## RESEARCH

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**xx. TITLE:** Effects of Organic Soil Amendments on Physiology and Pest Pressure

## OBJECTIVES

Nutrient Management:

- Evaluate approved organic amendments applied to wild blueberry soil and leaves at different times and rates on three organic wild blueberry farms in Maine.
- Quantify the effects of different organic amendments on wild blueberry physiology and morphology.

Pest Management:

- Evaluate disease, insect, and weed severity under amendment treatments.

**LOCATIONS:** Appleton, Surry, and Columbia Falls, ME
**PROJECT TIMEFRAME:** May 2019 – September 2022

## INTRODUCTION

Interest in market diversification continues to grow and transitioning to certified organic is one way to diversify. The number of MOFGA certified organic wild blueberry acres in Maine has grown from 1,800 acres in 2018 to 2,635 acres in 2020 (MOFGA personal communication). Producing wild blueberries under certified organic standards is challenging due to the limited number of organic fertilizers and pest management tools approved for use. Prior investigations of organic amendments used in wild blueberry systems include: manure (Warman 1987), papermill sludge (Gagnon et al. 2003), gypsum (Sanderson and Eaton 2004), biosolids (Lafond 2004), municipal solid waste (Warman et al. 2009) and seafood-waste compost (Mallory and Smagula 2014). These studies, however, produced variable results regarding blueberry productivity and marketable yield with few significant effects on soil organic matter or leaf nutrient concentrations. There is a demonstrated need for organic alternatives and further investigation into the rates, timing of applications, cost, physiological benefits and potential impacts on pest pressure with such additions.

Organic wild blueberry growers are hesitant to apply any nutrients because nutrients visibly “feed the weeds” which cannot be easily managed without the use of herbicides. Weed presence, soil pH, water availability, and the presence of nutrients in existing organic matter are all factors that affect nutrient uptake in wild blueberries (Drummond et al. 2009). Weeds compete with wild blueberry for space, water, and nutrients, resulting in reduced crop density and yield. The low soil pH (4.0-4.5) of commercial wild blueberry fields restricts the availability of nutrients such as nitrogen, phosphorus, and potassium for wild blueberry plants because the microbes that would help the plants take up these nutrients cannot live in such acidic conditions (Peterson 1982). All wild blueberry growers rely on the slow breakdown of organic matter to hold water and nutrients that are slowly broken down by soil microrganisms into a form that the wild blueberry plants can take up.

Organic amendments in other cropping systems have shown improved crop resilience by increasing soil moisture retention, soil water holding capacity and increased nutrient availability (Barber 1995; Jungk 1996; Williams et al. 2016), depending on the material applied. Improved resilience of our cropping system is particularly important with the observed shift toward a warmer climate with sporatic weather events (Maine Climate Office 2020). This study aims to identify materials that improve soil water holding capacity and nutrient availability for wild blueberries. While studying these ammendments we also have the goal to learn more about wild blueberry physiology. Here, we evaluate the efficacy of four organic soil amendments and one foliar spray treatment and their impact on wild blueberry growth and corresponding pest presence in three locations.

## METHODS

This project is replicated at three farm locations that were selected to represent three scales (small, medium, and large) and the three major wild blueberry growing regions (Mid-coast, Ellsworth, and Downeast) in Maine. The experimental design per location is a randomized complete block replicated 6 times with 9 treatments applied to 6' by 30' plots (Table 1). Soil was sampled at each location in 2019 and will be resampled in 2022. The foliar fertilizer and chicken manure were applied at the recommended time and rate according to the label and company representative instructions. The Cobscook blend, mulch, and compost were applied according to recommendations from University of Maine Extension Educator Mark Hutchinson (personal communication, 2019). All products were applied one time with the exception of the foliar fertilizer which was applied three times as recommended by the manufacturer.

All products were applied during the 2019 prune-cycle except for one foliar fertilizer treatment applied in the 2020 crop-year (Table 1). The foliar fertilizer (Seacrop 16) was applied three times per site at key growth stages throughout the season. Chicken manure was applied in Surry and Appleton the week of June 3$^{rd}$ and in Columbia Falls the week of June 12$^{th}$. The Cobscook blend was applied in Appleton the week of June 17$^{th}$, and in Columbia Falls and Surry the week of June 24$^{th}$. University compost was applied in Appleton (only) the week of June 17$^{th}$ and Mulch was applied in Columbia Falls and Surry the week of July 22$^{nd}$.

**Table 1**. Products tested at each of three organic farms in a randomized complete block design with 6 replicates.

| **Product** | **Location** | **Material** | **Rate** | **Rate Type** | **Crop Cycle** | **%N-P-K*** |
|---|---|---|---|---|---|---|
| Control | ALL | None | N/A | N/A | N/A | N/A |
| North American Kelp Co. Seacrop16 Foliar Fertilizer | ALL | Liquid Foliar Spray | 1.2 L/242 gal. $H_2O$/A | N/A | Prune | 0.18% N 6.37% P 4.89% K |
| | | | | N/A | Crop | |
| North Country Organics Cheep Cheep Chicken Manure 4-3-3 | ALL | Granular Soil Applied | 1089 lbs./A | Low | Prune | 4% N 3% P 3% K |
| | | | 2178 lbs. /A | High | Prune | |
| | ALL | | 7.5 yd$^3$/A | Low | Prune | 0.4% N |

| | | | | | | |
|---|---|---|---|---|---|---|
| Coast of Maine Cobscook Blend Garden Soil | | Loose material Soil Applied | 15 yd$^3$/A | High | Prune | 0.14% P<br>0.12% K |
| Mark Wright Disposal Dark Brown Mulch | Columbia Falls & Surry | Loose material Soil Applied | 7.5 yd$^3$/A<br>15 yd$^3$/A | Low<br>High | Prune<br>Prune | N/A |
| University of Maine Compost | Appleton Only | Loose material Soil Applied | 7.5 yd$^3$/A<br>15 yd$^3$/A | Low<br>High | Prune<br>Prune | 0.41% N<br>0.11% P<br>0.10% K |

*N-P-K represented as total nitrogen, phosphorus as $P_2O_5$, and potassium as $K_2O$

## Data Collection

### *Physiology and Morphology*

Six stems from each plot were randomly selected and marked to monitor chlorophyll content from June to September on a crop year (2020). Chlorophyll content was measured by a SPAD Chlorophyll Meter (SPAD 502; Minolta Corp, Osaka, Japan), Ten random leaves from each plot were collected in August'2020 to quantify leaf size and their dry biomass. Leaf area was determined using LI-3000A area meter (Li-Cor, Lincoln, NE, USA), then the leaves were oven-dried at 70ºC to constant mass and weighed.

Additional leaf samples were taken in the 2019 prune-year at the tip dieback stage (late July, early August) around 1-month after the application of organic amendments (except for mulch). Leaf samples were taken at each location by collecting all leaves from 40 stems/plot, dried at 43°C and ground for leaf nutrient analysis at the University of Maine Soil Testing Service in Orono, ME. The same foliar analysis will be repeated in 2021.

### *Pest Pressure*

Insects, weeds, and disease were monitored in the same 0.37 m$^2$ quadrats (twice per plot) as pant physiology throughout the 2019, 2020 field seasons. In the 2019 prune-year pest scouting took place 3 times (once per month) from July to September at each of the three locations. In the following 2020 crop-year pest scouting took place 3 times May to July at each location. Pest severity (percent cover) for weeds, insect and disease were quantified using equal interval ranks between 0 and 6, where: 0 = not present, 1 = ≤1%-17%, 2 = 17%-33%, 3 = 33%-50%, 4 = 50%-67%, 5 = 67%-83% and 6 = 83%-100%. Weeds were identified into two groups in 2019 (grass and broadleaf) and in 2020 weeds were identified by genera and counted to obtain weed number per quadrat. In 2020 the number of wild blueberry stems with insect or disease damage were also identified and counted in addition to ranking.

### *Crop Productivity*

Blueberry cover was quantified using the same equal interval ranking at the time of each pest scouting. Additionally, in the 2019 prune-year, stem heights and the number of buds per stem were recorded for 8 stems per plot at all locations late August to early Sept. In the following 2020 crop-year, fruit-set and fruit-drop were monitored with repeated measures on the same 4 stems per plot. Fruit-set measures included flower counts at peak bloom, green fruit counts prior to ripening, and blue fruit counts during ripening. Percent fruit-set was quantified by the number of green fruit relative to the number of flowers per stem, while fruit-drop was established through the number of blue fruit relative to the initial number of green fruit observed for each stem.

Harvest took place on August 3rd, 6th and 11th, 2020 in Appleton, Surry and Columbia Falls, respectively. Harvest procedure included hand raking an exact quadrat in the flagged locations where repeated scouting had taken place, followed by hand raking the entire plot. Quality measures were also taken for each treatment including a 100-berry count to quantify average berry size and a brix measure of the relative sugar content.

Data Analysis

The effects of the fertilizer treatments on chlorophyll concentration, leaf size, dry biomass per leaf of wild blueberry plants were statistically compared using a one-way analysis of variance (ANOVA) followed by a LSD (least significant difference) post-hoc test in SPSS software ($\alpha = 0.05$). Each site (Appleton, Surry and Columbia Falls) was analyzed individually.

Due to the nature of count data collected in the field (which often has a high number of zeros creating a skewed distribution) much of our data failed the assumptions of normality and equal variance often required to run parametric statistical tests. All data was transformed with a square root transformation prior to any statistical testing. Transforming the data worked for all harvest, leaf nutrient and fruit-set data (yield, 100-berry, brix and fruit counts). Ranked data and pest count data visually improved following transformation, but the data continued to statistically fail for normality. Statistical tests were carried out despite non-normality after establishing there were no serious problems with the data.

Single date measurements including: the counts of flowers, green fruit and blue fruit, percent fruit-set and fruit-drop, harvest yield, berry size, sugar content (brix) and leaf nutrients were evaluated using a generalized linear model (GLM), followed by a Tukey's Pairwise comparison in JMP (JMP®, Version 14.3) across all treatments ($\alpha = 0.05$). Ranked blueberry cover and pest data were transformed to their corresponding percent mid-point and compared across both years (2019 and 2020) using a full-factorial repeated-measures mixed model design in JMP. Here, the full factorial tested the effects of year, treatment, and any interaction between year and treatment for the ranked response variables. Pest count data collected in 2020 was tested using a linear repeated-measures mixed model design in JMP. Additionally, the effect of weed pressure (weed number/$m^2$) on yield was investigated using a nonparametric Spearman $\rho$ Correlation also in JMP.

## RESULTS

Effects of Organic Amendments on Wild Blueberry Physiology

In the Appleton and Surry wild blueberry fields, leaf chlorophyll concentration of wild blueberry plants was significantly higher in the high rate of chicken manure (cheep cheep) treatment compared to the control and other treatments. However, in the Columbia falls' field, leaf chlorophyll concentration was significantly higher in both low and high rate of chicken manure (cheep cheep) treatments followed by the high rate of mulch and prune year's SeaCrop16 application. In all those three fields, SeaCrop16 foliar treatment application in the prune year (2019) showed significantly higher leaf chlorophyll concentration compared to its crop year (2020) application.

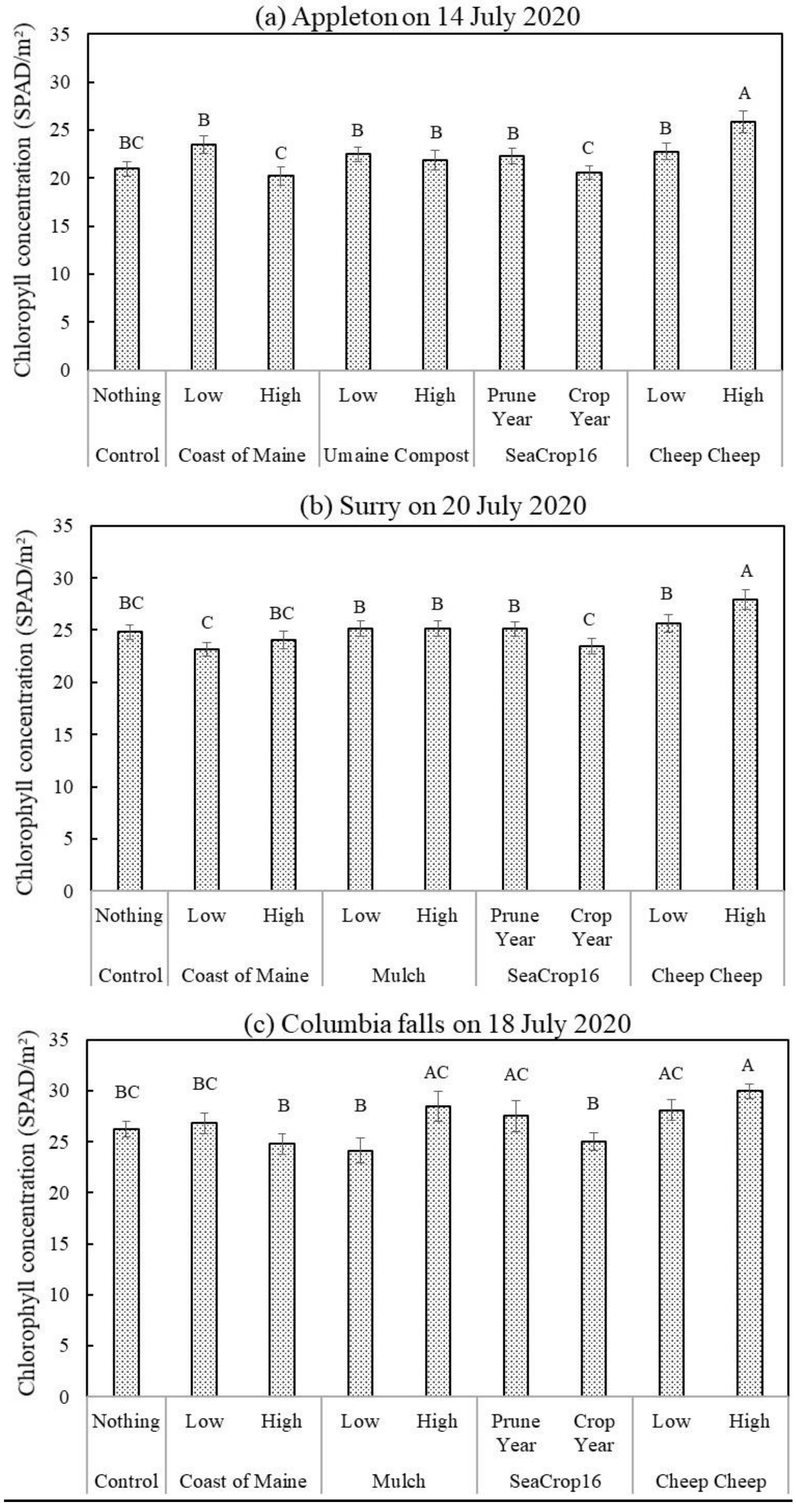


**Figure 2.** Comparison in chlorophyll concentration of wild blueberry leaves during mid-July among different treatments in (a) Appleton, (b) Surry, and (c) Columbia Falls, Maine.

Error bars indicate the standard error of the mean. Different letters indicate significant differences at the significance level of $P < 0.05$.

Effects of Organic Amendments on Wild Blueberry Morphology

Overall, no significant differences were observed in the wild blueberry leaf sizes in any of the three organic wild blueberry fields. In the Appleton field, both low and high rates of coast of Maine cobscook blend treated plots and the control plot had comparatively higher leaf size than the other treatments. In the Surry field, the control plot, plots with the low rate of cobscook blend and chicken manure, and the SeaCrop16 treated plot in the prune year (2019) had higher leaf size compared to the other treated plots. In contrast to the leaf sizes observed in the Appleton and Surry fields, the high rate of chicken manure and SeaCrop16 in the crop year (2020) at Columbia Falls had higher mean leaf size compared to the control and other treatments.

Regarding the wild blueberry leaf dry biomass, significant differences were observed among the treatments in Appleton and Columbia Falls fields but not in the Surry field.
In the Appleton field, higher leaf dry mass was observed in the control plot and the treated plots with both low and high rates of Coast of Maine Cobscook blend, SeaCrop16 applied in the prune year (2019), high rate of chicken manure compared to the other treated plots. In contrast, in the Surry field, the observed leaf dry mass was almost similar among the different treatments including the control plot. However, in the Columbia falls field, the high rate of chicken manure treated plot had significantly higher leaf dry mass compared to the control plot (Figure 3).

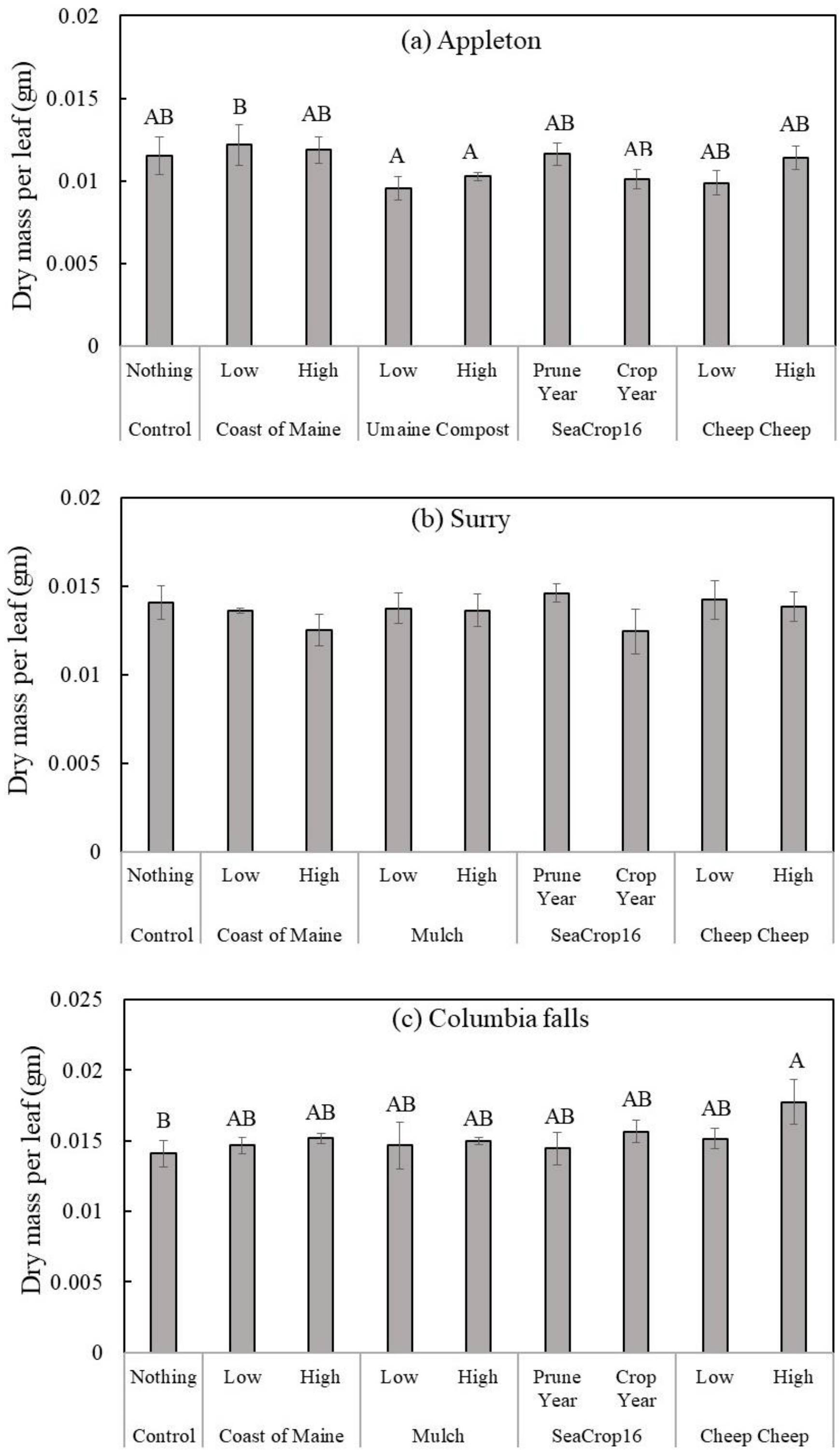


**Figure 3.** Comparison in dry biomass of wild blueberry leaves during harvesting among different treatments in the (a) Appleton, (b) Surry, and (c) Columbia Falls, Maine. Error bars indicate standard errors of the mean. Different letters indicate a significant difference at the significance level of $P < 0.05$ in the (a) Appleton and (c) Columbia Falls sites. No significant differences were observed in leaf dry biomass in the (b) Surry site.

Effect of Organic Amendments on Leaf Nutrition – Preliminary Data

Here, nutrient availability is quantified through leaf nutrient content. Leaf samples were collected and analyzed in 2019 following all organic amendment applications and 2020 samples will be analyzed this winter. As expected, the macronutrients N, P and K were highest with the highest rate of chicken manure (4-3-3). Micronutrients (Ca, Mg, Mn, Al, B, Cu, Fe, Zn) did not exhibit significant treatments differences with the exception of magnesium (Mg) and boron (B) where mulch (high-rate) and University compost (low-rate) were significantly higher than the chicken manure (high-rate), respectively. We know wild blueberry responds slowly to the environment and different organic amendments release nutrients at different rates over time. Leaf nutrient analysis from 2020 is ongoing and crucial to observing micronutrient concentrations and slow-release amendments like compost and mulch.

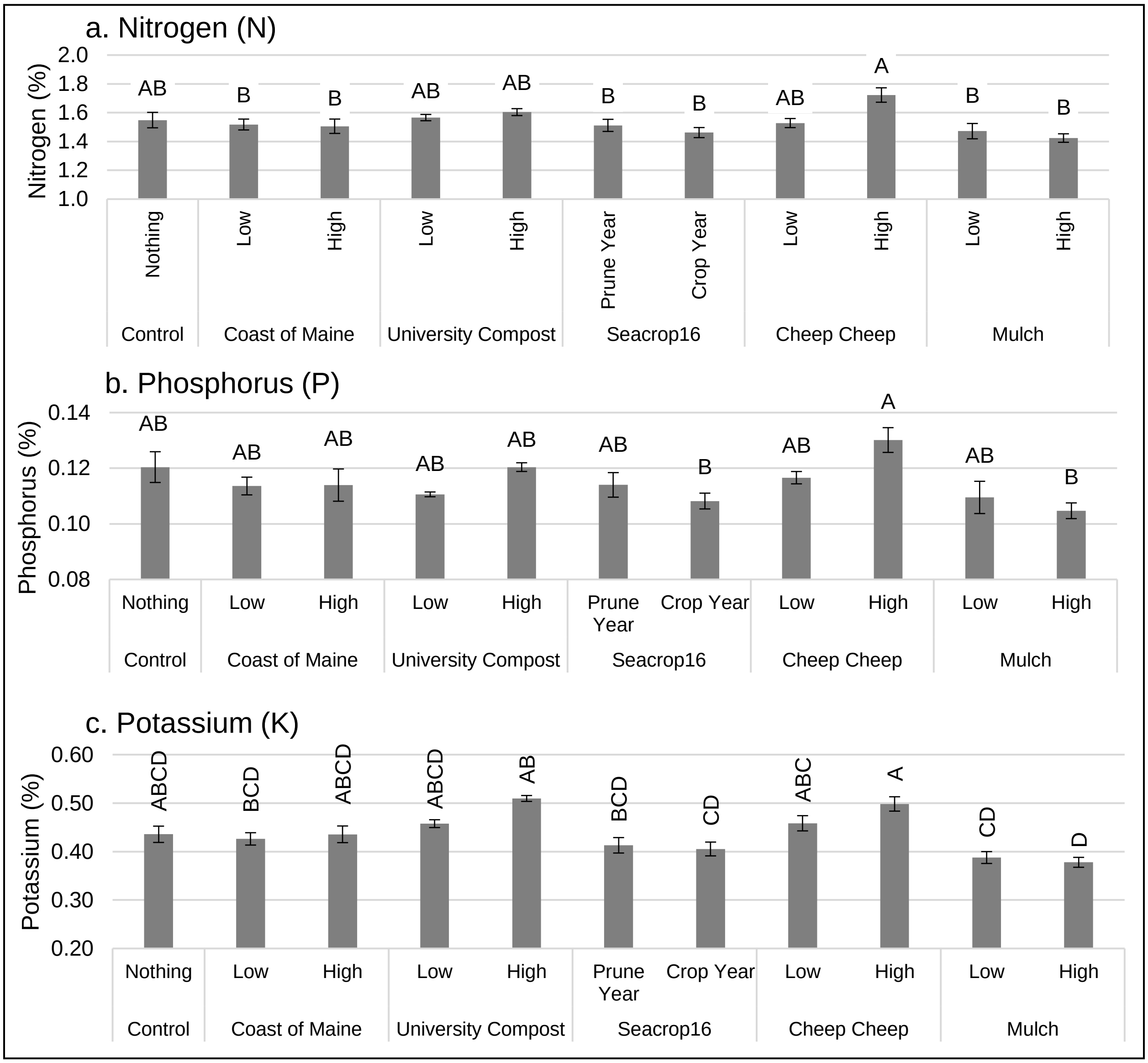


**Figure 4.** Macronutrients: nitrogen (a), phosphorus (b) and potassium (c), leaf nutrient concentrations collected in 2019 around 1 month following organic amendment application. Letters indicate significance at the 0.05 level of significance. Error bars indicate the standard error of the mean.

<u>Effect of Organic Amendments on Blueberry Cover and Pest Incidence, 2019 and 2020</u>

Blueberry cover and pest pressure were ranked by treatment in both 2019 and 2020. In the 2019 prune-year, no significant differences were observed between treatments in blueberry cover or the incidence of insects or disease. Weed scouting in 2019, however, had revealed a significantly higher frequency of grasses in the chicken manure (Cheep Cheep) plots relative to the control (Table 2). A greater frequency of broadleaf and grass weeds were observed in 2019 when compared to 2020. This difference could be due to the prune-vs. crop-year with greater opportunity for weed growth in the prune-year. However, slight changes in sampling technique and timing between the two years are likely the ultimate contributor. Overall, chicken manure had the highest occurrence of grasses in 2020 and 2019, and the greatest variety of weed species present in 2020. University Compost (high-rate) had grass present but no broadleaf weeds across both years. The top grass species observed in 2020 were poverty oat grass followed by witch grass for all treatments. The top broadleaf species varied by treatment (Table 2).

**Table 2.** Weed presence observed by treatment across all three locations sampled July-September in the 2019 prune-year and May to July in the 2020 crop-year.

| | | **2019 Prune-year** | | **2020 Crop-year** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Frequency** | | **Frequency** | | **Species Present** | **Top Broadleaf** | |
| | | **Broadleaf** | **Grass** | **Broadleaf** | **Grass** | | **1st** | **2nd** |
| | | ---------- % ---------- | | ---------- % ---------- | | ---- # ---- | ------- Species ------- | |
| **Control** | Nothing | 12% | 50% | 2% | 19% | 9 | Cow Wheat | Birch Sapling |
| **Coast of Maine** | Low | 14% | 34% | 4% | 16% | 9 | Canada Mayflower | Golden Rod |
| | High | 20% | 33% | 5% | 17% | 7 | Choke-berry | Cow Wheat |
| **University Compost** | Low | 0% | 30% | 2% | 3% | 5 | Winter-green | Canada Mayflower |
| | High | 0% | 17% | 0% | 2% | 2 | - | - |
| **Seacrop16** | Prune | 23% | 38% | 9% | 15% | 10 | Cow Wheat | Canada Mayflower |
| | Crop | 13% | 31% | 3% | 11% | 7 | Birch Sapling | Cow Wheat |
| **Cheep Cheep** | Low | 33% | **62%** | 7% | 20% | 13 | Red Sorrel | Bracken Fern |
| | High | 23% | **61%** | 10% | 21% | 15 | Choke-berry | Red Sorrel |
| **Mulch** | Low | 25% | 40% | 6% | 10% | 10 | Bunch-berry | Golden Rod |
| | High | 15% | 40% | 5% | 9% | 5 | Bracken Fern | St. John's Wort |

When combining the 2019 and 2020 ranked data, treatment differences were apparent in blueberry cover and pest pressure. Blueberry cover was significantly higher in almost all treatments with the exception of Coast of Maine and Mulch at the highest rate and University Compost at both rates (Figure 2). It’s important to note that the University of Maine Compost was only applied at 1 of the 3 locations, thus, blueberry cover appears high but the statistical results for this treatment are weak due to relatively low sample size. The high-rate of chicken manure resulted in significantly higher weed cover than all other treatments (except for the low-rate chicken manure), across both years (Figure 2). Additionally, the high rate of the University of Maine Compost resulted in the lowest weed cover. Despite the smaller sample size, this was significantly lower than all treatments except for the low-rate University Compost and the Seacrop 16 foliar spray (crop-year, applied).

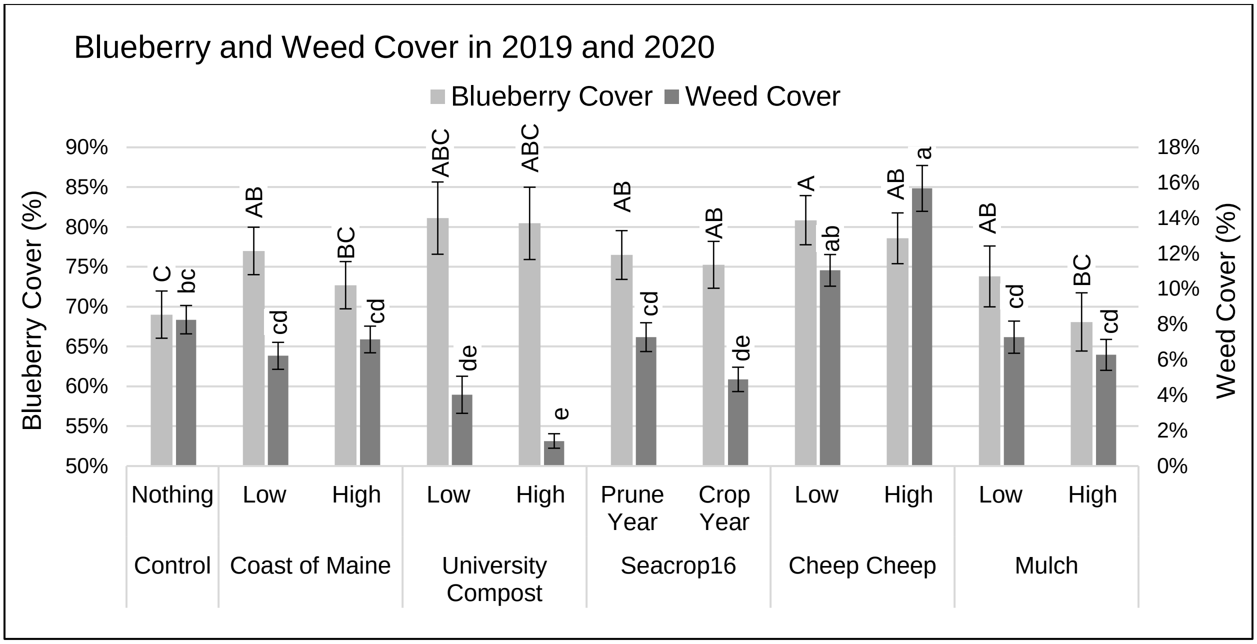


**Figure 5.** Blueberry cover and weed cover measured across all 3 locations (Hope, Surry and Columbia Falls) over 2019 and 2020 under organic amendment treatments. Letters indicate significance at the 0.05 level of significance. Capital letters are to be compared separate from lowercase letters. Error bars indicate the standard error of the mean.

Insect and disease pressure (% cover) across 2019 and 2020 also presented statistically significant differences across treatments (Figure 3). The highest insect pressure was observed with the chicken manure, followed by the mulch and foliar fertilizer (prune-year, applied). The types of insect's present were consistent across treatments with the top pest being flea beetle (larval and adult), followed by tip midge and red stripped fireworm. The only exception was University Compost, where less flea beetle damage occurred at the particular site this was applied; making the top pest tip midge, followed by red stripped fireworm. Disease pressure was interestingly lowest in the chicken manure plots, and highest in the foliar fertilizer (crop-year, applied), making these treatments statistically different from one another. Diseases present were also consistent across treatments with the top category being Leafspot followed by Mummy berry and Phomopsis. University Compost was again the exception, with higher Mummy berry occurrence than Leafspot (likely due to location rather than treatment).

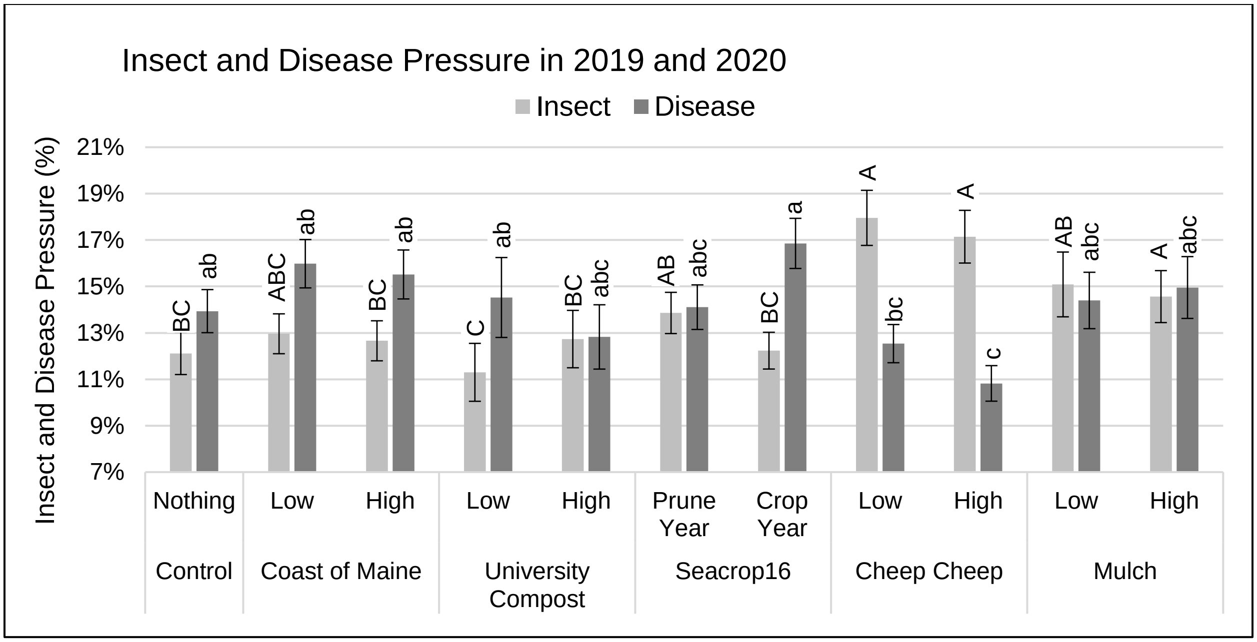


**Figure 6.** Insect and disease cover measured across all 3 locations (Hope, Surry and Columbia Falls) over 2019 and 2020 under organic amendment treatments. Letters indicate significance at the 0.05 level of significance. Capital letters are to be compared separate from lowercase letters. Error bars indicate the standard error of the mean.

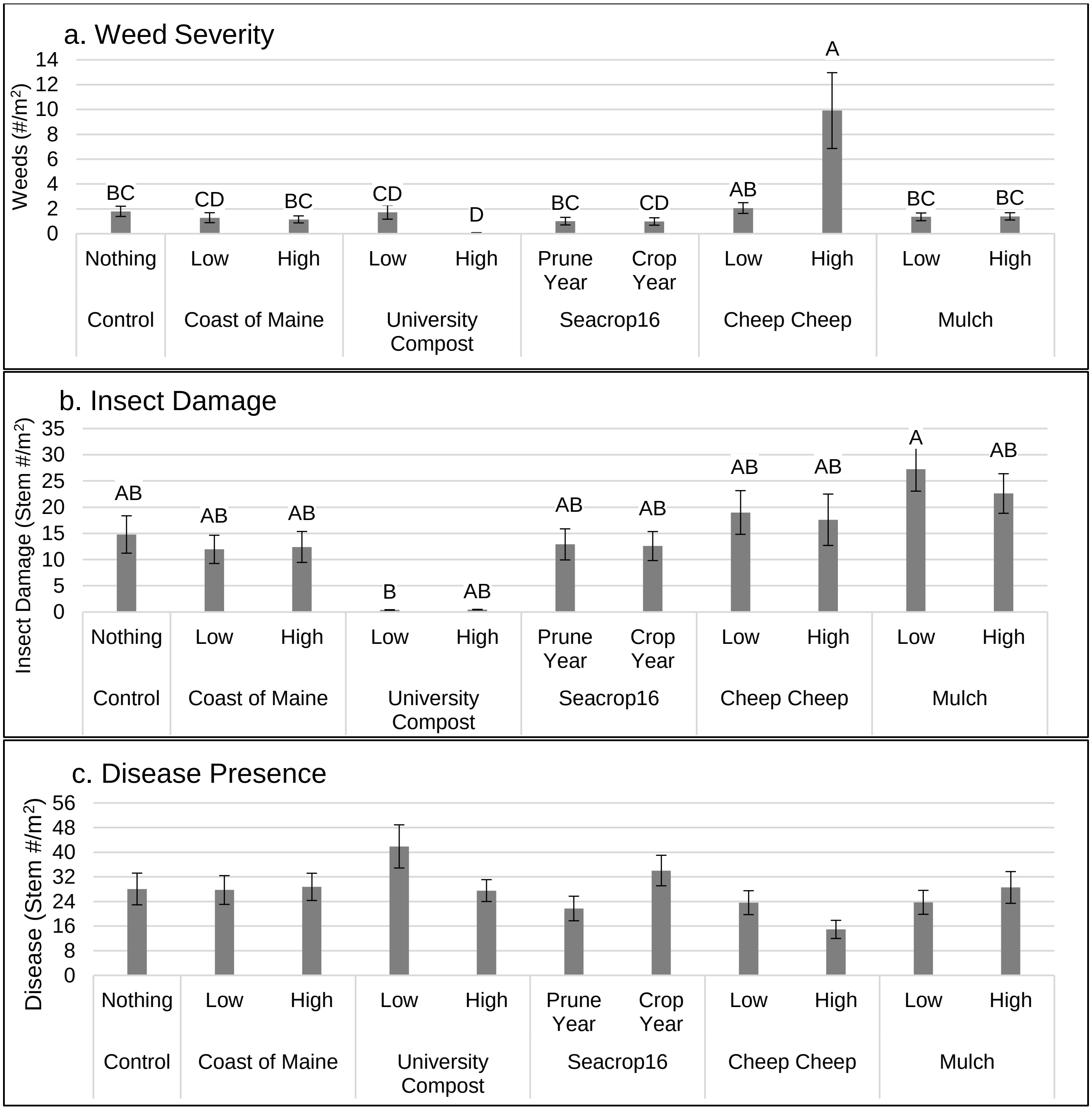


**Figure 7.** Weed severity (a), insect damage (b) and disease presence (c), measured across 3 locations (Hope, Surry and Columbia Falls) from May-July, 2020. Letters indicate significance at the 0.05 level of significance for weed intensity and insect damage. Treatment differences for disease presence (c) were nonsignificant. Error bars indicate the standard error of the mean.

Wild Blueberry Productivity; Fruit Set and Fruit Drop

In the 2019 prune-year wild blueberry productivity was quantified through measures of stem height, and corresponding bud number. These indicators did not present significant differences among treatments. In the 2020 crop-year blueberry productivity was monitored through flower and fruit development and subsequent fruit drop prior to harvest. The number of flowers, green fruit and blue fruit (per stem), counted at each location throughout the season presented no significant differences between treatments (data not shown). This count data was then used to establish the percent of fruit set (flower to green fruit) and fruit drop (green fruit to blue fruit) by treatment for the 2020 crop-year (Figure 4). While treatment differences were nonsignificant, it's worth noting that the chicken manure (low-rate) had the highest fruit set and the high rate of University Compost had the highest fruit drop, relative to all other treatments.

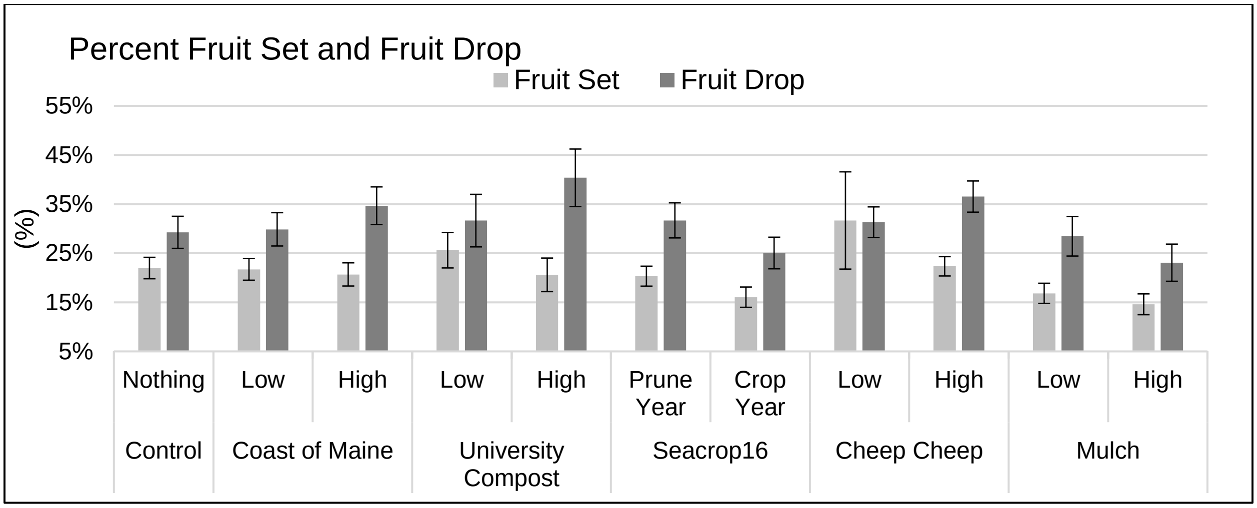


**Figure 8.** Percent fruit set and fruit drop by treatment, measured across 3 locations (Hope, Surry and Columbia Falls) in the 2020 crop-year. Treatment differences were nonsignificant. Error bars indicate the standard error of the mean.

<u>Effect of Organic Amendments on Harvest Yield and Quality</u>

The 2020 harvest yield of the wild blueberry did not exhibit significant treatment differences across all three locations (Figure 5). Despite no statistical significance, every treatment that received organic amendments yielded higher than the control. Here, the highest yielding treatments were mulch (low-rate) followed by the foliar spray (crop-year, applied) and the University compost (low-rate).

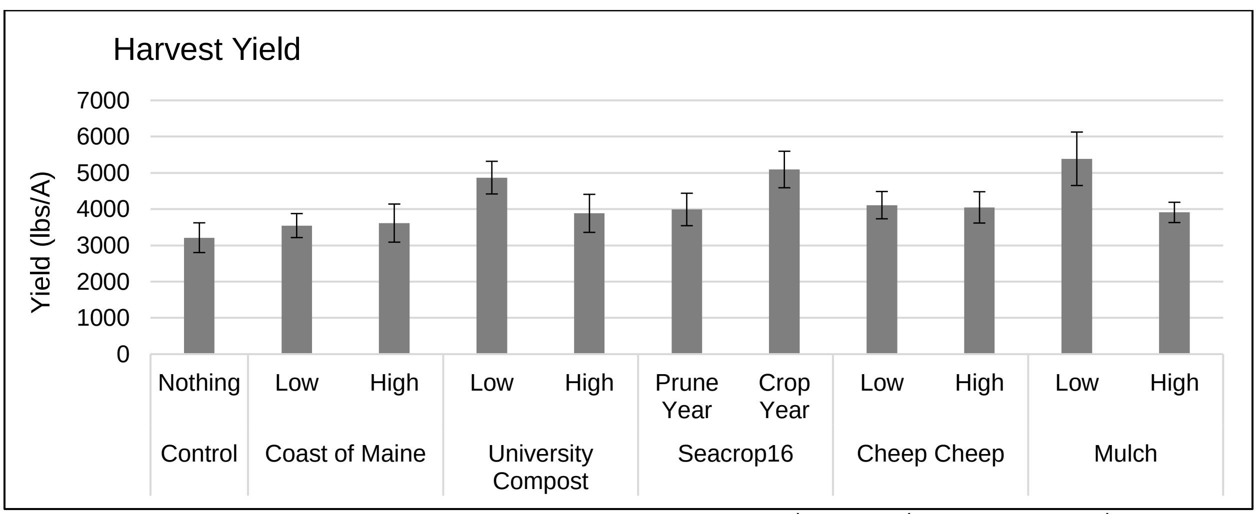


**Figure 9.** 2020 wild blueberry yield harvested on Aug 3rd, Aug 6th, and Aug 11th, in Hope,

Surry and Columbia Falls, respectively. Treatment differences for blueberry yield were nonsignificant. Error bars indicate the standard error of the mean.

Berry quality measures taken at the time of harvest included brix as a measure of berry sugar content and 100 berry weight as a measure of berry size (Figure 6). Berry sugar content was highest in the chicken manure treatments and lowest with University Compost, although treatment differences were nonsignificant. Berry size was significantly lower in both mulch treatments than the University compost (low-rate). All other treatments showed no significant differences from one another in berry size. It is worth noting that while University compost exhibited large berry size, it also had the lowest sugar content, suggesting the berries had a higher water content.

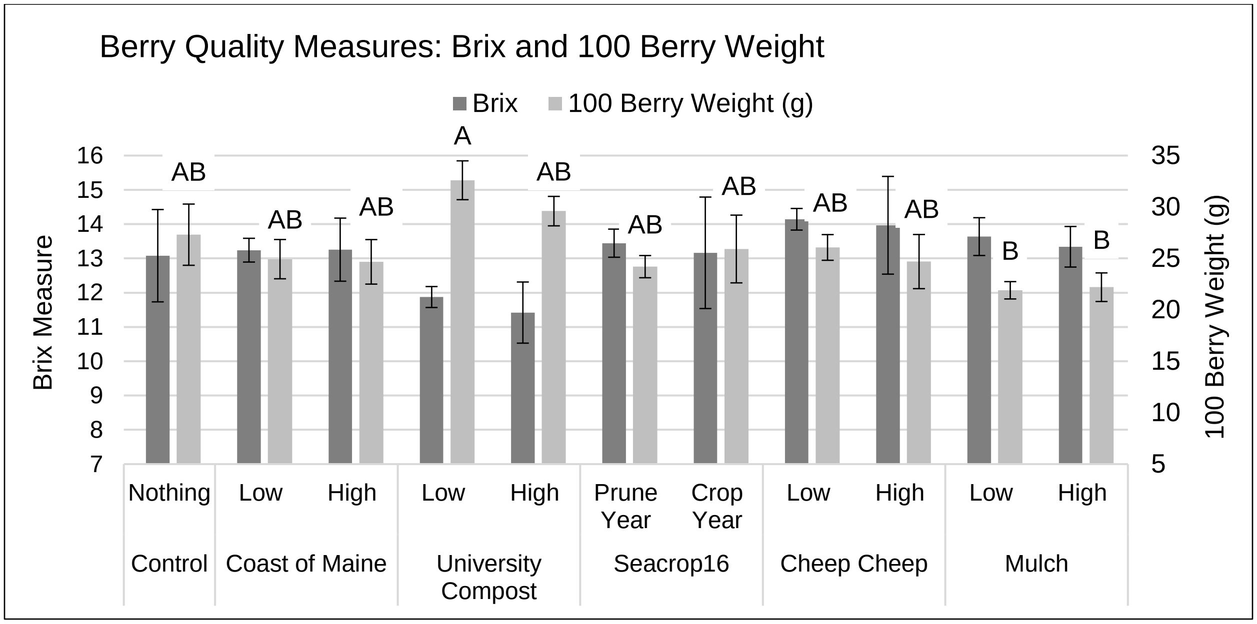


**Figure 10.** Brix, as a measure of berry sugar content and 100-berry weight (berry size) harvested on Aug 3rd, Aug 6th, and Aug 11th, in Hope, Surry and Columbia Falls, respectively. Treatment differences for brix measures were nonsignificant. Letters indicate significance at the 0.05 level of significance for berry size. Error bars indicate the standard error of the mean.

Effect of Pest Pressure on Yield

Investigating the potential effect of pest pressure on wild blueberry yield in the 2020 crop-year showed a significant correlation between weed pressure in the chicken manure (high-rate) treatment and lower yield (Figure 7). Here, the significant correlation between weed pressure and yield ($p = 0.0196$) suggests the weed pressure was detrimental to the blueberry despite any enhanced growth caused by the manure. The yield of the low-rate mulch treatment also significantly correlated to both insect and disease pressure suggesting these negatively impacted the harvested yield.

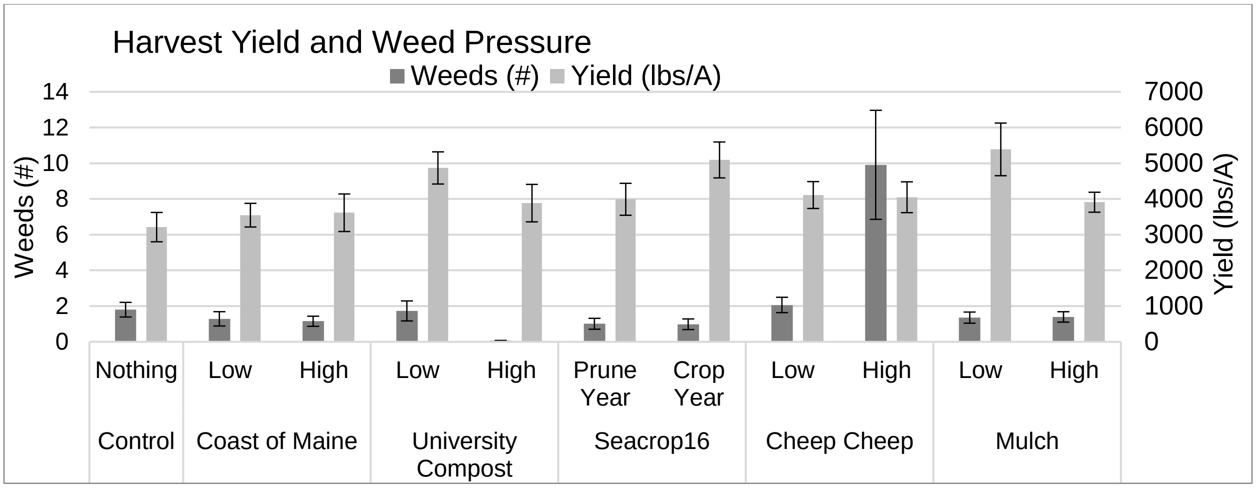


**Figure 11**. Harvest yield compared with weed intensity, measured across 3 locations (Hope, Surry and Columbia Falls) in the 2020 crop-year. The asterisk (*) indicates a significant correlation between weed intensity and yield at the 0.05 level of significance. Error bars indicate the standard error of the mean.

## DISCUSSION

From the 2 years of data collected so far from this 4 year study, some soil ammendments may be able to improve the condition of organic wild blueberry plants. The highest percent of grass was observed in both rates of chicken manure yet the low rate of chicken manure showed less grass and significantly higher blueberry cover. We also observed a significantly higher chlorophyll concentration in chicken manure treatments. This is most likely due to the higher nitrogen content of the chicken manure (Table 1). Nitrogen is the most important nutrient for building leaf chlorophyll which further helps to improve photosynthetic performance followed by better crop production (Taiz et al. 2015). The Cheep Cheep product has a high macro and micro-nutrient concentration where N-P-K is 4-3-3 and Fe, Cu, S, Ca, Mg, Zn, Mn are present. These nutrients make up 40% of the material. The remaining 60% is organic matter. This indicates that lower rates of chicken manure should be explored with continued monitoring of all pests.

Compost applications appear to have increased water holding capacity in the soil which led to significantly larger berry size. Increased soil water holding capacity allows the plant to move nutrients that fuel berry cell expansion.

SeaCrop16 applications in the prune year (2019) proved to more effective than other treatments yet this same trend was not observed in the 2020 crop year. Seacrop16 contains cytokinin, a plant growth hormone that can potentially protect plants from drought and frost damage and promote photosynthesis (Novakova et al. 2007). In 2020, wild blueberry experienced higher temperatures and drought conditions making plants stressed in these fields without irrigation. This may be why the 2019 SeaCrop16 application proved to be one of the efficient treatments compared to the 2020 SeaCrop16 application.

<u>Product Costs</u>

The cost of products used plays a critical role in implementation by wild blueberry growers (Table 2). The Coast of Maine Cobscook Blend was the most expensive product, followed by North Country Organics Cheep Cheep. Both the North American Kelp Seacrop 16 foliar fertilizer and Mark Wright Disposal mulch had lower costs per unit and were also applied at lower rates compared to the chicken manure, thus resulting in overall lower costs compared to all other treatments. No cost was given for compost because it was donated by the University of Maine for this study.

**Table 2**. Cost of a single application of the organic amendments used in this trial. Prices may vary based on quantity purchased, grower size, retailer and year.

| Product | Rate Type | Rate Applied | Rate Unit | Cost ($/acre) | Unit Cost |
|---|---|---|---|---|---|
| Control | N/A | N/A | N/A | N/A | N/A |
| North American Kelp Co. Seacrop16 Foliar Fertilizer | Prune or Crop | 1.2 /242 | L /gal $H_2O$/A | $14.70 | $49/gal |
| North Country Organics Cheep Cheep Chicken Manure 4-3-3 | Low | 1089.0 | lbs/A | $814 | $0.74/lb |
| | High | 2178.0 | lbs/A | $1628 | |
| Coast of Maine Cobscook Blend Garden Soil | Low | 7.5 | $yd^3$/A | $2025 | $270/$yd^3$ |
| | High | 15.0 | $yd^3$/A | $4050 | |
| Mark Wright Disposal Dark Brown Mulch | Low | 7.5 | $yd^3$/A | $240 | $32/$yd^3$ |
| | High | 15.0 | $yd^3$/A | $480 | |
| *University of Maine Compost | Low | 7.5 | $yd^3$/A | N/A | N/A |
| | High | 15.0 | $yd^3$/A | N/A | |

***Cost unknown, provided by university for study**

## CURRENT RECOMMENDATIONS

None at this time.

## NEXT STEPS

- Monitor plant growth and pest pressure in the 2021 prune-year: blueberry cover, stem height, buds per stem, weed, insect and disease.
- Monitor soil moisture as well as leaf chlorophyll content, leaf anthocyanin content, and leaf photosynthetic electron transport rate once every month (June to October) on 6 marked stems in each plot during the 2021-2022 crop cycle.
- Measure the leaf size, their dry biomass, stem height, leaf nutrients, yield at the end of the season.
- Resample leaf nutrient concentrations in 2022.

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