

Organic Sources of Fertility for Fresh Market Broccoli

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ABSTRACT:

Field experiments were conducted in 2010 and 2011 to assess the release of plant-available N to broccoli plants from five N-rich soil amendments approved for organic production. Broccoli fresh weight measurements, soil and plant mineral N contents were used to assess potential synchrony between N sources and broccoli N demand during the cool moist spring weather in Maine. Data shows that fish meal supplied an optimal pattern of N for high broccoli yield in both years. Soil analysis in 2010 showed N availability from fish meal differed from other fertility sources, with greater initial NH_4^+ availability and consistently high NO_3^- levels from early to mid-June.

INTRODUCTION:

Growers who rely on commercially-available bagged organic fertilizers have little information on the most efficient and economical choices for vegetable cropping in different seasons. Some of these bagged fertilizers have a relatively high C:N ratio and take time to decompose enough to release nutrients into the soil as a plant available form. This mineralization process is enhanced by warm weather and moist soils, so time of year, soil texture and rainfall can have a huge effect on the efficiency of these fertilizers. Further, organic fertilizers may contain considerable quantities of nutrients other than N, including micronutrients, so their true value should be determined by field evaluation. Late spring-early summer is a key climactic season in Maine, when conditions are cool and moist. The growth cycle of broccoli fits this short growing season and the crop is very responsive to nitrogen. Broccoli yield and growth parameters were used to indicate the synchrony between nitrogen availability and crop demand.

METHODOLOGY:

Trials were located at University of Maine Roger's Research Farm, in 2010 and 2011. Cultivar 'Gypsy' was grown in randomized complete block design of six nitrogen source treatments with four replications. Plants were spaced 84x30 cm apart. Blood meal, fish meal, pelletized poultry manure, soybean meal and Chilean nitrate were supplied at a rate to provide 180 kg ha^{-1} of N to each plot in 2010, and 143 kg N ha^{-1} in 2011. Amendments additionally provided various quantities of other macro and micronutrients (Table 1). Control treatments were not amended with N fertilizer. Phosphorus and potassium were supplied by 112 kg ha^{-1} bone char and 90 kg ha^{-1} SulPoMag, respectively.

Growth and quality of plants were measured weekly until harvest. On two occasions destructive samples were used to measure biomass. Soils sampled were measured to a depth of 22 cm. for NO_3^- -N and NH_4^+ -N content. Plants were harvested at commercial maturity and evaluated for fresh weight measurements and dry weight nutrient content.

RESULTS AND DISCUSSION:

Biomass and Yield Production:

Trials indicate that source of organic fertility has a significant effect on plant yield, in terms of total biomass, head biomass and diameter. Averages over two years show the biomass of broccoli heads receiving no N fertility to be 6,724.5 kg ha⁻¹ and 9,812 kg ha⁻¹ for fish meal. All other treatment yields were not significantly higher than the control in 2010, and not significantly different from each other in 2011, averaging 8,292.5 kg ha⁻¹.

Soil Nitrogen Dynamics

Soils amended with fish meal and Chilean nitrate were typically highest in NO₃⁻ content, although the quantities were not always significantly different from other sources of fertility. Trends of soil N content among treatments were markedly different. Chilean nitrate had high NO₃⁻ availability from the start of the season, with a striking decline soon afterwards. Fish meal provided fairly consistent, ample levels of available NO₃⁻ throughout the season, and a generous quantity of NH₄⁺ to young transplants. It appeared to be best synchronized with broccoli N needs of all the amendments.

Tables

Nutrient Analysis of Soil Amendments Used:

Material	% N	% Ca	% K	% Mg	% P
Blood meal	13.5	0.885	0.127	0.035	0.095
Fish meal	9.36	8.84	0.629	0.167	4.59
Poultry manure	3.11	1.76	2.39	0.571	1.20
Soybean meal	6.72	0.199	1.80	0.220	0.739

Fertilizer Micronutrients measured as ppm:

Material	Al	B	Cu	Fe	Mn	Zn
Blood meal	205	13.1	3.20	216	7.20	22.1
Fish Meal	61	1.97	0.985	163	14.8	128
Poultry manure	3231	41.7	332	1821	361	442
Soybean meal	58.9	20.3	12.6	211	29.3	49.7

Broccoli Yield According to Organic N Source @ 180 kg/ha N – 2010, @ 143 kg/ha N - 2011

(kg/ha)	Fish	Chilean	Blood	Poultry	Soy	Bare
Total Biomass						
2010	62,791	60,266	58,772	53,856	53,815	47,383
2011	21,829	20,088	17,504	19,116	19,520	12,950
Head Yield						
2010	14,896	11,611	11,749	11,245	12,306	10,450
2011	4,728	5,349	4,993	4,710	4,377	2,999