**Living with Black Root Rot**

Marvin Pritts, Horticulture, Cornell University, Ithaca, NY 14853, mpp3@cornell.edu

Strawberry growers in the Northeast face many difficulties in maintaining healthy strawberry fields, particularly as plantings get older or when berries are planted in the same location as a previous crop. In addition to stress from cold and damp weather, soils often contain pathogens that can increase over time and negatively affect roots under suboptimal conditions. Factors associated with the development unhealthy roots include the age of a planting, the length of time a field has been in berries, the degree of soil compaction, the use of fumigants and herbicides, and planting on flat beds. Typical symptoms of poor root health include a decline in vigor, small leaves, wilting, and blackening roots and lack of root hairs. Symptomatic plants usually occur in patches in the field. The causal organisms seem to vary from one location to another, but generally consist of varying levels of *Phythium, Rhizoctonoa, Phytophthora, Fusarium* pathogens and *Pratylenchus* nematodes. Because of the complex nature of this disease, scientists have named it the Black Root Rot (BRR) complex.

One approach to manage black root rot is to kill the offending organisms. However, there are no products that selectively kill the all of the culprits and leave the many more benign and beneficial organisms unharmed. Certain fungicides have activity against *Phytophthora* and *Pythium,* and can help in situations where these two organisms predominate. Typically, though, growers with severe problems will either avoid planting in those sites again or they will fumigate. Fumigation is effective over the short term, but because the beneficial organisms are also killed, reintroduced pathogens can grow quickly without competitive organisms in the environment, creating a worse environment in a few years. A teaspoon of healthy soil may contain between 600 and 800 million bacteria from 10,000 species; several miles of fungi from 5,000 species; and 1,000 species of protozoa, so specifically targeting three or four pathogenic genera in this complex is beyond the ability of current chemistry.

A second approach is to create conditions that discourage the establishment of harmful levels of BRR pathogens. This approach, while not targeted at specific pathogens, is a more desirable alternative to fumigation because it does not involve the use of synthetic biocides. This holistic approach involves improving the biological, physical and chemical environment of the soil.

Poor internal drainage is the major factor contributing to black root rot in strawberries. This can be addressed by installing tile drainage, decreasing soil compaction, and planting on raised beds. Compaction in isolation has a small negative effect on strawberries, but when combined with standing water, creates conditions very favorable for strawberry root pathogens. Growing certain cover crops with penetrating roots and subsoiling to break up compacted layers are methods to reduce compaction. Excessive cultivation will destroy soil structure and also lead to compaction and poor internal drainage.

Organic matter is the food source for the biological component of the soil. Soils high in organic matter tend to harbor a more diverse set of microorganisms which, in turn, seem to suppress the establishment of pathogens. Organic carbon pools in soil are important not only for increasing the cation exchange capacity of the soil, but also for N cycling. Some microbes are also able to fix $N_2$ gas from the air, providing another source of plant available N. The presence of microorganisms in the soil also increases soil aggregation through bacterial mucigel and fungal hyphae. Aggregation improves water infiltration, aeration, and reduces erosion. Without soil C these important microbial populations would decline and the benefits would decrease.

Methods of increasing organic matter include cover cropping and composting. Certain cover crop sequences suppress soil pathogens better than others, and work almost as well as fumigation. However, too much compost can excessively increase water holding capacity and create favorable conditions for soil pathogens. Also, we have evidence that too much straw can be detrimental to strawberry plant growth. For these reasons, it is difficult to develop hard and fast rules for managing soils.

An example of this difficulty involves the use of straw mulch for protecting strawberries for winter. A survey of strawberry farms in NYS indicated that almost all have low levels of biological soil health which may reflect low levels of beneficial microorganisms and less competition for disease organisms. This may partially explain the long term decrease in yield per acre in NYS reported by the National Agricultural Statistics Service, and the increasing incidence of BRR that growers report. One difference between berry fields with low biological soil health and adjacent fields of vegetables with higher values is that strawberry growers use a large amount of straw for winter protection each year. One might expect that large additions of organic matter would enhance soil health, but it is possible that this large annual influx of straw might actually reduce microbiological activity, increase soil moisture in already wet soils, and make plants more vulnerable to BRR. We are studying various soil amendments/mulches and depth of tillage to determine how they affect biological soil health, and if so, what is the nature of those amendments that deplete, rather than enhance, soil health.

Until more is known, growers should try to prevent the establishment of BRR by ensuring that internal drainage is adequate, avoiding compacting soils, and ensuring that organic matter is high. Rotations of various cover crops between plantings of strawberries will suppress pathogens that otherwise would carry over into the new planting. Cornell University has a soil health test that determines where a soil falls on indicators of physical, biological and chemical health, and recommends adjustments in practices that can be made to improve these indicators.

Healthy soil will lead to healthy plants. While one can also obtain healthy plants in sterile soil, this is impractical to achieve in perennial cropping systems.

Considerable information on soil health is contained in a free 175 page publication: Berry Soil and Nutrient Management: A Guide for Educators and Growers

http://fruit.cornell.edu/berry/production/soilnutrientmgmt/pdfs/BerrySoilandNutrientManagementGuide.pdf

Also, Cornell has archived a series of 14 webinars specifically about soil management. These can be found at:

http://fruit.cornell.edu/berry/webinar/archive.html#Soil