

# **FIELD TESTING LIVESTOCK WASTE TESTING LAB MANURE RECOMMENDATIONS**

Report for year-3, 2006-2007  
To Florida Department Agriculture and Consumer Services

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## **OBJECTIVES**

Current UF/IFAS recommendations for using livestock wastes in crop fertilization have been developed from manure mineralization research in northern states (Klausner et al., 1994; Sims, 1986; Vigil and Kissel, 1991). Further, no mineralization studies dealing with vegetable crops grown with polyethylene mulch could be found in the literature. Recommendations assume 50% of the N is available in the first year from application. Previous field work with mulched vegetables showed very little N remained after one season with mulched cabbage and squash (Hochmuth et al., 1992).

The objectives of this study are to evaluate mineralization rates and patterns with poultry manure with vegetables, such as muskmelon over a three-year period. The focus will be on the use of manure with mulched vegetable crops and to test the current approach to making a fertilizer recommendation based on N, with 50% of the N supplied from the manure. This report is for the third year of research.

## **MATERIALS AND METHODS**

### *Crop Production:*

Muskmelons were grown with recommended production practices, including polyethylene mulch and drip irrigation at the North Florida Research and Education Center-Suwannee Valley (NFREC-SV) near Live Oak, Florida in the Spring season of 2006. The soil was a Lakeland fine sand. The soil for the experimental area was plowed and disked in preparation for manure application.

*Poultry manure and fertilizer treatments:*

On 20 March, 2006, broiler poultry manure, with litter, was applied to plots and incorporated with a rototiller. The manure contained 52, 68, and 46 lbs per ton of N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O, respectively, based on the analyses from the University of Florida IFAS Livestock Waste Testing Laboratory at NFREC-SV. Fertilizer recommendations for muskmelon on this site were 150, 0, 150 lbs/acre N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O, respectively. The experimental treatments are presented in Table 1. The treatments containing manure were nitrogen-based.

Table 1. Fertilizer treatments (rate based on N) used in poultry manure mineralization study at NFREC-SV, Spring, 2006.

| Treatment | Percentage of N from |         | Manure<br>T/A | From manure lbs/A |                               |                  |
|-----------|----------------------|---------|---------------|-------------------|-------------------------------|------------------|
|           | Manure               | Soluble |               | N                 | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |
| 1         | 0                    | 100     | 0             | 0                 | 0                             | 0                |
| 2         | 25                   | 75      | 0.73          | 38                | 50                            | 34               |
| 3         | 50                   | 50      | 1.44          | 75                | 98                            | 66               |
| 4         | 75                   | 25      | 1.92          | 100               | 130                           | 88               |
| 5         | 100                  | 0       | 2.88          | 150               | 196                           | 132              |
| 6         | 125                  | 0       | 3.61          | 188               | 245                           | 166              |
| 7         | 0                    | 0       | 0             | 0                 | 0                             | 0                |

Potassium-magnesium sulfate was used to equilibrate the amounts of K applied (150 lbs/A K<sub>2</sub>O) and ammonium nitrate was used to supply the soluble N. Since the soil tested high in P (Mehlich-1 extractant), no P fertilizer was applied, except that supplied from the manure.

Manure and soluble fertilizers were applied by hand to the plots and were rototilled into the soil, followed by fumigation with methyl bromide and mulching with black polyethylene mulch. Drip irrigation tape was placed 1 inch deep in the center of the row before the mulch was applied. The plots were 32 feet in length and the bed centers were spaced 5 feet apart. Automatic recording soil temperature data loggers were placed 4 inches deep in the soil under the mulch and 4 inches from the center of the bed on the opposite side of the plant row from the drip tube. Muskmelon transplants 'Athena' were planted 4 April, 2006, two weeks after mulching. Irrigation water was applied by drip irrigation to maintain the soil moisture in the soil 6 inches deep in the bed at -8 to -12 cb. Insect pests and diseases were controlled in the season with recommended pest control practices.

#### *Soil Sample collection:*

Poultry litter treatments were applied as per the experimental field layout on March 20, 2006. Prior to land application, two consolidated samples of poultry litter were obtained for further analyses of total C and Total N contents of the litter. The manure contained 52, 68, and 46 lbs per ton of N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O, respectively, based on the analyses from the University of Florida IFAS Livestock Waste Testing Laboratory at NFREC-SV.

A PVC cylinder of 30cm length and 5.08 cm i.d., with the bottom end open to the surrounding soil and the top covered with a plastic flat cap, was driven (with a rubber mallet) vertically into each of the 28 plots, for enabling soil sampling, @ one cylinder per each of the weekly sampling (8) events. A total of 7 additional cylinders in each of the treatment were installed for the 7 samples collected during the first set of daily sampling, prior to planting. Two holes drilled into the sides of each soil sampling cylinder to ensure continuous contact with the surrounding soil.

A total of 7 soil samples from the surface 0-6 inch (0-15cm) depths were collected on days 1, 2, 3, 6, 7, 8, 9 immediately following the treatment application, one each from all the seven treatments.

After the first set of sampling, cylinders (soil samples) were collected one each from each of the 28 plots at approximately 8 weekly intervals, with the last (8<sup>th</sup>) sampling coinciding with the final harvest of melons on June 12<sup>th</sup>, 2006.

#### *Soil Analyses:*

All the soil samples collected were analyzed at the UF/IFAS ARL for Total Kjeldahl Nitrogen (TKN), Ammonium (NH<sub>4</sub>-N) and Nitrate (NO<sub>3</sub>-N) concentrations using standard procedures for digestion and/or colorimetric analyses, to provide the amounts of mineralized nitrogen pools in the soils corresponding to the TKN pool.

#### *Fruit harvesting:*

Fruits were harvested 6 times beginning on 2 June and ending on 12 June. Fruits were harvested when the background color of the fruit began to turn yellow and the fruits were graded into marketable (no defects and weighing >3.0 lbs) and unmarketable (too small or with defects) categories and weighed.

#### *Experimental design:*

The experiment consisted of 7 treatments and 4 replicates in a randomized complete-block design. Yield data were analyzed with analysis of variance and treatment means were separated by LSD 0.05.

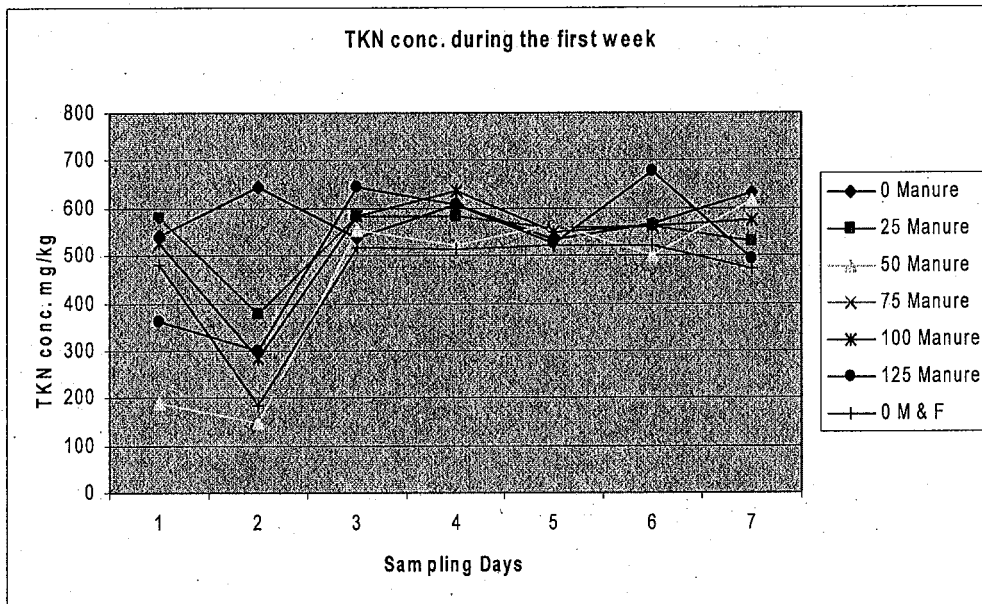
## RESULTS and DISCUSSION

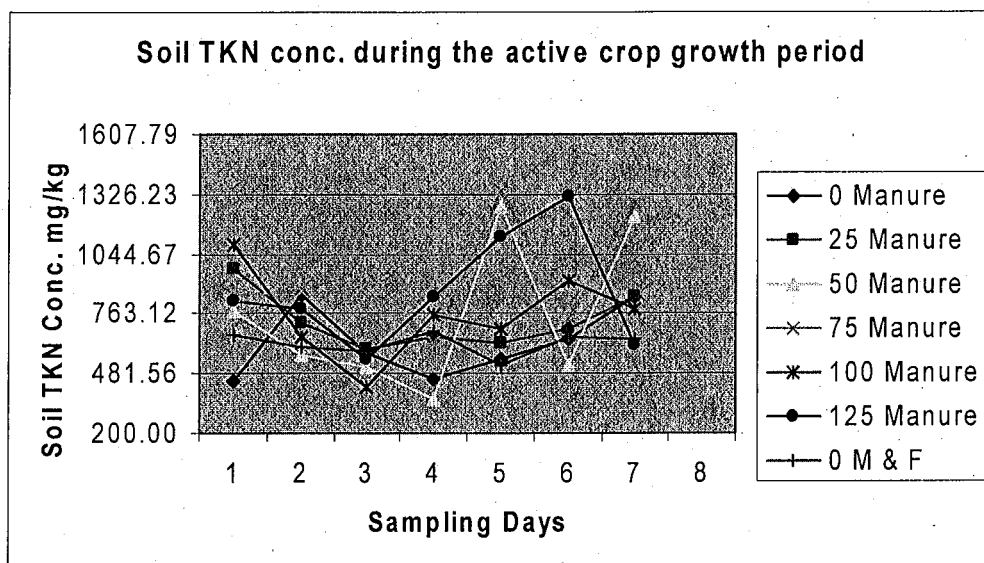
### *Soil and manure mineralization results:*

#### Soil N concentrations - Results - Study Year 3 - Spring 2006

Soil samples were collected immediately after poultry litter application from all the treatments every day during the first week and then once a week for the next 8 weeks. The soil samples were analyzed for nitrate, ammonium and Total Kjeldhal Nitrogen.

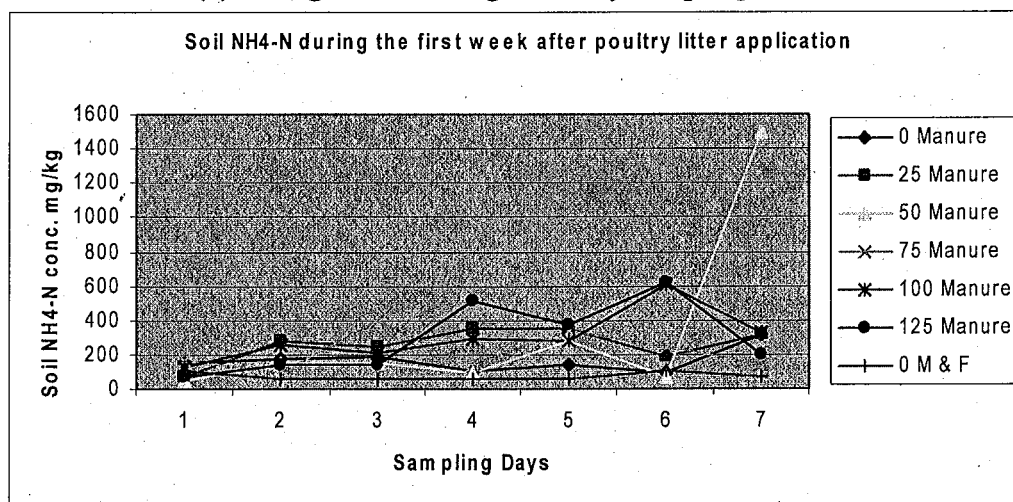
Figs.1 a & b. Total Kjeldhal Nitrogen in soil samples collected (a) during the first week after treatments and (b) during the following 8 weekly samplings.

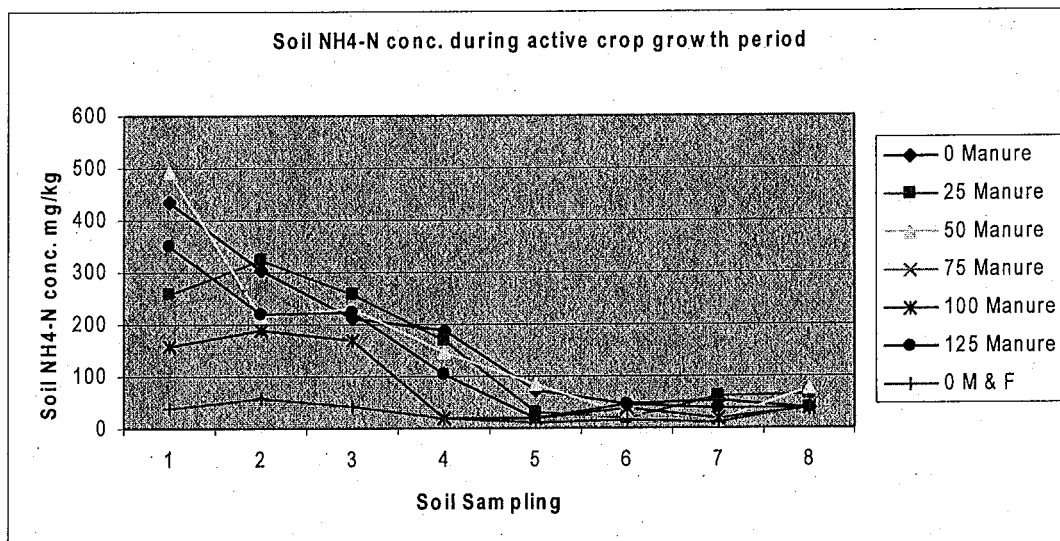




Treatment that received a 50:50 combination of manure and fertilizer had the lowest TKN concentration immediately after application of the treatments but increased significantly in 7 days showing potential for mineralization and supply during the active crop growth. The treatments that received manure applications have shown higher TKN levels throughout the 8 weeks of active crop growth phase leaving complete fertilizer and control treatments with the lowest potentially mineralizable nitrogen.

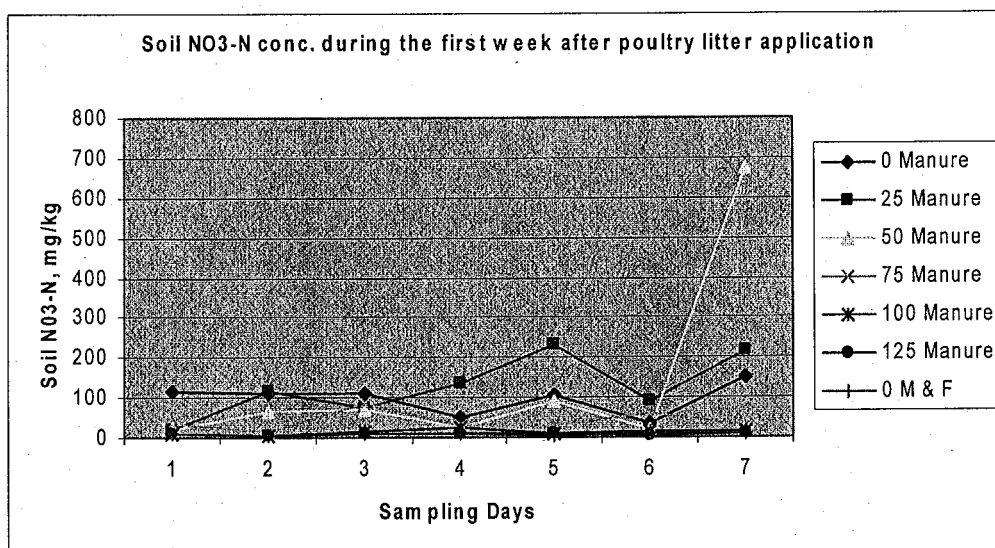
Figs 2. a & b. Soil ammonium in samples collected (a) during the first week after treatments and (b) during the following 8 weekly samplings.

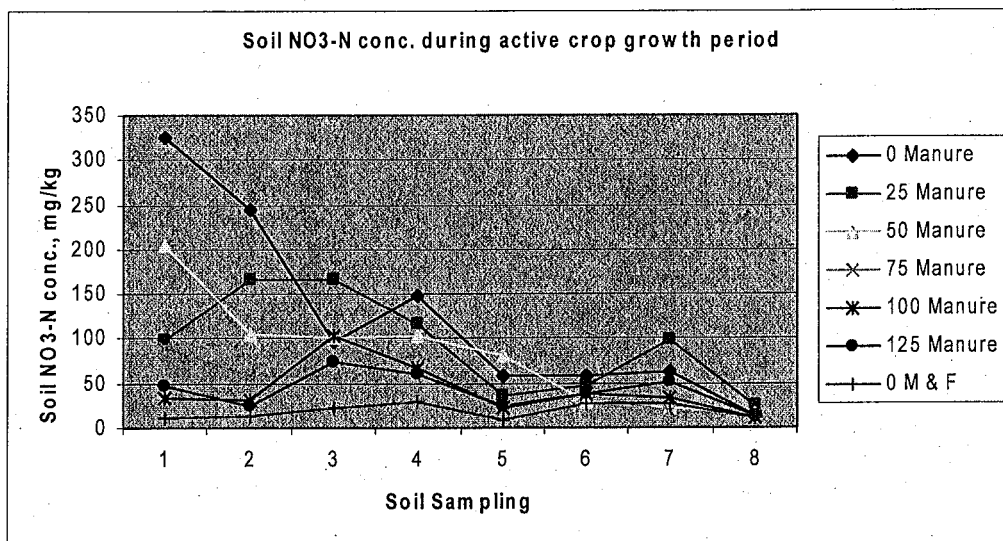




In treatments that did not receive any manure, obviously soil ammonium concentrations were lowest during the first week after treatment application. Overall soil ammonium gradually declined during the active crop growth phase which indicated mineralization of organic nitrogen at the same rate and that the available pool of organic nitrogen reduced. This further indicated that the rate of mineralization over the 8 week active crop growth period possibly coincided with the crop N requirement and uptake.

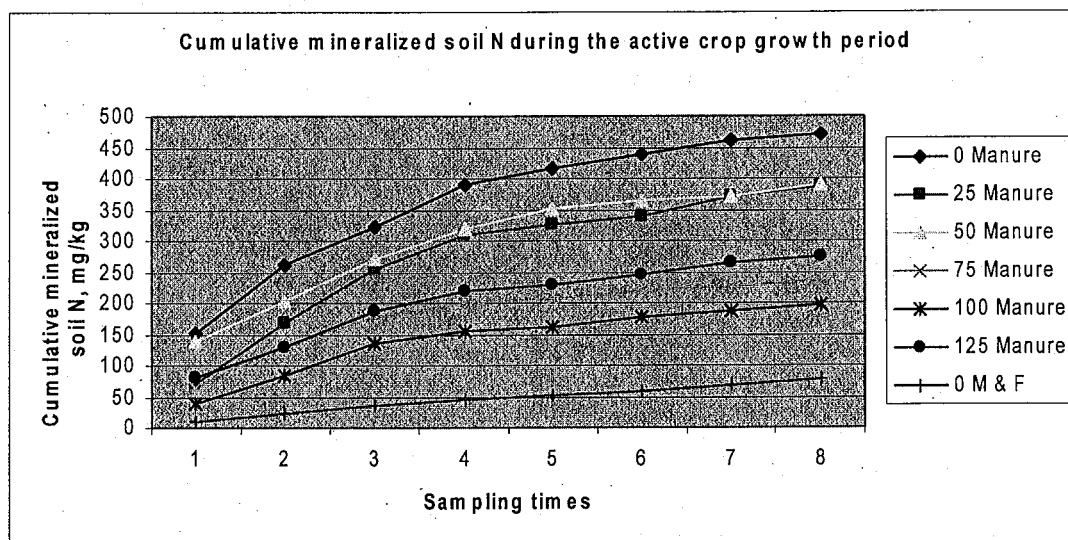
Figs 3. a & b. Soil nitrate concentrations in samples collected (a) during the first week after treatments and (b) during the following 8 weekly samplings.





Applied soluble fertilizer has the most influence on soil nitrate levels since no mineralization step is involved; however at times higher rates of mineralization can result in higher soil nitrate concentrations even in manure-amended soils. The treatment that received a 50:50 combination of manure and fertilizer showed soil nitrate concentrations above or around 100 mg/kg up to 4 weeks in the active growth stage and then gradually reduced to 18 mg/kg during the subsequent 4 weeks until harvest.

Fig. 4. Cumulative mineralized soil nitrogen during the 8 weeks of active crop growth period.



Cumulative mineralized soil nitrogen levels showed highest concentrations in treatments that received nitrogen entirely from soluble fertilizer as expected. The next higher concentrations were found in treatment that received a 50:50 fertilizer to manure combination. Higher rates of manure applications at 125%, 100% and 75% in fact suppressed the rates of mineralization as a result of longer time requirement for adjusting of C:N ratio to <20 naturally. A combination of relatively slow release manure nitrogen with highly soluble source effectively provides the optimum nitrogen requirement to the crop during the active growth period. Such a gradual release of mineralized nitrogen also results in minimized risk of leaching losses. This agrees directly with the current recommendations of the IFAS Livestock Waste Testing Laboratory, promoting the use of organic nitrogen sources such as manure.

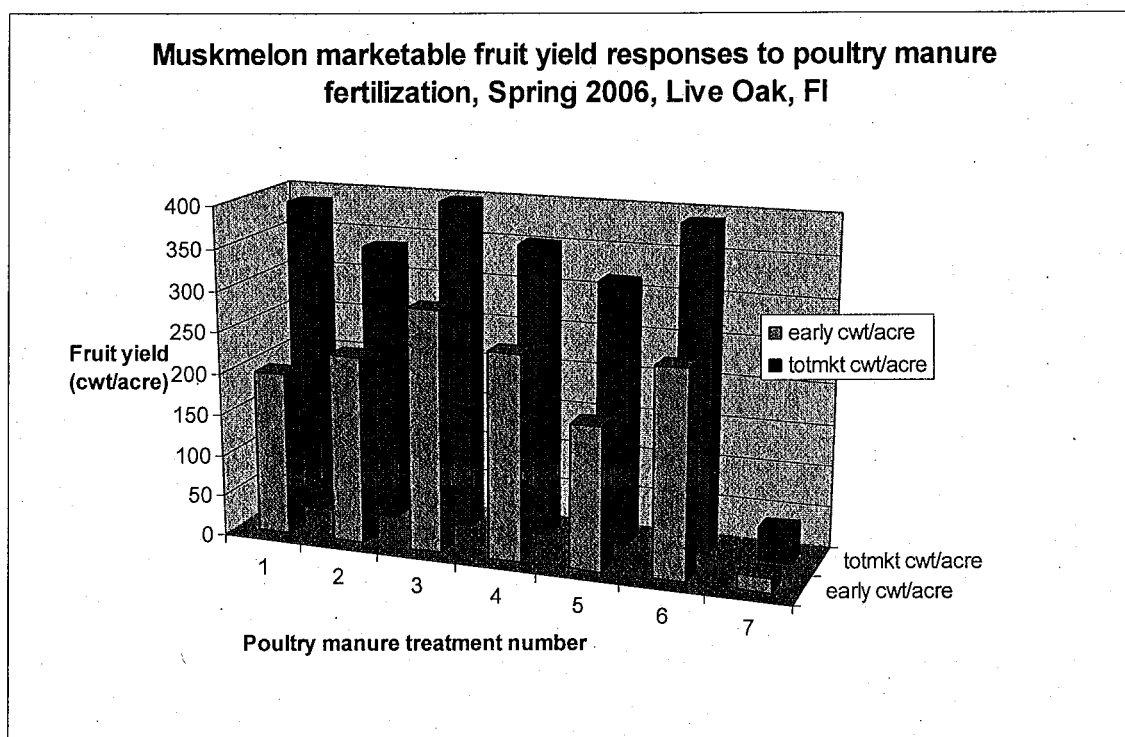
#### CROP YIELD RESPONSES:

Muskmelon yield was affected by fertilizer treatment (Figure 5). Early (first 2 harvests) and total-season (6 harvests) fruit yields with any fertilizer treatment were greater than yield with zero N. There were no differences in yield among muskmelons receiving any combination of manure/soluble fertilizer. Yields were typical of commercial muskmelon production in Florida. The results show that the current approach to making manure fertilizer recommendations with 50% of the N from manure is on target, but that muskmelon will grow equally well with anywhere from 25 to 100 % of the N supplied from manure, as long as the recommended amount of N is supplied during the season. Fertilizer recommendations supplying the lower portion of N from manure could be used where there is little need for P and the recommendations with the greater portion of manure in the total fertilizer recommendation could be used where P is needed or where the recommendation is largely N-based.

#### *Project summary:*

Cumulative N patterns as shown in Fig 4, coupled with the fruit yield response results, prove that plant N requirement is adequately met through a 50:50 combination of poultry litter and inorganic fertilizer, directly supporting the IFAS LWTL recommendations, one of the primary objectives of this study.

Figure 5. Muskmelon marketable fruit yield responses to poultry manure fertilization, Spring 2006, Live Oak, FL.



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