Understanding Strawberry Root Problems that Impact Berry Farm Profitability: Results of Eastern NY survey

Laura McDermott[1], Elson Shields[2], Tony Testa[2], James O'Connell[3], and Natasha Field[1]
[1]Cornell Cooperative Extension, Eastern NY Commercial Horticulture Program, Hudson Falls, NY
[2]Dept. of Entomology, Cornell University, Ithaca, NY
[3]Cornell Cooperative Extension, Ulster County, Kingston, NY

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New York State strawberry growers reported in the 2017 National Agricultural Statistics Service (NASS) survey that the state strawberry crop totaled over 6 million pounds of berries, virtually all sold to the fresh market, for a value of over 18 million dollars. Farmers also reported planted strawberry acreage of 800 acres, a loss of 900 acres since 2005, not coincidentally the year methyl bromide use was prohibited in NYS.

"This article describes the findings of a survey (verifying) that weeds, soil-borne diseases and nematodes remain as significant barriers to profitability for strawberry farmers."

Weed pressure, root disease, plant parasitic nematodes and soil insects have all been identified by strawberry industry groups as barriers to success with strawberry production in the northeast United States. Research (Subbarao et al. 2007) into best management practices has revealed that cover cropping and proper crop rotation will significantly reduce the impact of disease on strawberry production; these recommendations, however, are not being used on all farms. This article describes the findings of a survey, supported by the New York Farm Viability Institute (NYFVI), that was initially part of a larger effort to identify and then manage soil-borne insects using entomopathogenic nematodes (EPNs) (McDermott et al. 2017). These findings verify what the industry has identified: that weeds, soil-borne diseases and nematodes remain as significant barriers to profitability for strawberry farmers.

Methods

Fifty-eight strawberry growers in 17 eastern NY counties were visited during the 2016 and 2017 growing seasons. Extension educators assessed the planting and considered site history, production system, grower evaluations, management inputs, etc. The survey was designed to find weevil infestations to further field test the effectiveness of native EPNs to provide long-term control of strawberry root weevil and black vine weevil. In addition, a comprehensive field assessment was conducted for each field showing general loss of vigor. Soil, plant and insect samples were taken to provide diagnostic confirmation of plant disease, insects, nematodes and overall soil health. Results of assessments were communicated to farmers and management options were discussed.

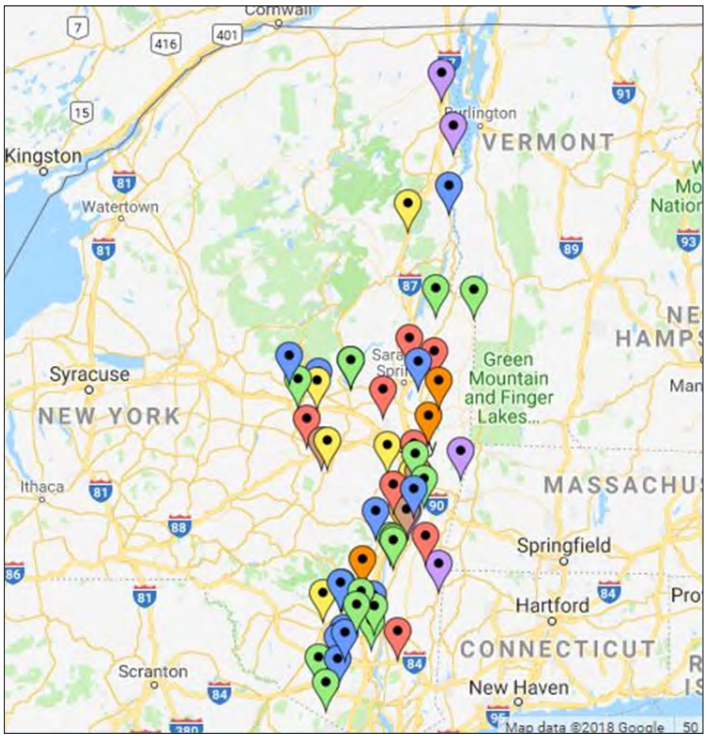

Figure 1. Distribution of strawberry farms surveyed in Eastern NY.

Results

Of the 58 farms surveyed, 41 farms (71%) were identified to have a soil-related barrier that was impeding profitability (Figure 1). Seventeen farms (29%) had no soil-related issue in the strawberry field that was examined. Sixteen (28%) were experiencing weed pressure that negatively impacted production, vigor and overall planting longevity. Three of the farmers stated that their inability to control weeds was the reason they were discontinuing strawberry production on their farm. Twenty-nine farms (50%) had soil samples examined – for disease, insect, nematodes and/or soil health.

Results of tests indicated more pressure from soil-borne disease than soil insect pests or nematodes (Figure 2). Pathogens that cause black root rot were found on 28% (16) of farms surveyed. *Rhizoctonia fragariae* and other *Rhizoctonia spp.* were found to be the most predominant pathogen, found on 17% (10) farms surveyed. *Pythium spp.* were found on a single farm and *Fusarium spp.* were found on 17%, or 10 farms surveyed. While there

was some overlap in farms, the 10 farms that had *R. fragariae* isolated were not exactly the same as those with *Fusarium*. Five farms (9%) surveyed had 2 or more of these pathogens present. *Verticillium dahlia,* the pathogen causing Verticillium wilt, was found on 3 farms (5%) surveyed and *Phytophthora fragariae,* the pathogen that causes red stele, was found on one farm (Figure 3). Four farms surveyed were found to have four different species of nematodes present and three had related black root rot disease damage identified.

Eight farms (14%) surveyed had insects identified as being potential barriers to good vigor and production. Two farms had populations of root weevils that were significant (Figure 4). These farms were treated with native entomopathogenic nematodes with excellent results, which remain three years post-treatment. Strawberry rootworm and white grub larvae were found on two different farms in high enough populations to cause damage. The only other insect that was found was sap beetle, which has become a significant strawberry fruit pest on some farms, although it does not harm roots.

Abiotic disorders and secondary infections were identified as causing some loss in vigor on 15 farms surveyed (26%). Of these farms, all but 2 farms had another primary pest problem identified. Ten farms were identified as having soil health issues. Nine of these farms had a comprehensive soil health analysis done. Results ranged from medium to excellent ratings, with a median rating of 66 and an average of 65. The most prevalent problems identified was aggregate stability, organic matter and soil respiration.

Discussion

Over the last two decades, as methyl bromide was phased out and then discontinued in 2005, Northeast strawberry growers have changed production systems due to continued pressure from a diverse population of pests. Many growers have adopted the recommendations of lengthy crop rotation and cover cropping, but this survey shows that nearly half of farms are still facing soil-borne issues significant enough to reduce vigor and productivity. These farms are often, but not always, ignoring these recommendations. Reasons for this procedural drift include access to land; U-Pick farms in particular prioritize customer access and in certain areas appropriate sites are hard to find.

While land access is a real concern, there are other reasons that effective management practices are not being implemented. One reason is that proper site preparation must be done prior to planting. If shortcuts are taken, there is little help for fields infected with soil-borne disease. It can be difficult for farmers to separate the effects of pest and disease damage from the very similar symptoms caused by a variety of soil health and weather issues. Diagnostic symptoms caused by abiotic stressors that are below ground make it hard to recognize the problem when management action should be taken. Lastly, it's difficult to identify the diseases and disorders, as symptoms look almost identical (Cox 2018). Figure 5 shows the similarities of diseases and winter injury, explaining visually the difficultly for extension specialists and farmers to do accurate field diagnostics. Furthermore, even with laboratory assistance, it can be difficult to isolate pathogens from strawberry roots. All of these facts compound the complex issue of root loss and related plant death.

June-bearing strawberry plants grown as short-term perennials need to be renovated and winterized. These processes differ

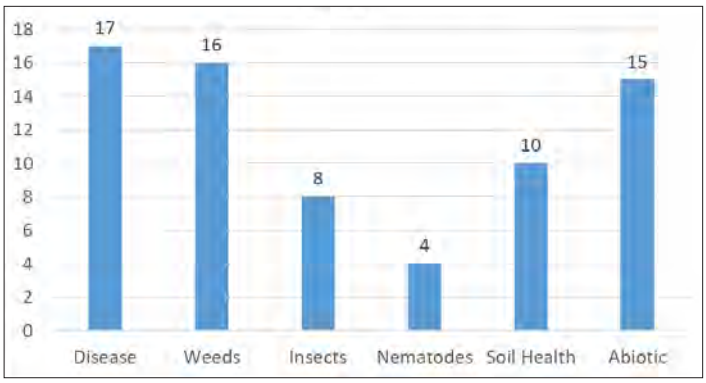

Figure 2. Soil-related barriers identified on 58 NY strawberry farms.

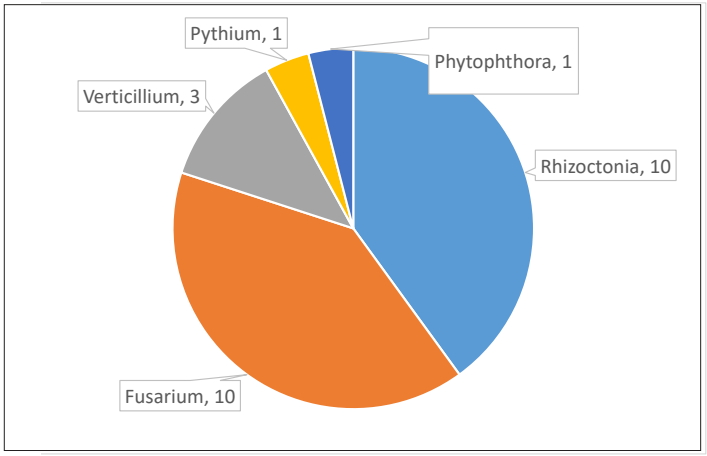

Figure 3. Relative prevalence of soil-borne disease found on 17 NY strawberry farms.

Figure 4. The strawberry field pictured is typical of plantings showing soil-borne disease and/or insect pressure. [photo: J. O'Connell]

depending on production systems. As a strawberry plant grows, the crown grows up, exposing more of that sensitive tissue to cold winter temperatures. Renovation after harvest helps address this concern by requiring that a 1/2" of soil is thrown on the crowns. Additional winterization occurs after the plant stops growing late in the fall. Longer warm autumn seasons have made this more

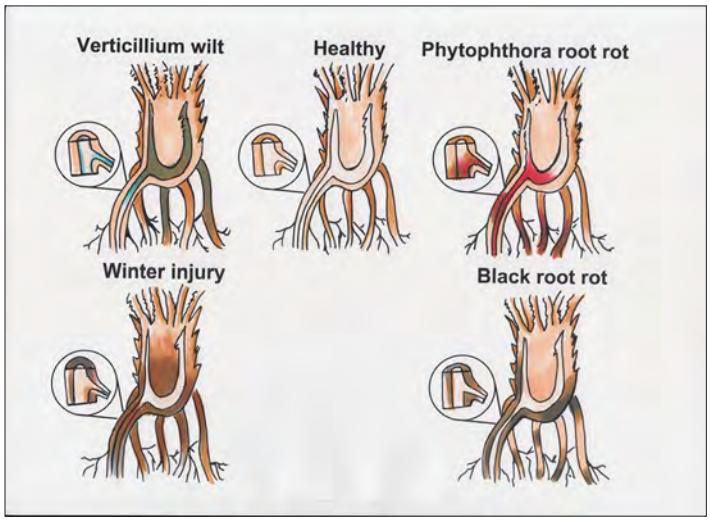

Figure 5. Diagnostic tips for recognizing root diseases and freeze injury in damaged strawberry crowns. [Illustration: Kerik Cox, SIPS, Cornell University]

difficult for growers to manage (Union of Concerned Scientists 2006). As growers look to plasticulture to solve weed issues, the renovation and winterization requirements change and growers need to alter their practices accordingly. It becomes more difficult to protect the plant crown and straw mulch is harder to keep on a plastic covered raised bed.

Soil health and how management inputs interact is another area of consideration. This survey found that aggregate stability, organic matter and surface and subsurface soil hardness often rate very poorly in perennial strawberry production, a finding also noted in previous work (Pritts et al. 2015). The annual incorporation of winter straw mulch at renovation would seem to guarantee good soil health, but it can act quite the opposite. Organic matter that is not being actively converted may exacerbate issues with active carbon, mineralizable nitrogen and soil respiration triggering problems with the soil's biological life. Soil aggregation is affected by the soils' biological activity, which produces compounds and by-products or "glues", aiding in aggregation. When biological activity is diminished, aggregation is reduced.

As berry farmers struggle with the challenges presented by weed pressure and soil-borne disease, a growing number of farmers are looking backward to chemical options, including hiring contract fumigation companies to do the work. In general, chemical fumigants offer varying degrees of control and none are completely effective in controlling weeds, diseases, insects and nematode pests. Fumigation has also been implicated in long-term soil health decline, as it reduces beneficial micro-organisms along with the pathogens (Herrick 2018).

Successful management of strawberry weed, disease and insect pests requires an integrated approach utilizing identification, education, recommendations, and effective sustainable applications. More research is needed in novel approaches to managing soil-borne disease under northeast conditions. This includes biofumigation and anaerobic soil disinfestation (ASD). Additional attention should be given to refining the timing and application of management options like cover cropping and crop rotation in light of new production practices and climate change.

It is hoped that the results of this survey will serve as an impetus for further work in addressing the ongoing problem of soil barriers to northeast strawberry farm productivity and profitability.

Acknowledgments

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Laura McDermott is Senior Extension Associate and **Natasha Fields** is a technician with Cornell Cooperative Extension, Eastern NY Commercial Horticulture program. **Elson Shields** is a field crops entomologist at Cornell University in Ithaca, NY, and **Tony Testa** is a research support specialist in Dr. Shields' program. **James O'Connell** is a Senior Resource Educator with Cornell Cooperative Extension in Ulster County.