Investigating Forage Radish and Compost as a Means of Alleviating Soil Compaction in Post-plant Bramble and Blueberry Fields

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Long-term perennial berry crops (highbush blueberry, brambles) are grown on over two thousand eight hundred acres in New England, of which five hundred eighteen acres are in Connecticut (USDA Census 2012). They generate high value since they are sold almost exclusively to the fresh market. Poor growth leads to reduced production and reduced grower revenue, and is the result of one or several factors including site related issues, soil fertility, soil compaction, plant damage from wildlife, insects and diseases, and abiotic disorders.

One of the factors leading to poor plant performance in established fruit plantings is soil compaction. It is measured as pounds per square inch (psi) using a penetrometer pushed into the soil to a depth of six inches (surface hardness/compaction) and a depth of six to eighteen inches (subsurface hardness/compaction). Root growth is restricted in moderately compact soils with a surface (0– 6 inch depth) penetrometer reading of 125-220 psi, and a subsurface (6 – 18 inches depth) penetrometer reading of 220 to 280 psi. Penetrometer readings greater than 220 psi (surface) and 300 psi (subsurface) are considered severely compacted soils (4).

Compacted soils have reduced pore space which causes a restriction in root growth (2, 15). Blueberry and bramble plants have fibrous root systems that do not easily penetrate compacted soils which can result in reduced plant growth. In addition, compacted soils have been shown to reduce water and nutrient uptake by plants, and in Wisconsin, research has shown potassium uptake is reduced in compacted soils (15), a high demand element that is critical in blueberry and bramble production (9, 10).

As a part of a separate study with Cornell, soils in established berry fields were tested for a number of biological, physical and chemical parameters in 2012. Of the five Connecticut fruit farms participating in that project, four had compacted soils in established berry fields as determined by penetrometer readings, as well as poor production and poor plant growth as determined by the growers.

There is extensive research supporting pre-plant cover crops and incorporation of compost for alleviating soil compaction for annual cropping systems. Research also supports the use of cover crops and incorporating compost in soil to alleviate soil compaction as a pre-plant management tool in perennial crops. Little research has been done using cover crops and compost in a post-plant situation to alleviate soil compaction. (6,7,8,12,15,16)

This study investigated two treatments to alleviate soil compaction in addition to the check: the effectiveness of a forage radish cover crop system; and a surface application of compost. The treatments were applied at three farms: an established raspberry field planted in 2010 on sandy loam soil; and two established blueberry fields, one planted in 2006 on gravelly loam soil, and a certified organic block planted around 1985 on fine sandy loam soil. Treatments were applied within the plant row, and replicated three times at each site, to determine if they would reduce soil compaction. At the raspberry field each rep was 10 feet long for a total of 90 feet. At the two blueberry fields, each rep consisted of 3 bushes for a total of 27 bushes per farm.

There were two requirements for a cover crop for this study – that it winter kill to reduce competition with the berry plants for water and nutrients in the spring as well as the need for herbicide or hand weeding, and that the cover crop be known for alleviating soil compaction. The forage radish, a brassica, is a tender plant that quickly germinates when seeded in the early fall, is killed with low winter temperatures and decomposes in a relatively short time in the spring. It large taproot, often growing to one to two feet, penetrates compacted soils, increases large pore spaces in the soil and decomposes quickly, increasing water and air infiltration and opening soils for greater root penetration. (1,4,11,13,14)

Compost applied to the soil surface will attract soil microbes that decompose the compost and aerate the soil as they move through the soil profile, a process that will increase soil pore space and soil organic matter content over time. (3,5,10) Incorporating compost throughout the root zone provides more immediate results, (7,8) but is not practical in an established berry field due to the shallow root systems of berry plants.

Procedures

In early September 2013, compost was evenly spread in a 2’-2.5 wide band in the raspberry row, in a 2.5’-3’ wide band in the conventional blueberry row, and in a 2’ diameter circle around the organic blueberries (grower mows around each plant) to a depth of 2-3 inches. The forage radish was seeded at the rate of 15 lbs. per acre on bare ground in the raspberry and non-organic blueberry plots and through the sod and weed covered mulch in the organic blueberry plot.

Pre-treatment soil penetrometer readings were taken at each treatment at depths of 0-6 inches and 6-18 inches, 5 locations per rep at each depth. All three locations are pick-your-own operations. Yield data was collected by harvesting all ripe fruit just prior to opening to the public and estimating the remainder.

Soil penetrometer, yield and growth measurements were recorded for each of the next two years. Growth measurements included number of new canes per bush for blueberries and number of canes per ten feet of row for raspberries.

Statistical analysis was conducted looking at differences within and between treatments from years 1 to 3.

Results

Each location was analyzed separately.

Differences among years within treatments: **Compost** – There were no statistical differences in soil compaction, yield or growth attributed to the compost treatment between years 2013-2015 at any of the three farms.

Radish – There were no statistical difference in soil compaction, yield or growth attributed to the forage radish treatment between years 2013-2015, at any of the three farms.

Differences among years between treatments (comparing the compost to the radish to the check): At the **organic blueberry field** and **raspberry field**, there were no statistical differences when comparing the radish to the compost to the check for yield, plant growth and soil penetrometer readings at surface and sub-surface depths.

At the **non-organic blueberry field**, there was no statistical difference for yield or plant growth. However, there was a statistical difference in soil penetrometer readings at the 0-6 inch depth between the check and the radish treatment in years 2014 and 2015. The compost treatment showed a statistical difference between it and the check at the 0-6 inch depth in 2015. There was no statistical difference between the compost and radish treatments. There were no sub-surface differences between the forage radish, compost and the check.

Conclusions

The three participating farms had compacted soils prior to the trials based on soil penetrometer readings. Expectations were for reductions in soil compaction after one year with the forage radish treatment, which germinated and grew during the fall before being winter killed. Expectations were for positive impacts on soil compaction from the compost treatment by year two, due to the length of time for it to be broken down by soil microbes.

The lack of differences in soil penetrometer readings between the forage radish treatment and the check plots at the organic blueberry field can be attributed to the difficulty in establishing the radish through the sod and weeds. Although the bushes had wood chips applied around each bush in the spring, by September when the radish was planted, a heavy weed population had taken over the area. Moving the wood chips to get to bare ground for seeding was very difficult. Between the bushes was established sod. Seeding was accomplished by poking holes through the sod and weed cover. Very few radish seeds germinated and

Organic blueberry Non-organic blueberry Raspberry

Forage Radish Treatment

Organic blueberry Non-organic blueberry Raspberry

Compost Treatment

grew. The difficulty moving the wood chips also made the compost application to bare soil unattainable. The compost was applied as close to the soil as was possible. The difficulty in applying compost close to soil microbes could explain the lack of change in soil compaction. Additional years may be needed for a positive change.

At the non-organic blueberry field, each blueberry row was wood chipped and weeds were kept to a minimum through the use of herbicides. Moving the wood chips allowed for relative ease in radish seeding and establishment, as well as applying compost to the bare soil surface allowing access by soil microbes. Both treatments worked for surface compaction Additional years may be needed for positive change in subsurface soil compaction as well as to see significant differences in growth and yield.

At the raspberry field the weeds were at a minimum within the rows. The radish easily established and grew. Longer time may be needed for positive impacts on sub-surface compaction, yield and growth.

Alternatively, there may not be any changes made in the lifetime of the plantings because physical soil properties are hard to change once plants are established. Prior to planting, growers should check soil compaction levels and take corrective measures if needed.

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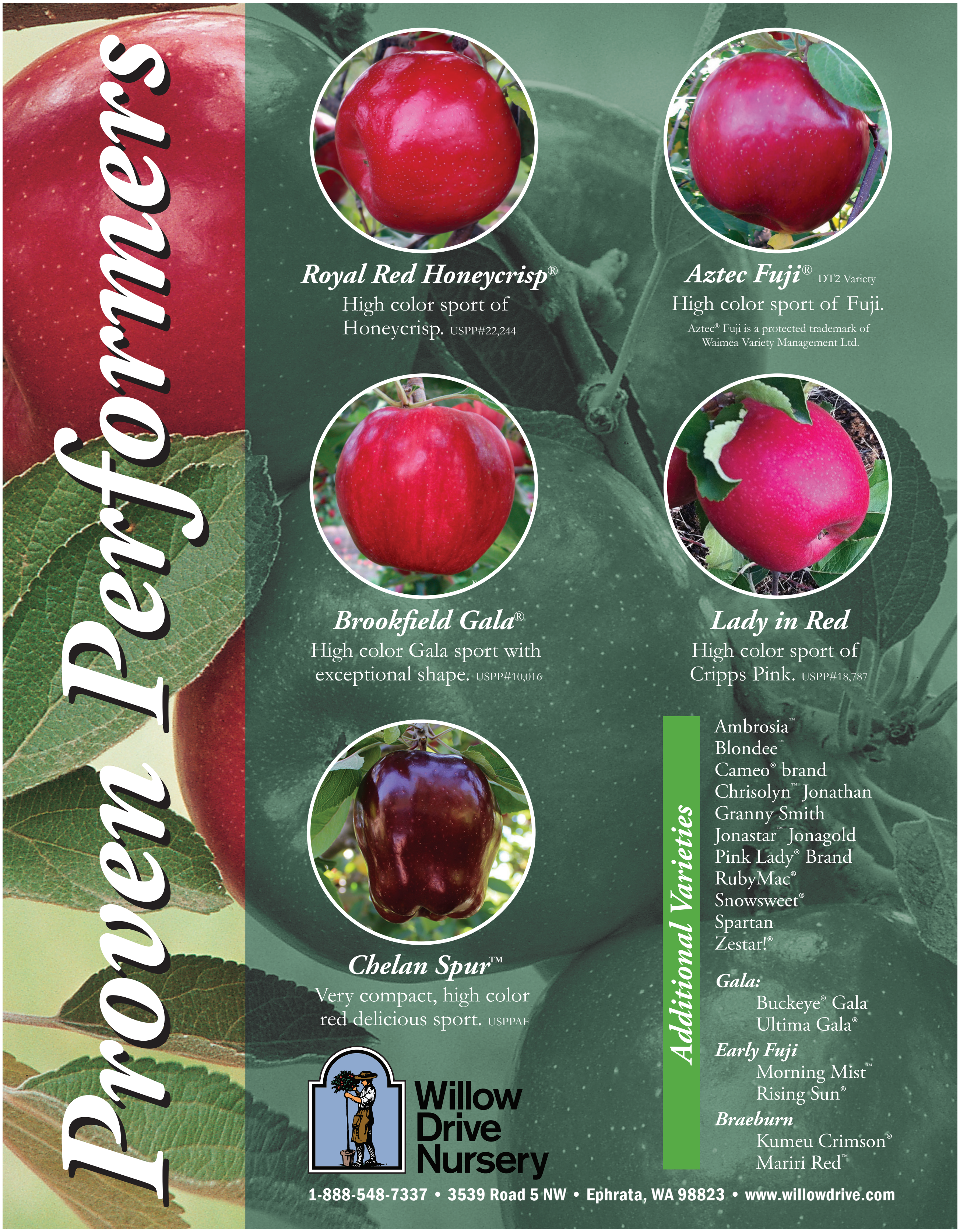

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