Soil nutrients in organically fertilized potting media under greenhouse conditions

Liz Perkus[1], Carl Rosen[2], Julie Grossman[1], Mary Rogers[1], John Erwin[1], Justin Carlson[3], Joanne Slavin[3], and Greg Schweser[4]

University of Minnesota Department of Horticultural Science[1], Department of Soil, Water, and Climate[2], Department of Food Science and Nutrition[3], and University of Minnesota Extension[4]

Introduction

As interest in local food continues to rise, vegetable growers are looking for crops to meet that demand. In Minnesota and the upper Midwest, there is special interest in crops that can be grown throughout the winter in greenhouses. Arugula (*Eruca sativa*), mizuna (*Brassica rapa* var. *nipposinica*), and red giant mustard (*Brassica juncea*) are three such leafy crops that are often grown in greenhouses in the winter, either sold separately or together as a baby leaf mesclun mix.

Many growers are also interested in producing food organically, either for personal beliefs or market premium. However, most organic fertilizers are designed for field use where climate and biology can break nutrients into plant available forms. It is not well understood how most organic fertilizers perform under greenhouse conditions, and there are not existing fertility recommendations for specialty crops such as arugula, mizuna and red giant mustard. This study observed media nutrient profile and crop yield to determine whether certain organic fertility options perform well under greenhouse conditions and to learn more about mesclun crop nutrient needs.

Objectives

1. Does treatment (media + fertilizer) affect fresh weight of mesclun crops over harvest period
2. Do media nutrient level differ over time across media type and crop

Materials and Methods

Three mesclun crops, arugula, mizuna, and red giant mustard, were grown in five different fertility treatments in 11 by 22 inch trays in a greenhouse with 24°C days, 13°C days, and an 18 hour photoperiod. Treatments were fertilized to reach nitrogen recommendation levels for spinach grown in soils low in organic matter, 50 lb/acre.[1] The first round of crops were planted on November 12-15, 2014. Crops were harvested at baby leaf stage (true leaves 4 inches long) from Decemeber 9-16, 2014. Soil samples were taken at harvest from 6 representative locations within the flat. The second round of crops were planted on February 23, 2015 and harvested March 27, 2015 to April 20, 2015. Soil samples were taken on April 13, 2015.

Crops were weighed for fresh weight. Soils were processed by the Research Analytical Lab at University of Minnesota, Twin Cities Campus, St Paul, MN using a mass corrected Spurway analysis.

Treatment	Media Base	Fertilizer
All-in-One (AO)	Purple Cow Organic Potting Mix ©	Compost from mix 0.5-0.2-0.4
Conventional Comparison (CC)	SunGro LC8 ©	CalMag Dark Weather Feed © 15-5-15
Custom Mix (CM)	Peat, vermiculite, and compost	Compost and blend of greensand, rock phosphate, bloodmeal, and lime
Fish Emulsion (FE)	Sunshine Natural and Organic Planting Mix ©	Drammatic © 2-5-0.2
Poultry Litter (PL)	Sunshine Natural and Organic Planting Mix ©	SUSTÅNE © 8-4-4

Acknowledgements

Thanks to Michelle Dobbratz, Julian Esparza, Esther Gesick, Tori Hoeppner, Peyton Ginakes, Lindsey Miller, Sonora Nolan-Rapatz, Daniel Raskin, Jared Rubinstein, JiJY Sooksa-Nguan, Aimee Talbot, and Samuel Voss for field, lab, and technical support.

This project was funded by MnDRIVE.

Results

- Crops differed in fresh weight across treatments ($p = 0.007$). Arugula had lower fresh weight than red giant mustard and mizuna (89.63 g, 146.28 g, and 146.79 g, respectively).
- Fresh weight differed between treatments across crops ($p < 0.001$). Poultry Litter had the lowest fresh weights (64.60 g) and Custom Mix, and All in One had the highest fresh weights (172.01 g and 192.91 g, respectively).
- Fresh weight differed among treatment-crop combination ($p < 0.001$). Arugula grown in Fish Emulsion had the lowest fresh weight (37.98 g), and mizuna grown in All in One had the highest fresh weight (229.52 g; Figure 1).
- Media nutrient levels were not affected by crop. However, nutrient levels did differ between treatments (Table 1).
- Nitrogen, phosphorus, and iron levels were not affected by crop but were affected by time (Figure 2a, 2b, and 2c, respectively). For instance, nitrogen decreased from 3630.29 to 1683.09 mg/kg dry soil between planting and harvest in the All in One treatment (Figure 2a).

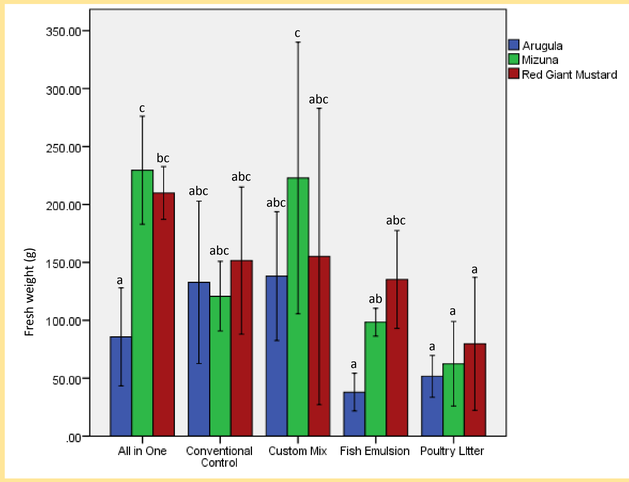

Figure 1: Average harvest fresh weight of arugula, mizuna, and red giant mustard (g). Letters denote mean separation by crop and treatment using Tukey's HSD ($p = 0.05$).

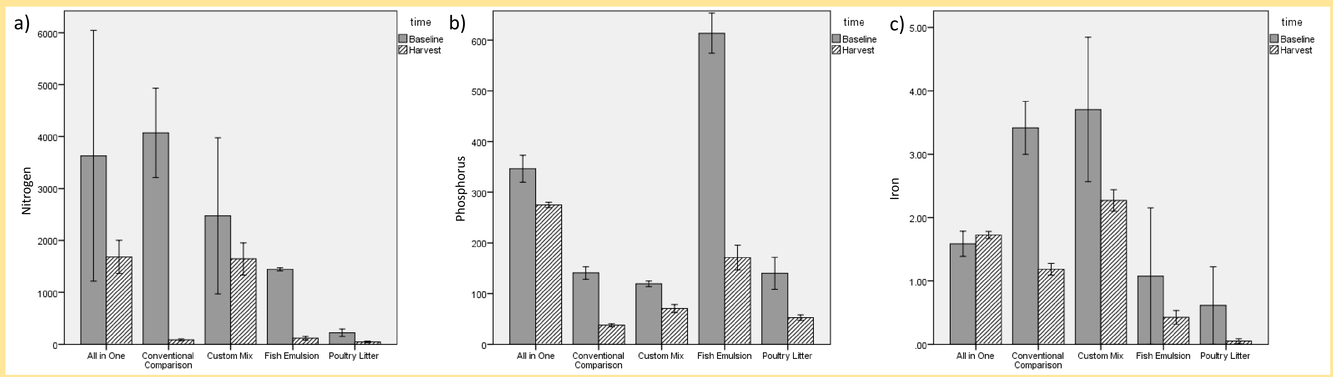

Figure 2: Treatment media nutrient levels (mg/kg dry soil) of nutrients that changed over time; a) Inorganic nitrogen, b) Phosphorus, and c) Iron. These nutrients were not significantly different between different crops. Error bars shown are one standard error.

Table 1: Treatment media nutrient levels (mg/kg dry soil) of nutrients that did not change over time. These nutrients were not significantly different between different crops. Letters denote mean separation by nutrient between crop treatments using Tukey's HSD ($p = 0.05$). Highest value per nutrient is shaded in red, and lowest value per nutrient is shaded in blue.

Treatment	Soluble Salts (EC)	K	Ca	Mg	Na	Mn	Zn	Cu	Mo	B
All in One	267.88 a	1918.79 a	1253.23 a	637.48 a	586.19 c	1.96a	0.57 a	0.26 b	0.05 a	2.56 b
Conventional Control	139.53 a	243.88 a	1774.39 b	1352.97 c	322.08 a	0.78 a	0.81 b	0.00 a	0.01 a	0.13 a
Custom Mix	910.86 b	8911.39 b	2874.02 c	923.61 b	332.85 ab	6.41 b	0.80 b	0.03 a	0.16 b	4.01 c
Fish Emulsion	79.12 a	112.65 a	1326.13 a	1310.39 c	456.27 b	1.29 a	0.86 b	0.00 a	0.01 a	0.00 a
Poultry Litter	70.44 a	119.53 a	1310.96 a	1275.49 c	350.85 ab	1.50 a	0.86 b	0.00 a	0.00 a	0.00 a

Conclusions

- The best treatments for arugula were Conventional Comparison and Custom Mix.
- The best treatments for mizuna were All in One and Custom Mix.
- The best treatment for red giant mustard was All in One.
- The Fish Emulsion and Poultry Litter treatments had low fresh weights for all three crops.
- No change in media nutrient level over time may suggest nutrient above necessary levels, and change in media nutrient level over time may suggest nutrient below necessary levels.

Reference

1. C. J. Rosen and R. Eliason, "Nutrient Management for Commercial Fruit & Vegetable Crops in Minnesota" (University of Minnesota Extension Service, St Paul, MN, 2005).