. Overflow fields seem to be freed of black

shank quicker than non-overflow fields. Even though overflow fields may again be infested where tobacco stubble lodges, a rotation in overflow land is probably safer than a similar rotation on higher ground because soaking seems to cause the resting spores to germinate and disappear.[4]

Varieties of Burley Resistant to Black Shank

A black shank resistant breeding line, designated as L8 has been developed from a wild species of tobacco, *N. longiflora Cav.* This L8 breeding line is not satisfactory for commercial use because it develops a physiological leaf spot (Fig. 5). The spotting sometimes be-

Fig. 5.— Physiological spotting in L8.

[4] W. D. Valleau and *et al.* Kentucky Agricultural Experiment Station Bulletin 592, *Experiences with Control of Black Shank of Tobacco in 1952.* (University of Kentucky, Lexington, 1952), pp. 13-14.

comes so severe that the leaves are destroyed before harvest. However, the F_1 hybrids of this line with standard varieties have proved to be highly resistant to black shank and are usually, relatively free from the physiological spot. Farmers have grown F_1 hybrids (L8 x standard varieties) in heavily infested soil with complete satisfaction to yield, quality, and freedom from black shank. Race 0, the common race of the black shank fungus in Kentucky, will not infect hybrids which have L8 as one of the parents. However, the F_1 hybrids between L8 and standard varieties are not resistant to Race 1.

The burley tobacco varieties (Burley 37, 11 A, 11 B, and 49) currently being grown are moderately resistant to both races of the black shank fungus (Fig. 3 and Table 2). This type of resistance will give satisfactory control when used in rotation. However, when these varieties are grown in a field where losses of a susceptible variety have been heavy they may also suffer losses. In moderately infested fields losses with these resistant varieties have been very limited. For a better understanding of the relative resistance of each variety see Table 2.

Table 2.— Relative Resistance of Black Shank Varieties to Race 0 and Race 1.

Variety	*Race of Black Shank*		*Black Root Rot*	*Fusarium Wilt*
	Race 0	*Race 1*		
Burley 11 A	Medium	Medium	Low	High
Burley 11 B	Medium	Medium	Low	High
Burley 37	Medium	Medium	Low	Low
Burley 49	Medium	Medium	High	Low
Burley 37 x L8	High	Low-Med.	Low	None
Burley 21 x L8	High	None	Low-Med.	None
Kentucky 12 x L8	High	None	Medium	Med.-High

Use of Resistant Varieties or Hybrids in Control of Black Shank

If you can't control black shank through crop rotations, plant your field in a variety moderately resistant to both races such as burley 37, 11 A, 11 B, or 49. To identify the race you have, plant a stick row of one of the hybrids, Ky 12 x L8 or Burley 21 x L8. If the hybrids in your stick row don't become diseased, you have Race 0 and you can plant the next crop in a hybrid. But if any of the plants are infected, Race 1 is present. As stated earlier, L8 is completely susceptible to Race 1, and you'll have to continue growing one of the standard varieties.

Don't use the hybrid, Burley 37 x L8, for a stick row test because it has only "low-medium" resistance to Race 1, and this hybrid will not give a true test unless the field is heavily infested.

Grow the Burley 37 x L8 hybrid only in fields where you know that Race 0 exists. This is important because the Burley resistance has been reduced by one-half in making the hybrid, and one-half of this resistance is not enough to withstand a high population of Race 1.

If black shank can neither be controlled by the standard resistant varieties nor the L8 resistant hybrids, then you should not attempt to grow tobacco in that field for at least 3 years. Upon returning to the field with tobacco, plant Burley 37, 11 A, 11 B, or 49, for the L8 resistant hybrids may not give control in this field.

You may want to grow one of the hybrids because they are resistant to more diseases. For example, Ky 12 x L8 is resistant to the major diseases: mosaic, fusarium wilt, black root rot, wildfire, and black shank.

Fig. 6.— Black shank destroyed this crop late in the growing season. Prevent this kind of loss on your farm.

CONTROL CHECK LIST

If you don't have black shank on your farm, don't get it:

1. Make sure you set plants from a black shank free area.
2. Make sure tools and equipment are free of black shank, especially if you borrow them. If you lend your tools, be sure that they will

be used in an uninfested field or clean them before bringing them back to your farm. Use a 1-400 nabam solution for cleaning tools and equipment.

3. Make sure the water you use for setting and irrigating is not contaminated with black shank.
4. Make sure visitors don't bring infested dirt clods to your farm on their shoes, equipment, or vehicles.
5. Make sure that the manure, tobacco stalks, or barn sweepings you spread on your tobacco ground is not infested.

Remember: black shank fungus is carried by water and in and on anything that carries soil.

If you have black shank on your farm:

1. Put your tobacco ground in a grass or grass-legume mixture. Don't use it for tobacco for at least 3 years.

If you don't have enough land for rotation:

1. Use a black shank resistant variety.
2. Don't attempt to grow tobacco in a field for at least 3 years if neither a black shank resistant variety nor hybrid gives satisfactory control of the disease.

This publication replaces Kentucky Cooperative Extension publications Circular 491, *Kentucky Program for Control of Black Shank in Tobacco,* and Circular 520, *Prevent Loss From Black Shank of Tobacco.*

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