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FERTILITY AND WEED MANAGEMENT IN ORGANIC HIGHBUSH BLUEBERRY PRODUCTION

Final Research Report E2006-06

INTRODUCTION

The blueberry, considered a nutritional 'superfood' due to its high level of antioxidants, is drawing lots of attention from health-conscious consumers. Simultaneously, consumer demand is greater than ever for organic fruit, resulting in a huge market opportunity for organic blueberries. Organic producers are constantly challenged by weed and fertility management due to the lack of conventional methods available to them. Production strategies must be tailored to organic principles, such as the use of mulches for weed control and as an organic source of nutrients.

The objective of this project was to test the efficacy of thick applications of mulch as a strategy for weed control for highbush blueberry (*Vaccinium corymbosum* L.) and to evaluate its effect on plant productivity and soil fertility. Highbush blueberries thrive in areas that are well-drained and have a good level of organic matter, making them an ideal crop for compost and mulch use. Mulches have been utilized in horticultural crops for weed suppression, but have not been tested as a 'dual-purpose' cultural practice for both weed control and nitrogen fertility in organic blueberry production.

Blueberry plant with compost treatment (N. Burkhard)

WHAT WAS DONE?

A two-year (2005-2006) study was conducted at a commercial blueberry farm in the Annapolis Valley of Nova Scotia. Five fertility and mulch treatments as well as a control (Table 1) were arranged in a split-plot randomized block design, with each plot divided into weeded and non-weeded subplots. Treatments were applied in an established field of 4-year old 'Duke' highbush blueberry plants in 2005 (Trial 1) and repeated in 2006 at an adjacent location (Trial 2). The site had sandy loam soil, which was modified at planting by the incorporation of manure-sawdust compost (at 175 m^3 ha^{-1}).

Throughout each field season, measurements were taken to assess the effect of mulch application on weed control, crop productivity and nitrogen fertility. These included: soil samples, compost nutrient analysis, weed ground cover surveys and biomass measurement, leaf nutrient analysis, yield (total fresh weight, berry number and berry weight), berry quality analysis (total polyphenolics, sugar content, titratable acidity), plant canopy measurements, and PRS™ (Plant Root Simulator) probes to monitor spring nitrogen mineralization (data not presented).

Table 1. Treatment descriptions for highbush blueberry fertility – weed management trials

Trt	Description	Application Rate
C	Control	-
AS	Ammonium sulphate fertilizer	60 kg N ha^{-1}
NW	Nutri-Wave® dehydrated poultry manure	30 kg N ha^{-1}
PN	Pine needles	80 t ha^{-1}
MS	Horse manure/ sawdust compost	550 t ha^{-1}
SC	Seafood waste compost	360 t ha^{-1}

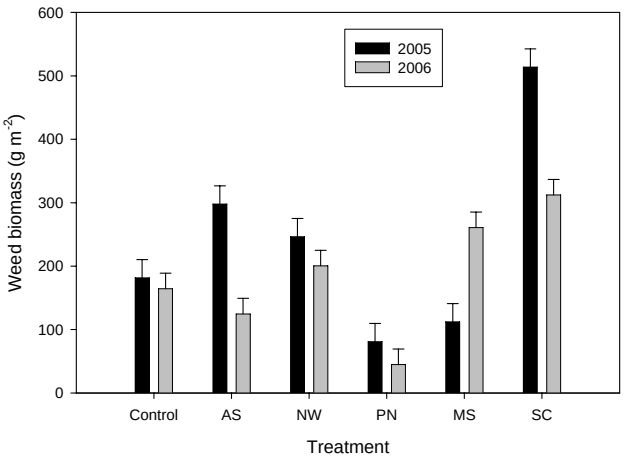

Figure 1. Mean weed biomass (+ SE) as influenced by treatment in the application year

An analysis of variance was conducted for weed parameters using the GLM procedure in SAS and the Mixed procedure for all other parameters; orthogonal contrasts were constructed to compare means when significant.

RESULTS: WEED CONTROL

Weed biomass was significantly reduced by the pine-needle mulch in 2005 and 2006 (Fig. 1). This was also reflected in the weed cover surveys conducted twice per season (data not shown). The highest weed biomass occurred in the seafood compost for both years. Less nitrogen was sequestered by weeds in Trial 1 compared to Trial 2 (Fig. 2), which could have been due to soil fertility and seasonal weather conditions. In both trials, pine-needle mulch resulted in the lowest weed N content for all treatments.

Compost and fertility treatments at Blueberry Acres (N. Burkhard)

Predominant weed species included: sheep sorrel (*Rumex acetosella* L.), vetch (*Vicia* spp.), common ragweed (*Ambrosia artemisiifolia* L.), common lambsquarters (*Chenopodium album* L.), mouse-eared hawkweed (*Hieracium pilosella* L.), clover (*Trifolium* spp.), yellow foxtail [*Setaria glauca* (L.) Beauv.] and barnyard grass [*Echinochloa crusgalli* (L.) Beauv.].

The most successful weed species were perennials such as sheep sorrel and vetch that can reproduce by rhizomes and underground rootstock. Thick mulch layers had a limited effect on their growth since these weed species were able to grow through the mulch to reach ideal conditions instead of being starved of light under the mulch layer. It is suspected that one of the reasons the pine-needle mulch was most effective at suppressing weeds is because it did not provide weed seeds with a suitable growing medium as was the case for the two composts.

RESULTS: PLANT RESPONSE

In 2005, berry yield was unaffected by treatment application (Table 2), as was the case for specific berry weight (data not shown). Also, there was a significant interaction between treatment and weed management for berry number, but this did not seem representative of the trend for that year. In 2006, both treatment and management significantly influenced yield, berry number and specific berry weight, indicating a strong and consistent effect. Generally, berry parameters were higher in mulched, hand-weeded subplots compared to unmulched plots.

Table 2. Mean berry yield (n=3) as influenced by weed management and treatment during the application year

	Yield (g bush^{-1})	
	2005	2006
Treatment		
Control	62.4	25.0
AS fertilizer	34.0	53.8
Nutri-Wave®	35.0	53.6
Pine needles	34.7	68.6
Manure compost	54.4	140.9
Seafood compost	67.1	110.4
Weed Management		
Weeded	46.0	88.6
Unweeded	47.9	54.1

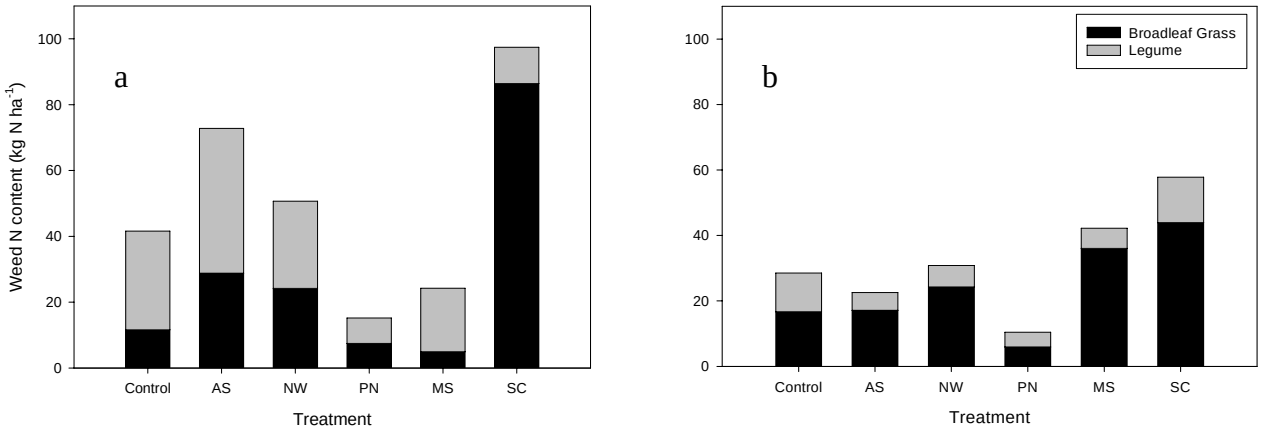

Figure 2. Weed nitrogen content categorized by broadleaf, grass and legume species biomass for 2005 (a) and 2006 (b) in the application year

Mulch treatments had an effect on berry soluble solids (*P*=0.041) for weeded plots (data not shown). This was due to the significant contrast between the seafood waste compost and the manure compost, which had the highest (12.8 ºBrix) and lowest (11.3 ºBrix) sugar content, respectively. No significant treatment effects were found for other berry quality parameters (total polyphenolic content, titratable acidity and pH).

Plant canopy volume was significantly affected by weed management. In the application years of Trial 1 and Trial 2 (Fig. 2), plant canopy volumes were significantly lower in unweeded subplots (*P*=0.016 and *P*=0.009, respectively). In the second season of Trial 1, the lack of weed control also decreased plant canopy volume (*P*=0.008; data not shown). In addition, plants treated with mulch were found to have significantly higher canopy volumes than those in the control and fertilizer treatments (*P*<0.001).

The clear effect of weed growth on canopy volume was not as evident for leaf nitrogen content (Table 3). Plants in both trials were influenced more by treatment in the application year (*P*=0.009 for both) as leaf N content was higher for mulched plants than for unmulched plants (those in the control, AS and NW plots). In addition, higher leaf N values for weeded mulch plots in 2006 resulted in a significant interaction between weed management and treatment application (*P* = 0.041).

Table 3. Mean percent leaf nitrogen content (n=3) as influenced by weed management and treatment in the application year

	Leaf N (%)	
	2005	2006
Treatment		
Control	1.25	1.18
AS fertilizer	1.28	1.17
Nutri-Wave®	1.27	1.16
Pine needles	1.40	1.22
Manure compost	1.42	1.28
Seafood compost	1.52	1.38
Weed Management		
Weeded	1.35	1.27
Unweeded	1.36	1.19

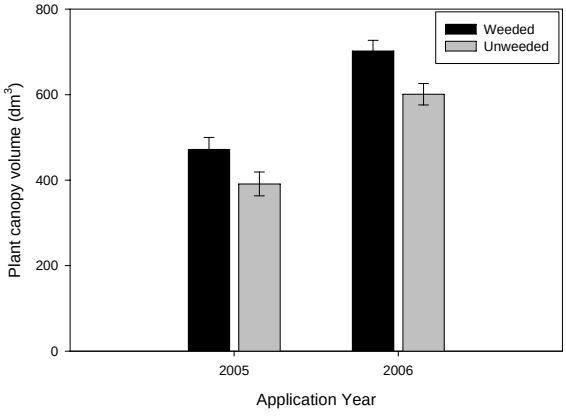

Figure 3. Mean plant canopy volume (±SE, n=3) as influenced by ground cover management

CONCLUSIONS

Plant productivity (yield, canopy volume, leaf N) was typically higher for mulch treatments, especially in compost-amended plots.

Pine-needle mulch proved to be the most effective treatment in suppressing weed growth for highbush blueberry in both trials and did not result in deleterious effects on crop vegetative or reproductive growth.

The seafood waste compost tended to encourage weed growth; while it may have prevented some weed emergence through the mulch layer, weed seeds that germinated in the compost itself experienced prolific growth due to available nutrients in the compost.

Granular dehydrated poultry manure (Nutri-Wave®) had similar results to ammonium sulphate fertilizer throughout the study, indicating that it could be a suitable organic source of N fertilization for highbush blueberry.

Berry samples were collected to assess fruit yield and quality (N. Burkhard)

CREDITS

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THE BOTTOM LINE...

Weed control is a very important management consideration in organic production. Weed competition can reduce berry yields, leaf N content and vegetative growth of highbush blueberry plants.

Natural mulches, such as pine needles, can be used as an effective means of weed control without deleterious effects for plant productivity.

Compost application can provide excellent benefits with regards to soil moisture retention, temperature regulation, plant nutrient uptake and vegetative growth. For some composts, effects can be limited if used as mulch for weed control when there is a potential for weed seed contamination.

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