Black Root Rot in Tobacco

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Black root rot is an important disease of tobacco in Kentucky, causing estimated annual losses in excess of $6,000,000. It rarely causes spectacular damage in any one burley field since the recommended burley varieties have some degree of resistance to the causal fungus. However, in dark tobacco plantings damage may be extensive, especially where susceptible varieties are still planted. Still, the inability to see widespread damage from black root rot is misleading. A 5% yield reduction results in a high dollar loss because the acre value of the crop is great. In addition to the reduction in yield, a lower quality crop may result from the slower growth and later maturity of diseased tobacco. The later maturing crop runs a greater risk of being cured under unfavorable curing conditions.

Symptoms
Black root rot is a disease which primarily effects the plant roots. Visual observation of the infected plant may reveal several characteristic symptoms limited largely to the roots. However, these symptoms do not provide positive identification and only microscopic inspection will result in a definite identification of the disease.

The root system is the infection site for the black root rot organism. infected roots appear dark brown or black due to the presence of large numbers of black spores produced by the proliferating fungus. Also, the rotting of root tissues greatly reduces the number of roots, as may be seen in infected plants pulled from the ground. Large scars may appear on the main tap root. These scars resemble mechanical damage, but roots damaged by black root rot are darker in color than those injured mechanically.

The above-ground symptoms are stunting and irregular growth of the tobacco. Temporary nutrient deficiency symptoms may appear on affected plants. The disease seldom affects the entire crop of tobacco. The degree of infection varies from plant to plant and from area to area. On hot, dry days the leaves of infected plants may wilt and yellow more than leaves of healthy plants as a result of reduced water uptake by the diseased roots. The wilting and yellowing appear only in severe cases, whereas the stunting and underdevelopment occur in plants less severely infected. Stunted plants often bloom early and the tobacco field takes on an extremely irregular appearance.

Causal Organism
Black root rot is caused by the fungus Thielaviopsis basicola. The organism produces two spore forms: endoconidia and black or dark brown thick-walled spores called chlamydospores. The fungus is widespread and persists in soils almost indefinitely. The fungus thrives at relatively low temperatures and high populations of the organism are built up in the soil causing severe losses in cool seasons.

Spread of the Organism
Black root rot is spread mostly by spores. The black root rot fungus may persist for long periods of time in the soil, living off organic matter and roots of other perennial plants. The spores may remain viable in the soil for months.

The spores can be spread either by natural or by mechanical means with mechanical spread being the most significant method of dispersal. Man is so mobile in his farming operations that it is quite easy for small amounts of infected soil to be moved great distances. The movement of machinery from one farm to another is a good example of how infected soil may be moved. Using plants from an infected bed is another way of transferring black root rot. Any means of carrying soil from one area to another can spread the disease.

Predisposing Factors
Several weather and soil factors affect the severity of black root rot in the field. Under ideal conditions for tobacco growth, a crop of tobacco may be grown in an infested field with little loss to black root rot, whereas, in the same field, severe damage may be caused when the soil and weather conditions favor the disease.

Low temperature is a primary factor in the severity of black root rot. The optimum temperature for its development is an air temperature of 62-74 degrees F, and fortunately, tobacco is generally grown in a somewhat higher temperature range. This disease becomes most severe only at temperatures unfavorable for the host plant, especially cool weather early in the season. The increasing occurrence of black root rot in Kentucky in the past few years may be partly a result of earlier setting dates.

The amount of moisture also affects the severity of black root rot. It is not definitely known whether soil moisture is an independent factor or if it is simply related to the soil temperature since high soil moisture tends to lower the soil temperature. Excessive rains may be a factor only in lowering the soil temperature. The continuous use of tobacco land can be a very important factor in the build-up and persistence of the disease. Continuous cropping with both susceptible and moderately resistant tobacco varieties has been found to greatly increase the amount of black root rot.

Observations suggest that tobacco grown in heavily manured soils may suffer increased injury from black root rot. The population of the fungus is increased since the fungus can live on decaying organic matter. This was illustrated in Kentucky at the Greenville Soil Field, where the population of the fungus in soil from manured plots was greater than in soil from the adjoining unmanured plots in continuous tobacco culture.

The damage from black root rot is more severe under conditions of high organic matter than other conditions of low organic matter. Organic matter toxicity is increased by toxins produced when organic matter, either as crop residues or strawy manure, decays slowly. These toxins cause injury to tobacco roots in direct contact with them or in the immediate vicinity of decaying plant fragments in the soil, making it possible for the black root rot fungus to enter the roots more easily.

Soil pH has been found to influence the incidence of black root rot. Soils with a pH of 5.6 or lower have little black root rot but tobacco does not grow well either. The use of lime on tobacco fields makes conditions more favorable for the development of black root rot. Apparently, it is not pH effect alone, since the optimum pH range of the fungus in culture is 4.0 to 6.4. The increased incidence of disease at pH levels above 6.4 indicates that additional factors are involved. It is essential to lime acid soils, but excessive liming should be avoided. When soils become nearly neutral, or basic, phosphorus will revert to insoluble forms and some minor elements will be less available for plant growth. Thus, deficiencies may result.

Recent experiments have shown that the increased chemical salt content of soil due to heavy fertilization may be a contributing factor in increasing the severity of black root rot. This is one reason why fields which have received large amounts of fertilizer will be more likely to have black root rot.

Control
The best control of black root rot is prevention. If the disease has not invaded an area, care should be taken to prevent the black root rot organism from being brought into the area. Plants from other areas should not be used, since they might carry the disease on their roots. Also, equipment should be thoroughly cleaned before it is allowed to enter a non-infected area. In general, all care should be taken so that no soil containing the black root rot organism is brought into a non-infected field.

If black root rot has infected a field, the best method to reduce the severity is the use of resistant varieties on a rotation basis. The resistant burley tobacco varieties and their degree of resistance are listed in Table 1. These resistant varieties should not be used year after year in the same field because the fungus builds up so much that resistant varieties are affected. Because of the build-up of the fungus, even when resistant varieties are used, crop rotation must be practiced to reduce the effect of black root rot (Table 2). If crop rotation is not feasible then use varieties with high resistance to black root rot.

| Table 1.-Black Root Rot Resistance Varieties |
Variety                | Black Root Rot Res.
----------------------|---------------------
**Standard Varieties** |                     
Ky 10                 | Medium              
Ky 14                 | Med-High            
Ky 15                 | High                
Ky 17                 | High                
Va 509                | Medium              
**Hybrid Varieties**  |                     
MS Burley 12 x Ky 10  | Med-Low             
MS Burley 21 x L 8    | Med-Low             
MS Ky 14 x L 8        | Medium              
**Dark Tobacco Varieties** |                 
One Sucker:           |                     
Ky 165                | Med-High            
Fire-Cured or Air-Cured: |               
Ky 171                | High                

Rotations for Controlling Black Root Rot
If you know that a tobacco field has black root rot, sow it in a grass or a grass-legume mixture and do not use it for tobacco for at least three years or longer. If land is scarce, a two-year rotation, using only one alternate crop between crops of tobacco, is far superior to no rotation.
If possible, soybeans, red clover, alfalfa and other legumes susceptible to black root rot should be avoided in the rotation.
Cover crops and manure should be plowed under in plenty of time to insure complete decomposition before transplanting. If the cover crop and manure are plowed under six weeks prior to transplanting, regardless of height, the toxic period will pass before the tobacco is set. The amount of manure should not exceed 10 tons/acre. All manure, and part or all of the fertilizer, should be turned under so the fertilizer, especially nitrogen, can assist in the decomposition of the organic matter.
Maintain a soil pH of about 6.0-6.4. Excess lime may increase the incidence of black root rot.

### Table 2.-Some Suggested Grass and Grass Legume Mixtures for Seeding Black Root Rot Infected Fields

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate lb/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td></td>
</tr>
<tr>
<td>Tall fescue</td>
<td>12-15</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Orchard grass</td>
<td>10-14</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Kentucky bluegrass</td>
<td>8-12</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Clair timothy</td>
<td>4-6</td>
</tr>
</tbody>
</table>
## II.
- Red clover and 6-10
- Tall fescue 12-15
  - or
- Orchard grass 8-12
  - or
- Kentucky bluegrass 6-8

## III.
- Red clover 4-6
- White clover (including ladino) 1-2
  - and
- Tall fescue 12-15
  - or
- Orchard grass 8-12
  - or
- Kentucky bluegrass 6-8

## IV.
Use when pH is above 6:
- Alfalfa 12-15
  - and
- Orchard grass 4-6
  - or
- Tall fescue 4-6
  - or
- Kentucky bluegrass 6-8
  - or
- Clair timothy 6-8

### Control Check List
The following practices will aid in reducing damage from black root rot:
1. Select well-drained, good structured soils for tobacco. Black root rot symptoms are most often observed on tight, compact soils.
3. Turn cover crops in early spring to aid in preventing the build-up of toxins in the soil.
4. Do not use more than 10 tons of manure per acre on tobacco fields.
5. Fertilize according to soil test. Avoiding excessive fertilizer will reduce root injury from excess salts.
6. Avoid transplanting when soils are still cold or when air temperature is low.
7. Change tobacco fields at least every two years to reduce build-up of black root rot.
8. Even though the black root rot fungus will probably be maintained if legumes are used in the rotation, it will be more profitable in most cases to use a grass-legume mixture and a black root rot resistant variety.