Research Report

Prepared for BC Cranberry Marketing Commission

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Project Title: Canopy Management Trials

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BC Cranberry Growers

The funds for this project were to allow continued data collection during the 2018 field season to ensure continuity of projects and to collect preliminary data to inform research proposals for 2019.

Research Objectives

1) collect data from trials that are currently in the field and would benefit from another year of data collection. These trials include a canopy management trial located at the research farm as well as field trials located on farms in Richmond, including two sanding trials that were established in 2016.

2) The collection of preliminary data that will assist in the development of research proposals being considered for 2019.

Study #1: Research Farm Canopy Management Trial

Progress Status of the Objectives

The trial started early 2017. All treatments, except for biennial prune, were applied from the beginning. Data on canopy growth and soil characteristics were collected in mid-season in 2017. Yield data was collected in 2017. Biennial prune treatment was applied in April 2018. Yield data was collected in 2018, and the berry samples have been sent to Ocean Spray lab for the analyses on berry quality (in progress).

Rooting assessment and canopy depth is ongoing to ensure data included post-harvest root growth.

Materials and Methods

Plot Design and Treatments

The trial started from the beginning of 2017 season in Cranberry Research Farm in Delta. Seven treatments (1" sand, 1" sawdust, 1" sand + sawdust mix, light prune, heavy prune, biennial prune) were randomly applied to each plot measuring 20' x 40' for two cultivars (DeMoranville and Mullica Queen) and were replicated four times. Treatments were applied in early April. Each Plot was buffered by 1' margin, and cultivars were isolated by the walking pass (Figure 1). The Sand, Sawdust, and Sand and Sawdust mix was applied on top of the cranberry field using a spreader. The sand, sawdust, and mix treatments were then left for the treatments to settle beneath the canopy. The light prune and moderate prune were carried out using a pruner in late April in both 2017 and 2018. The third pruning, biennial prune was only done in 2018. The gradient set by light prune was what a typical grower would do, typical light prunes are around 0.8 tons/acre of vines removed (Oregon State University et al., 2002) whilst the moderate prune was approximately 1 inch deeper setting on the pruner.

Data Collection and Sampling

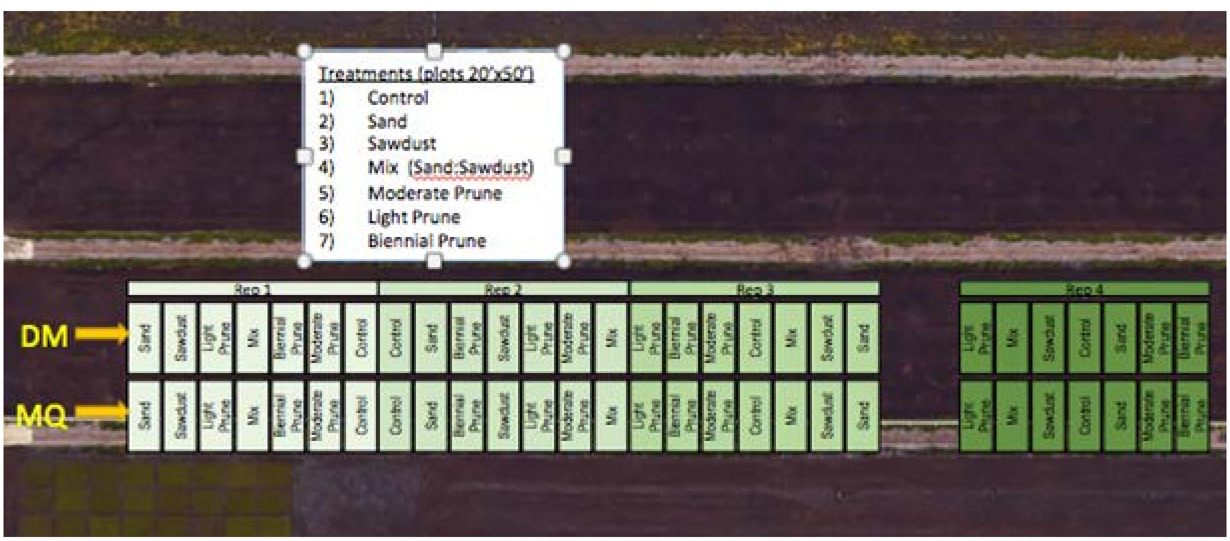

*Figure 1: Experimental design of the canopy management trial in the research farm. Each plot measured 20' x 40' and was buffered by 1' margin. Cultivars (DeMoranville and Mullica Queen) were isolated by a walking pass. Treatments (control, sand, sawdust, sand*sawdust mix, light prune, moderate prune, and biennial prune) were randomly assigned to each plot and replicated by four times.*

Total and flowering upright density and green and brown canopy depth were measured for the canopy characteristics during the growing season in 2017. Upright density was measured by counting the number of upright within a 30cm square quadrat. Green canopy depth was obtained by subtracting the brown canopy depth from the total canopy depth. Total canopy depth was measured from the soil surface to the average height of the top of uprights. Brown canopy was measured from the soil surface to the height of the canopy where foliage starts to appear. Upright count and the measurement of canopy depth were taken at three randomly selected locations per plot. Data collection in biennial prune plot was omitted as the condition was the same as heavy prune treatment.

Soil EC and pH were measured for the soil characteristics during the growing season in 2017. Soil core samples (depth = 10cm) were taken with a soil probe and transported to the lab at KPU. Each soil samples were added with two parts of distilled water and measured for EC and pH. Sampling in the biennial plot was omitted as the condition was the same as heavy prune treatment.

Berries were collected for the yield analysis in early October in both 2017 and 2018. Berries within a 30cm square quadrat were harvested at each of 3 randomly selected sampling locations per plot. In 2017, sampling in the biennial plot was omitted as the condition was the same as heavy prune treatment. Berries were transported to the lab at KPU and were weighed and counted in 2017. In 2018, berries were weighted in the field and were transported to the lab at Ocean Spray according to standard industry practice.

Results and Discussion

Upright Density (2017)

144 upright counts were taken using a 30 cm by 30 cm quadrat. Samples were randomly selected, within each treatment plot 3 subsamples were for both the Demoranville and Mullica Queen varieties. Initially the total number of uprights were counted followed by the total number of flowering uprights. These 3 subsamples were then averaged for both total uprights and flowering uprights to generate a value for each replicate of each variety. Flowering uprights were considered to be any uprights that consisted of either a flower or a fruiting structure. Measurements were taken in the last week of June/first week of July 2017.

The result might show an effect of sanding treatment (in both SA and MX) which increased soil temperature and induced root growth, resulting in a greater number of uprights. Although the difference was insignificant, light prune (LP) might release the shoots from apical dominance by removing the shoot tips, which resulted in a substantial amount of lateral shoot growth. Conversely, the greater amount of shoot and runner removal by HP reduced considerable number of buds, resulting in lower upright density compared to LP.

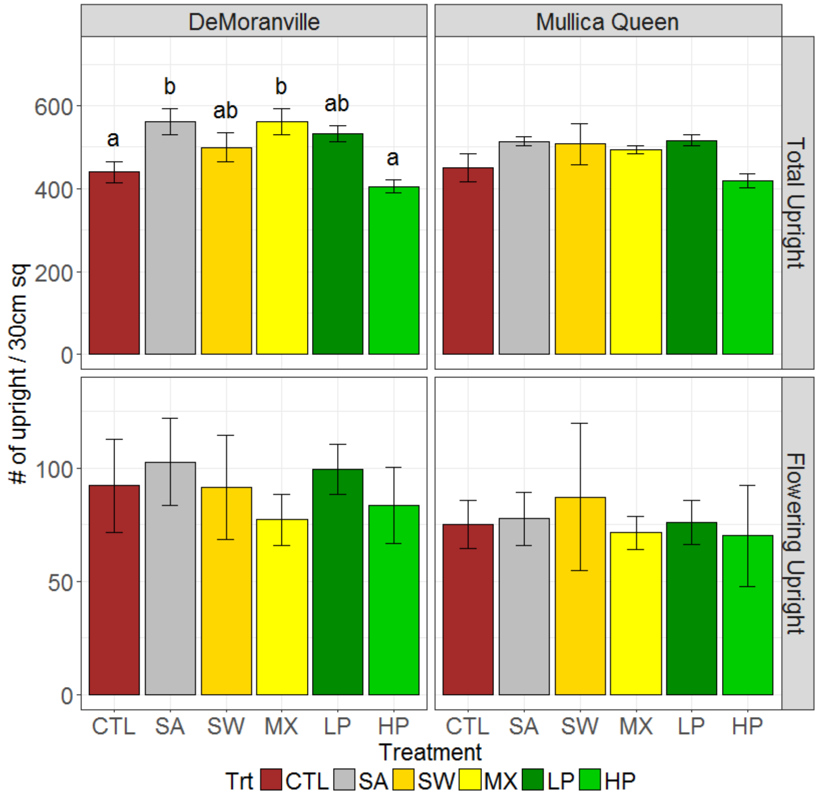

Figure 3: The density of total and flowering upright under seven treatments for DeMoranville and Mullica Queen. Treatments were: CTL=control, SA=1" sand, SW=1" sawdust, MX=1" of sand & sawdust mix, LP=light prune, HP=heavy prune. The error bars indicate the standard error of the mean. Biennial prune (BP) was omitted. Same letters indicate an insignificant difference between treatments. Plots without letters indicate insignificant difference among the treatments.

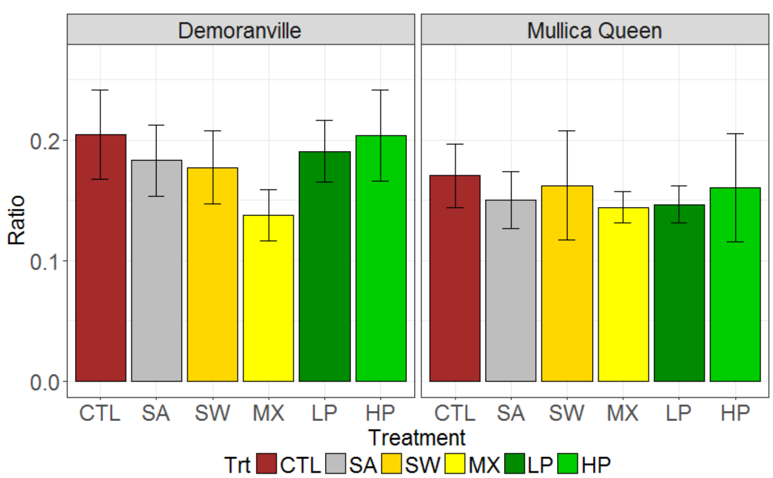

Figure 3: The flowering upright ratio (number of flowering upright / number of total uprights) under seven treatments for DeMoranville and Mullica Queen. Treatments were: CTL=control, SA=1" sand, SW=1" sawdust, MX=1" of sand & sawdust mix, LP=light prune, HP=heavy prune. The error bars indicate the standard error of the mean. Biennial prune (BP) was omitted. Differences among the treatments were insignificant.

Differences in mean flowering upright density among the treatments were insignificant due to the high variability in data (Figure 2). Although the differences were insignificant, the flowering upright ratio was slightly lower in SA, sawsust (SW) and MX than CTL for DeMoranville (Figure 3). However, the flowering upright ratio for Mullica Queen did not show the same trend as DeMoranville (Figure 3). The reduction of flowering upright ratio under SA might be consistent to the previous studies indicating the negative effect on yield for the first year following sand application.

Canopy Depth (2017)

A measurement of how deep the canopy appeared was taken in early July 2017. 168 samples were randomly selected, 3 per treatment plot. Canopy depth was measured first by pushing back the canopy to expose the top soil/sand/sawdust/mix layer. A meter stick was then placed into the canopy. Following this a piece of 30 cm by 30 cm coroplast with a hole cut out that is sufficient for the ruler to fit into was placed down on top of the canopy through the ruler. A measurement was then taken at the

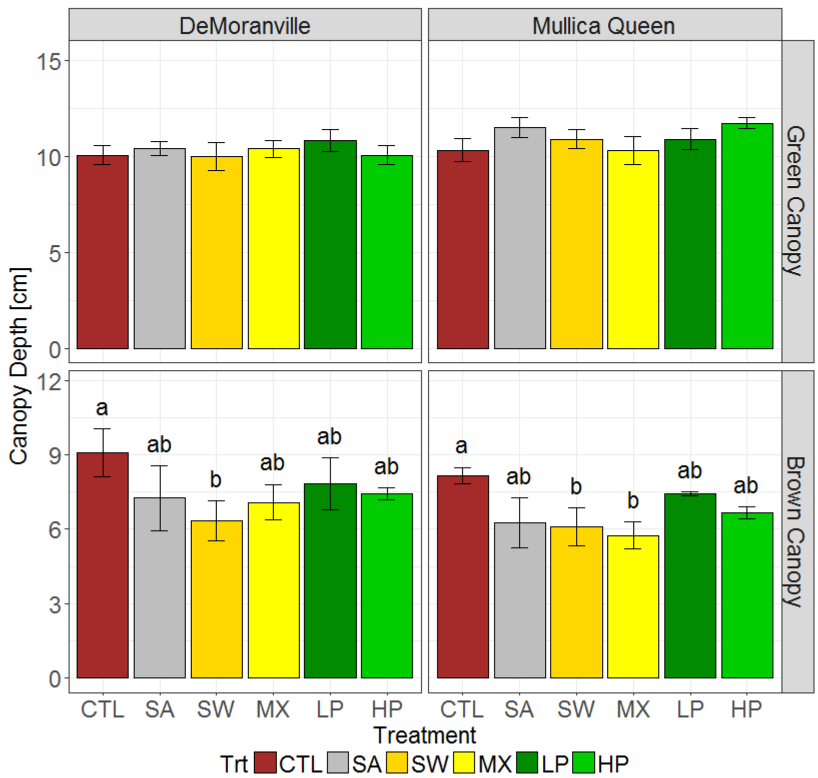

Figure 4: Canopy depth for green and brown canopy under seven treatments for DeMoranville and Mullica Queen. Treatments were: CTL=control, SA=1" sand, SW=1" sawdust, MX=1" of sand & sawdust mix, LP=light prune, HP=heavy prune. The error bars indicate the standard error of the mean. Biennial prune (BP) was omitted. Same letters indicate an insignificant difference between treatments. Plots without letters indicate insignificant difference among the treatments.

point in which the coroplast appeared to be most comfortable at. This measurement was the total canopy depth. The coroplast was then removed while keeping the ruler in the same position. The canopy was then moved back and it was examined at which point the green first appeared, this measurement was then taken from the soil to this point which measured the brown canopy depth.

Then by way of subtracting the total canopy depth from the brown canopy depth the green canopy depth was generated.

The mean depth of the green canopy was generally similar among treatments, and the differences were insignificant. The mean depth of brown canopy was significantly lower in SW for DeMoranville and in SW and MX for Mullica Queen compared to CTL. Rest of the treatments in both varieties, although the differences were insignificant, were also slightly lower than CTL (Figure 4). The reduced brown canopy with the treatments involving soil amendments (SA, SW, and MX) was expected as the application of the amendment increased the soil surface. The slightly shallower brown canopy depth in LP and HP, however, might be due to that the removal of runners causing the canopy to be depressed vertically by its weight.

Soil pH and EC (2017) The mean soil pH slightly increased in SA; however, the differences among the treatments were insignificant. The mean soil EC was similar among the treatments, except for SW in Mullica Queen showing a slight decrease.
Application of sand might increase pH very slightly; however, the relative amount to the peat soil in the 10cm-deep core was too small to cause a significant change. As to EC, It is possible that a high C/N ratio of sawdust slowed down the decomposition rate of the plant debris and peat immediately below.

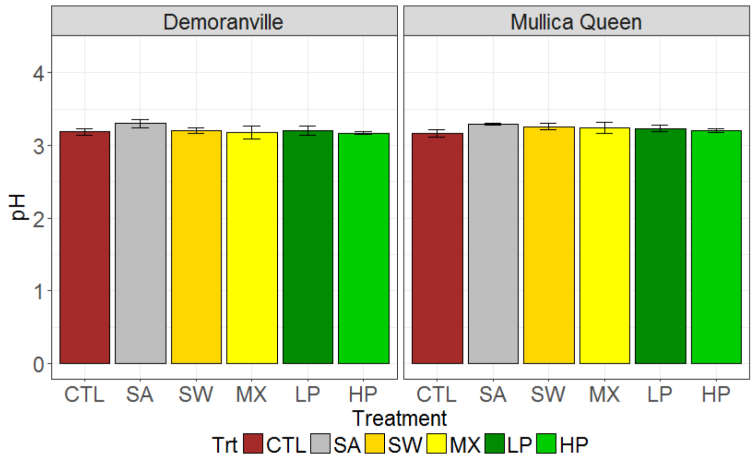

Figure 6: Soil pH under seven treatments for DeMoranville and Mullica Queen. Treatments were: CTL=control, SA=1" sand, SW=1" sawdust, MX=1" of sand & sawdust mix, LP=light prune, HP=heavy prune. The error bars indicate the standard error of the mean. Biennial prune (BP) was omitted. Differences among the treatments were insignificant.

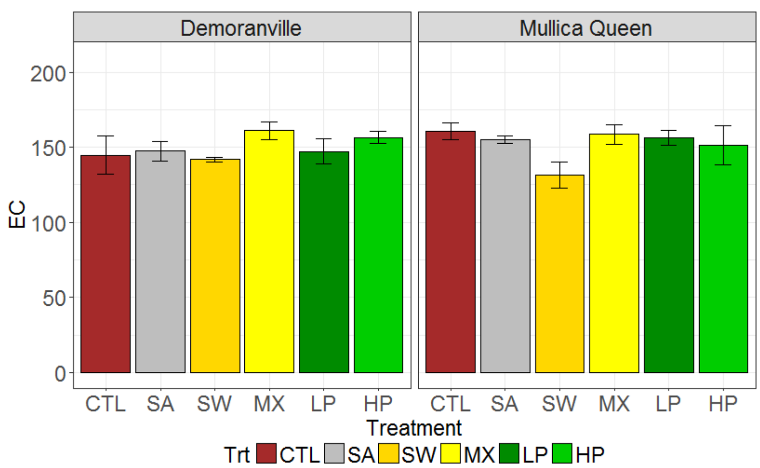

Figure 6: Soil EC under seven treatments for DeMoranville and Mullica Queen. Treatments were: CTL=control, SA=1" sand, SW=1" sawdust, MX=1" of sand & sawdust mix, LP=light prune, HP=heavy prune. The error bars indicate the standard error of the mean. Biennial prune (BP) was omitted. Differences among the treatments were insignificant.

Yield Estimate (2017, 2018)

For DeMoranville, the mean yield estimate was lower in SA than other treatments in 2017; however, the differences were insignificant. In 2018, the mean yield estimate was generally similar among the treatments. For Mullica Queen, the mean yield estimate was generally similar in 2017. The mean yield estimate was higher in LP in 2018; however, the differences were insignificant (Figure 7).

The change in mean yield estimate from CTL was negative for all treatments in 2017 for DeMoranville. For the same variety in 2018, the change from CTL became positive for all treatments. For Mullica Queen, the change was smaller compared to DeMoranville but was mostly negative 2017 and became positive in 2018.

The general declines of the yield estimate from CTL to other treatments observed in 2017 for both varieties were probably due to the known effect of sand application that sanding reduce yield for the first season and the pruning of runners effectively removed existing buds.

The positive difference from CTL to most of the other treatments in 2018 for both varieties might suggest effectiveness of the treatment on increasing yield; however, the effectiveness varies among the treatment, and the response from varieties might also vary. The result might indicated that SA had generally the severest impact on yield for the first year. While the yield of DeMoranville could bounce back to similar level as other treatments that of Mullica Queen continued to be negative in the second year. LP appeared to have the least fluctuation in relative change from CTL between two years and was more effective on increasing yield for Mullica Queen than DeMoranville.

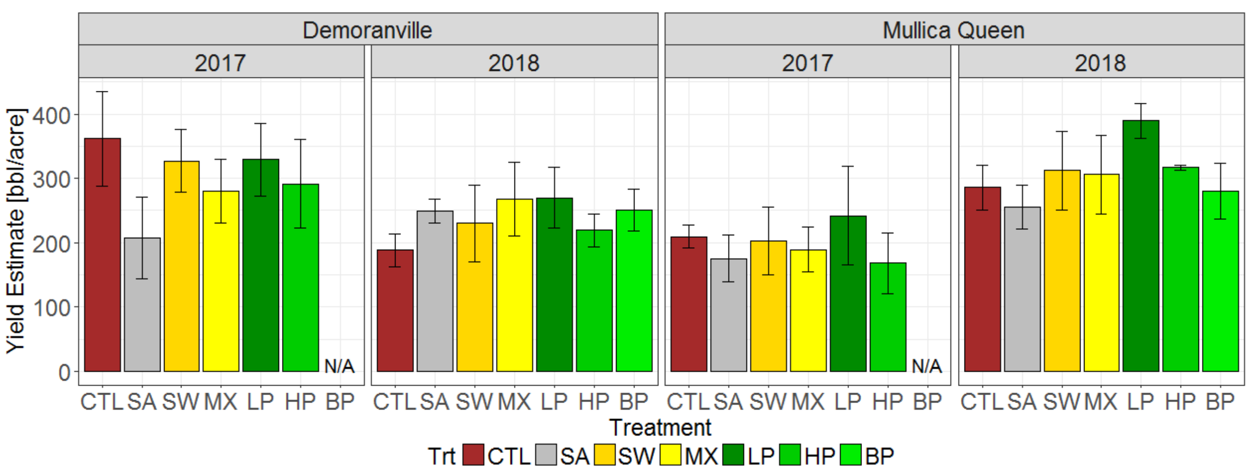

Figure 7: Yield estimate under eight treatments for each cultivar (DM: DeMoranville; MQ: Mullica) in 2018. Treatments were: SD = sand, SW = sawdust, MX = sand x sawdust mix, LP = light pruning, MP = moderate pruning, BP = biennial pruning, CTL = control (no treatment applied). Error bars indicate the standard error of the mean. The sample size was 4 for each treatment and cultivar. The mean yield estimate did not differ among the treatments. Relatively higher yield estimate was observed with LP of MQ, but the difference was insignificant. Differences among the treatments were insignificant.

Study #2: Root growth following Mowing Treatment and Impact of Casoron (observational)

Objective

- Observe the rooting under mowing and sanding (combined) treatment
- Assess the influence of Casoron application on rooting

Observation in June 14, 2018

Materials and Methods

This study was carried out in two fields that had been mowed to reduce canopy depth and then sanded to stimulate rooting. Five samples were taken form the mowed area in each bed (Bed F and T). In Bed T, additional five samples were taken in the mowed area which had not received a Casoron application. All other mowed area had received a Casoron application. In the lab, each sampled vine was washed thoroughly with water and cut in 5cm piece each. The number of root emerging points and root tips for each root ting points was counted under a microscope.

Results

Root growth was similar between the beds that had been mowed and sanded and had received a Casoron application. However, in Bed T, the area without Casoron application showed a significantly higher rate of root emergence (Figure 1A) and growth (Figure 1B)

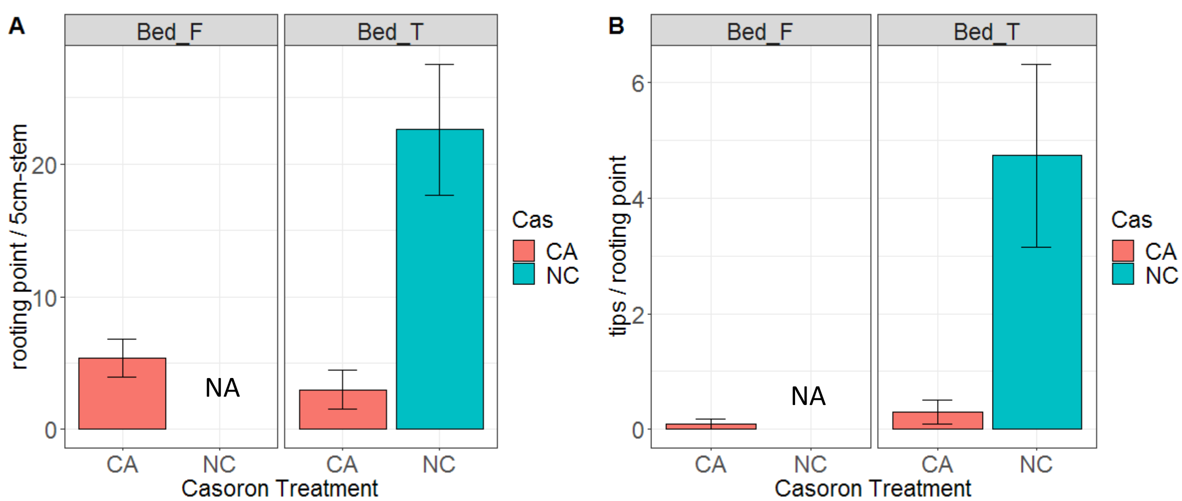

Figure 8-A: Mean number of root emerging points on the section (5cm) of underground stem buried in the sand. B: Mean number of root tips per rooting point. CA indicates Casoron treated area, and NC indicates area without Casoron application. Error bars indicate standard error of the mean. No data were available for NC in Bed F.

Observation in Sep 20, 2018

Materials and Methods

Five vines were samples at a mowed area in each bed (Bed F and T). In Bed T, additional five vines were sampled at a mowed area without Casoron application. Other mowed area was with Casoron application. In the lab, each vine was washed thoroughly with water and cut in 5cm piece each and assessed for the root volume. All roots were removed from the emerging points on the stem (vine), cut in small pieces, and scattered in a petri dish filled with water. The stem was placed in a separate petri dish as well (Figure 11). Petri dish of roots and stem were photographed. Each image was processed with ImageJ, and the area occupied with roots and stem were calculated (Figure 12)

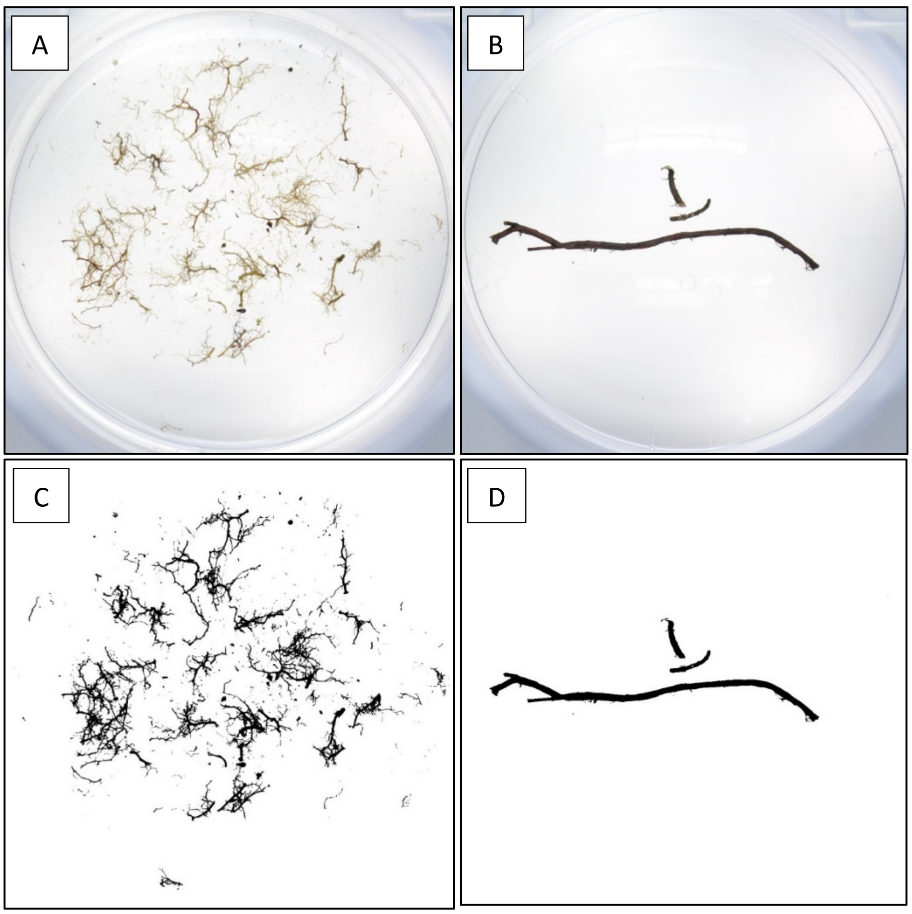

Figure 9: Root separated from the stem suspended in the water in the petri dish (A). Underground stem in the separate Petri dish without water (B). 8-bit, binary image of root in the petri dish (C) and underground stem (D). Images were processed to remove shadow around the petri dish and were further processed for calculating the total number of pixels which then were converted into the area in metric (mm^2).

Results and Discussion

The mean ratio of estimated root/stem volume with Casoron application was slightly higher in Bed F than T, but the difference was insignificant. The mean ratio of the estimated root/stem ratio was similar between CA and NC areas in Bed T (Figure 13). Despite having the significantly higher root growth in NC

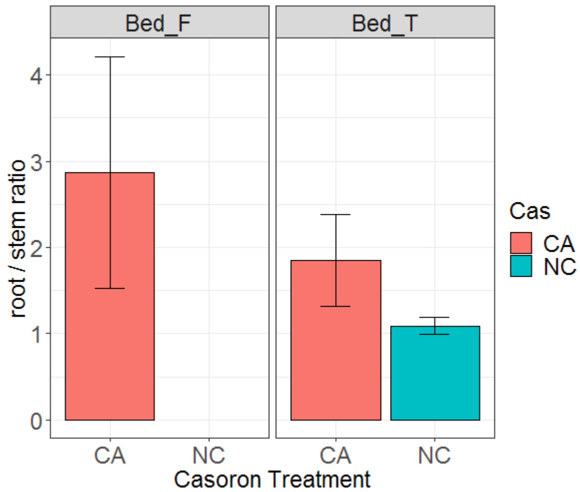

Figure 11: Mean root/stem area ratio comparison between with and without Casoron treatment in Bed F and T. The differences between beds (CA only) and with and without Casoron treatment (Bed T only) were non-significant.

Figure 10: Casoron treated area (left) and without Casoron treatment (right) in Bed T. The difference in the intensity of weed growth is clearly visible

area in Bed T in June (Figure 9 and 10), the root growth at the end of the season was lower in NC area than CA area. This was probably due to the intensive weed growth (Figure 14) during the season. This preliminary research indicates a need to further investigate the impact of Casoron on root growth.

References

Davenport, J.R. (2002). Nitrogen release in virgin and cultivated organic cranberry soils. Acta Horticulturae, 574, 341-346.

Davenport, J. R., & DeMoranville, C. J. (1993). A survey of several soil physical characteristics of cultivated cranberry bog soils in North America. *Communications in Soil Science & Plant Analysis*, *24*(13-14), 1769-1773.

Ofori, D. A., Newton, A. C., Leakey, R. R. B., & Grace, J. (1996). Vegetative propagation of Milicia excelsa by leafy stem cuttings: effects of auxin concentration, leaf area and rooting medium. *Forest Ecology and Management*, *84*(1), 39-48.

Oregon State University. (2002). *Cranberry Production in the Pacific Northwest.* Pacific Northwest Extension Publication. Print.

Strik, B. C., Bristow, P., Broaddus, A., Davenport, J., DeFrancesco, J. T., English, M., ... & Larson, B. (2002).*Cranberry production in the Pacific Northwest*. [Corvallis, Or.?]: Cooperative Extension of Washington State University, Oregon State University, University of Idaho and US Dept. of Agriculture.

Strik, B. C., & Poole, A. P. (1995). Does sand application to soil surface benefit cranberry production?. *HortScience*, *30*(1), 47-49.

Strik, B. C., Roper, T. R., DeMoranville, C. J., Davenport, J. R., & Poole, A. P. (1991). Cultivar and growing region influence return bloom in cranberry uprights. *HortScience*, *26*(11), 1366-1367.

Suhayda, B., DeMoranville, C. J., Sandler, H. A., Autio, W. R., & Heuvel, J. E. V. (2009). Sanding and pruning differentially impact canopy characteristics, yield, and economic returns in cranberry.*HortTechnology*, *19*(4), 796-802.