SOIL NITROGEN DYNAMICS FROM VARIOUS LEGUME CROPS USED FOR FERTILIY IN ORGANIC FRUIT PRODUCTION

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ABSTRACT

The increasing cost of importing animal manures for organic fruit orchard fertility has forced growers to seek alternative sources of organic nutrient inputs. The objective of this study was to evaluate the nitrogen (N) dynamics of several on-farm N sources as a viable supply of organic N fertilizer. The timing of N mineralization is also critical to achieving good fruit production. Four year old organic Suncrest peach trees were used for this study. There were five treatments and seven replications. The treatments applied were: 1) alfalfa/grass mix grown in the tree row and alleyway, mowed twice per season and the clippings left in place (this is the grower standard practice and for this study is considered the control), 2) alfalfa/grass mix grown in the tree row and alleyway, chopped twice per season and placed in tree row, 3) alfalfa imported from a neighboring field and place in the tree row at the rate of 2 tons per acre, 4) berseem clover grown in tree row and alleyway and 5) yellow sweet clover grown in tree row and alleyway. Soils were sampled bi-monthly each year for four months beginning in mid-June and analyzed for inorganic N. Soil ammonium-N (NH_4-N) levels remained relatively low throughout the first growing season, typically less than 8 ppm. However, soil nitrate-N (NO_3-N) levels rose from approximately 10 ppm in mid-June to peak in late July or early August in the 45-60 ppm range. A late frost in 2002 precluded yield data the first year.

INTRODUCTION

Organic peach production in Colorado accounts for approximately 20% of the state's peach production (Bosecker and Ament, 2002). Organic fruit production has historically relied heavily on locally available animal manures for fertility inputs. However, a recent study showed that reliance on yearly applications of animal manures can have a detrimental effect on fruit yields and soil salinity (Davis, et al, unpublished data). This fact, and the increasing cost of obtaining animal manures for organic fertility has forced growers to seek alternative sources of nutrient inputs to maintain soil nutrient levels for commercial production. Much work has been done on the N dynamics and mineralization of legumes and animal manure, however, this work has been done predominantly on annual row crops (Pansu and Thuries, 2002; Pansu, et.al. 2003; Tejada, et. al. 2002). Little work has been done on organic N dynamics under perennial crops. This multi-year study was undertaken to evaluate the effectiveness of utilizing on-farm resources for organic fertility and to develop a fertility management program for commercial organic fruit production. There were five treatments and seven replications. The timing of N mineralization and uptake from organic sources is critical to optimizing organic fruit size and production. If the N mineralizes prior to fruit formation there will be an over abundance of foliage produced at the expense of fruit size and production. If the bulk of the N mineralizes late, after early August, the fruit cannot utilize the N for increasing size prior to maturation and harvest. A four year old organic orchard of Suncrest peaches, a mid-season (late August-early September) ripening fresh market peach, was used for this study.

MATERIALS AND METHODS

This study is a randomized complete block design with five treatments and seven replications for a total of 35 plots. Each replication consists of five trees in a row. Tree spacing is 6 ft between trees and 13 ft between rows, for a total of 612 trees per acre. Data is collected on the three interior trees or tree area within each replication. Treatments were applied/begun in the spring of 2002 and include: a) alfalfa/grass cut (twice) and left in the tree row and/or alleyway (A/G Cut) (control), b) alfalfa/grass chopped (twice) and placed in the tree row (A/G Chp), c) alfalfa imported from a neighboring field at the rate of 2 tons per acre and placed in the tree row (A Imp), d) berseem clover grown in the alleyway (Bersclv) and e) yellow sweet clover grown in the alleyway (Ysclv). The alfalfa contains approximately 60 lbs of N, 15 lbs of phosphorus (P), 50 lbs of potassium (K) and 3 lbs of sulfur (S) per ton. Statistical analysis was done using Statistix 7 software package (Analytical Software, 2000). An analysis of variance was performed with least significant difference (LSD) at the 0.05 level, a 95% confidence interval for comparison of means for statistical significance.

Soil samples were taken prior to the initiation of this study in the spring of 2002 for a baseline nutrient and chemical analysis for the study area as a whole. Soil sampling for inorganic N analysis was initiated approximately one month following treatment application on each of the 35 plots. Soil samples were taken approximately every two weeks throughout the growing season. The bi-monthly soil samples were analyzed for (NH_4-N) and (NO_3-N).

RESULTS

Fertilizer Nitrogen - Results of the bi-monthly soil analysis for NH_4-N and NO_3-N for all treatment means are presented in graphical form for each of the different treatments in Figures 1 through 5.

The means for NH_4-N on all treatments remained relatively low, less than 8 ppm, through the whole season. Soil NO_3-N levels, on the other hand, start at approximately 10 ppm or less for all treatments at the first sampling of June 12th and peak on either July 24th or August 7th. The treatments that include alfalfa (A/G Cut, A/G Chp and A Imp) gradually increase from the first sampling until they peak (Fig. 1-3). Whereas, the two clover treatments (Bersclv and Ysclv) remain relatively low until the July 24th sampling (Fig. 4 & 5). Second year inorganic N results will be presented and discussed.

Figure 1. Inorganic N alfalfa/grass cut chopped 2002.

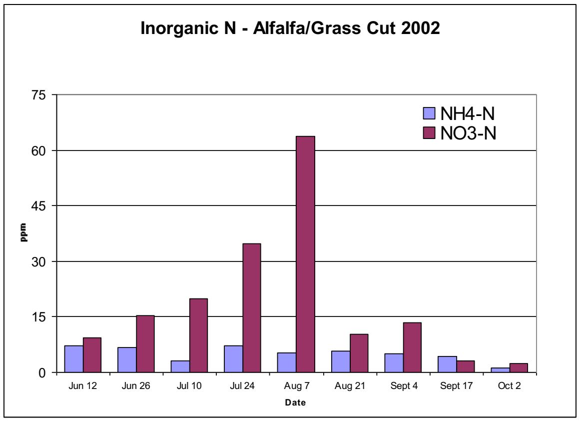


Figure 2. Inorganic N alfalfa/grass 2002.

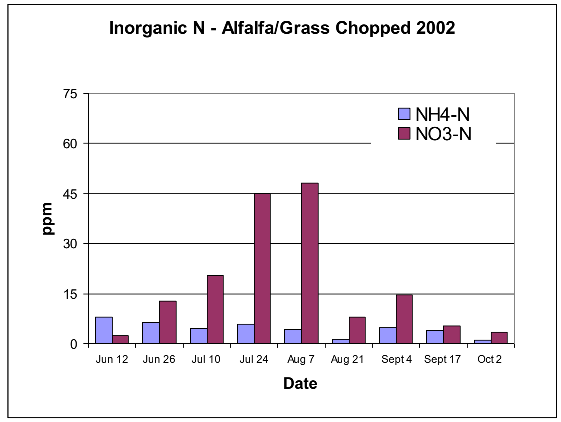


Figure 3. Inorganic N alfalfa imported 2002.

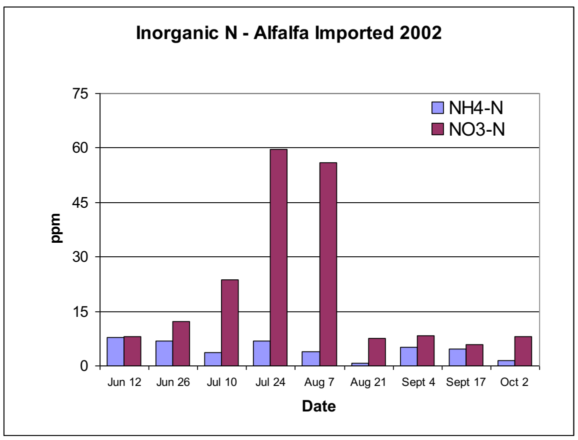


Figure 4. Inorganic N berseem clover 2002.

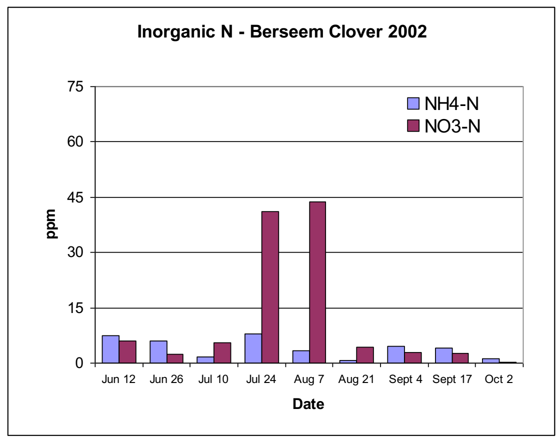
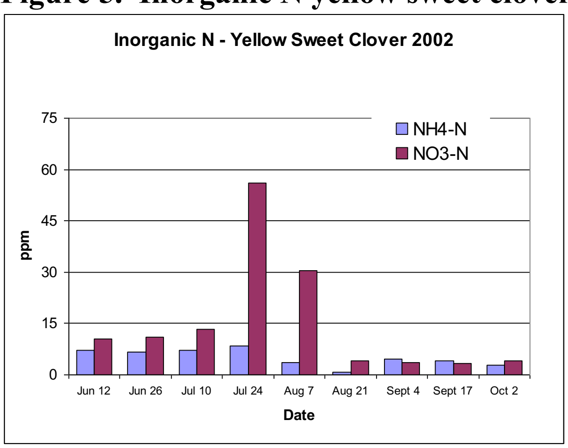


Figure 5. Inorganic N yellow sweet clover 2002.



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