2015 Vegetable Fertility Management Trial

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INTRODUCTION

Many organic vegetable producers have been relying heavily on livestock composts as a source of fertility on farm. Often, high rates of compost are applied to meet the nitrogen (N) needs of crops. When this strategy is implemented it can lead to over application of phosphorus (P) and potassium (K). As an example, a grower may apply poultry manure at 6 tons ac^{-1} for 3 consecutive years. This contributes 225 lbs ac^{-1} of P per year, where vegetable crop removal of P ranges from 10-80 lbs ac^{-1} per season. In this scenario, there is an over application of P, leading to an excess of 900 lbs ac^{-1} in 3 years in cases where the soil already had sufficient P levels. After multiple seasons of using composts, P levels may accumulate in the soil to the point where applying additional P poses an environmental risk to nearby waterways. Phosphorus loading and associated risk depends on soil type, slope, and proximity to water. However, with impending water quality regulations, farmers will be required to account for their nutrient balance.

There are few alternative fertilizer options for organic growers that primarily provide N with limited P and K. Sodium nitrate (SN), also known as Chilean nitrate, is a high N fertilizer that is mined from natural deposits of caliche ore found in the Atacama Desert of northern Chile. Organic growers have been attracted to SN because its N is 100% plant available, even in cold, early season soils, which makes SN especially desirable in regions with cool spring weather, like Vermont. There are few alternative, organic options that can quickly provide N to plants.

SN has been a highly valued fertilizer for organic growers, however, it may be less available as an organic option in the future. The goal of this research project was to evaluate the advantages of using SN and blood meal, another organic-approved N fertilizer alternative, in cool, early season soils for heavy N feeding vegetable crops. The two crops studied were sweet corn and cabbage. Sweet corn was chosen because it has difficulty germinating in cold soils without threat of fungal damage. Cabbage was chosen since many organic vegetable producers grow it as an early season, spring planted crop.

MATERIALS AND METHODS

The trial was conducted at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with four replications for both crops. -May. The sweet -May. x The previous crop was flax. The field was rototilled prior to planting using a skid steer. General plot management is listed in Table 1.

Main plots were fertilizer treatments of 1) SN (16-0-0) as starter fertilizer to meet 20% of the N needs and poultry manure (5-4-3) to meet the remaining 80% of the N needs, 2) blood meal (12-0-0) as starter fertilizer to meet 20% of the N needs manure to meet the remaining 80% of the N needs, and 3) a control of composted poultry manure alone to meet 100% of the N needs (see Tables 2 and 3 for fertilizer rates). The third treatment was considered a grower control, representing poultry manure application rates commonly used on organic vegetable operations in VT. Poultry manure was applied and incorporated on 5-May. SN and blood meal starter fertilizer was incorporated around the base of each plant during cabbage transplant (7-May) and at the V1 stage for sweet corn (15-Jun). Fertilizer rates were adjusted based off of estimated plant available N (PAN) rates at 70 days, which were determined from a lab incubation study. Blood meal has 53.2% PAN, SN has 23.4% PAN at 70 days after incorporation.

For both crops, soil nitrate samples were taken every two weeks until harvest. Soil temperature was continuously measured after seeding and transplanting and soil moisture was measured weekly. The cupping date for cabbage (start of head formation) was 12-Jun (Table 2). The middle four heads of cabbage per plot were harvested by hand on 2-Jul. At harvest, the following quality standards were measured: uniformity was measured visually over the entire plot to estimate whether all the heads were maturing at the same time and whether there were abnormalities, using a 1 (low uniformity) - 9 (high uniformity) scale; head solidity was measured visually and by touch over the four middle heads, using a 1 (less solid) 9 (more solid) scale; weight of each head harvested was measured; leaf thickness of the outer, wrapper leaf was measured for each harvested head using a digital caliper; tipburn was measured by cutting each head longitudinally and examining the young, inner leaves for necrotic margins and noted as either present or absent; and percent moisture was measured by sampling approximately 1 cup of each of the four heads harvested, chopping the cabbage in a food processor, and then taking approximately ½ cup of the chopped cabbage to weigh before and after drying in an oven.

The corn tasseling date was 31-Jul and the silking date was 2-Aug for sweet corn in all treatments (Table 3). Just prior to harvest, populations were counted and plant height and ear height were measured from the middle two rows only. Sweet corn was harvested by hand on 24-Aug from the middle two rows. At harvest, stalk nitrate level. Samples were sent to Dairy One laboratory for analysis. Percent moisture was measured by shaving kernels off of 3 ears per plot, making a slurry of the kernels in a food processor, and then taking approximately ¼ cup of the slurry to weigh before and after drying in a microwave. The number of ears in the middle two rows of corn was recorded. Also, the ear length, ear diameter, length of unfilled tip, husked corn ear weight, and unhusked corn ear weight were measured for 10 randomly selected ears from the middle two rows of corn per plot. Northern corn leaf blight and rust were measured visually over the middle two rows of corn and rated on a 0-5 disease severity scale.

Results were analyzed with an analysis of variance in SAS (Cary, NC). The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was significant ($p < 0.10$).

Table 1.

Table 2. Cabbage plot information, 2015.

Cabbage Information	Borderview Research Farm Alburgh, VT
Variety	Farao
Nutrient requirements	160 lbs ac^{-1}

Variations in yield and quality can occur because of variations in genetics, soil, weather and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real, or whether it might have occurred due to other variations in the field. At the bottom of each table, a LSD value is presented for each variable (i.e.

he difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties.

Table 5. Cabbage harvest quality data, Alburgh, VT, 2015.

Treatment	Uniformity 1= low, 9= high	Tipburn 1= present, 0= absent	Solidity 1= less dense, 9= more dense	Moisture %	Leaf thickness micrometer
1	7.5	0.00	6.0	85.7	219
2	7.5	0.06	6.0	85.5	219
3	7.3	0.00	5.5	85.2	219
p-value	0.87	0.44	0.88	0.59	0.56
LSD (0.10)	NS	NS	NS	NS	NS

NS

Table 8. Sweet corn harvest quality data, continued, Alburgh, VT, 2015.

Treatment	Plant height
	cm

Trial results were likely affected by unseasonal weather conditions. A goal of this research was to trial SN as an early season fertilizer, in cool, spring soils, however, with May experiencing 177 more growing degree days than the historical average, those conditions were not met. June experienced nearly 3 inches more rain than the historical average, while the rest of the season was dry. Heavy rainfall in June likely led to the loss of some N from all treatments but likely more so from the SN that was applied during this month.

Poultry manure was used as the base fertilizer in the SN and blood meal treatments and as the total source of fertility for the control treatment in order to replicate the fertility management strategy many organic vegetable producers use. See Table 10 for overall nutrient information per treatment. It is important to note that using poultry manure may not be the best fertility choice, considering it may provide excess K and P, which may in turn lead to environmental damage. Also, it is important to consider the cost of fertilizers on a price per pound of N basis (Table 11). SN provides the biggest economical advantage as a N source.