Using the Pre-sidedress Soil Nitrate Test in Butternut Squash and Peppers

by

John Howell

Soil organic matter, residues from cover crops and/or previous cash crops and applications of manure or compost provide nitrogen (N) for crop growth. Soil microbes consume soil organic matter as a food source and, as a result, N and other nutrients are released and made available for plant uptake. This process is called mineralization. The amount of N mineralized can be estimated and credited against the total N requirement of the crop to be grown. By crediting these N sources, growers can apply less fertilizer N without sacrificing yield. In some cases yield and/or quality has been improved because the previous combination of fertilizer and other N sources was excessive. By reducing fertilizer N applications there is less risk to water quality and some production costs are reduced.

It has been common for growers to apply a large portion of the required N as a pre-plant broadcast. This provides a large amount of N early in the season when crop uptake is low, which puts the N at risk for leaching unless it is protected by plastic mulch. For most crops N utilization efficiency can be increased and leaching risk reduced by applying only a small amount of starter N at planting and providing the remainder of the required amount during the growing season as a sidedress or topdress application. However, additional N may not be necessary if sufficient amounts are mineralized from organic sources. The Pre-sidedress Soil Nitrate Test (PSNT) can be used to measure the level of nitrate N in the soil. If this level is low, the crop would be expected to respond positively to additional N, and conversely, if this level is high, there would not be a benefit and the crop may be impacted negatively.

A threshold level should exist, above which additional N application would not be expected to increase crop yield. In the Northeast, a number of researchers have established that in sweet corn, 25 ppm nitrate N is an appropriate threshold. Experience on numerous farms in Massachusetts indicates that a higher threshold is appropriate for peppers, tomatoes and butternut squash, but this had not been established by research.

Activities: In 1997, 1998 and 1999 plots were established in pairs in commercial butternut squash fields to test crop response to sidedressed N over a range of nitrate levels as measured by the PSNT. Samples for the PSNT were taken to a depth of six inches shortly before the grower was ready to sidedress or topdress N. In each field one plot received no N and the other received 50 lb N/A. The plots were harvested and the yield of the plot with the N treatment was compared with

the untreated plot.

In 1998, 1999 and 2000, similar experiments were established in commercial pepper fields and at the UMass Research Farm. In 1998, most of the plots which were on one farm were lost, and the remaining plots were not sufficient to accurately analyze the data.

In 1997, soils were sampled to a depth of six inches. This seemed logical because the majority of squash roots would be expected to be in this zone. However, a 12 inch sampling depth is probably more consistent and should be a more reliable tool. This is the standard sampling depth for the PSNT. Sampling in 1998-2000 was to a depth of 12 inches. Therefore the upper six inches should have a higher level of N than the upper 12.

Results and discussion: In butternut squash, in 1997, where PSNT levels were above 60 ppm N, sidedressing with 50 lb N reduced yields. Where N levels were at or below 41 ppm sidedressing generally increased yield. Research in Connecticut showed that pumpkins did not respond positively to sidedressing with N if the PSNT level was above 30 ppm N. The sampling depth in the Connecticut work was 12 inches, which at most times, would be expected to have a lower concentration of N than a six inch sample which was used in our work with butternut squash in 1997. The upper six inches should also be more biologically active than the upper 12 inches. This is a possible explanation for the different threshold which is apparent in this work. Butternut squash and pumpkin have similar requirements of N and it would be expected that PSNT thresholds for these crops would be nearly identical.

In 1998, the PSNT results indicated that nearly all fields with plots had N levels below the anticipated threshold of 35 to 40 ppm. Only one field at 50 ppm was above this. There was a positive yield response to supplemental N applied at 50 lb/A in 61% of the In fields with low N levels. There was a negative response in the remainder of the fields. Statistical analysis of the data indicate no significant correlation between N level and crop response to additional N in 1998. Some growers noted that there was greater than normal variability than normal in squash fields in 1998. This probably accounts for the lack of significant correlation.

In 1999, was a significant correlation between N level and butternut squash response to supplemental N. These results indicate when the nitrate-N level as determined by the PSNT is 30 ppm or higher, butternut squash is not likely to benefit from additional N, and that such an application is likely to reduce yield.

In 1999, there was a highly significant correlation between nitrate-N level and pepper response to supplemental N. As with butternut squash, additional N rusulted in either no increase

or a reduction in yield if nitrate-N level was above 30 ppm. In 2000, N levels were lower than in 1999, probably due to leaching by rain. There was no significant corelation between nitrate-N level and response to supplemental N. This means that variation in pepper yields was not due to N treatments, but to other factors. With the cool, cloudy and wet weather that precominated the season, it is likely that peppers production was limited by those factors and N treatments could not correct for this.

Conclusions: The PSNT is a tool growers can use to optimize N application. This research along with several years of experience indicates that an appropriate threshhold is about 30 ppm nitrate-N. Above this level, sidedressing or topdressing supplemental N would be of no value and will likely decrease yield of butternut squash and peppers. Research in Connecticut has shown similar results in pumpkins. This can save money and time, improve crop yield and reduce the likelihood of N leaching and water contamination.

Experience over several years has shown that, barring unusual weather conditions, PSNT levels in a field tend to be fairly consistent from year to year. Once these values are known for a field, a grower probably does not need to test every year. As a tool, the PSNT should be used along with a grower's experience and knowlege of fields. Interpretation of PSNT results should be made with regard to weather conditions.

I will be happy to work with any growers who want to try using the PSNT. You can contact me at (413)545-5307.