# NEW FERTILIZERS OFFER OPTIONS FOR GROWERS

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Onions are generally considered heavy feeders especially if you include the fertilizer requirements for producing the transplants. In addition, they are a long season crop with transplanting beginning the end of November and harvest beginning in April. This long season gives growers many options in their fertility program both in respect to the materials they use and application timing. For example, several years ago Meister (Helena Chemical Co., Collierville, TN), a slow release fertilizer, was introduced to onion growers as a single application product. This worked well in most years, however, during years of heavy rainfall with high leaching potential many growers found they had to apply additional fertilizer.

Most growers still use a formulaic approach with various materials applied in 5-6 applications. Soil test recommendations have been updated to reflect more accurately what the crop needs, which has been a reduction in P and K recommendations. Additionally, research has shown that as few as three applications are sufficient to produce a good quality crop.

Recently several slow release fertilizers have been introduced to the Vidalia onion growing region and we have been evaluating them over the last couple of years. These experiments were to evaluate the effectiveness of these materials as well as other input options and rates in production of short-day onions in southeast Georgia.

## Methods

In the 2004-2005 season there were 24 treatments in the experiment and in the 2005-2006 there were 12 treatments (Tables 1 and 2). In both seasons the experimental unit or plot was four rows of onions planted on a bed prepared 6-ft on-centers with 12 in. between-row and 5.5 in. in-row spacing. There was a 5 ft. in-row alley between each plot. Each plot was 20 ft. long and the experiment was arranged in a randomized complete block design with four replications. The variety used each season was ‘Sweet Vidalia’. In the 2004-2005 season plants were transplanted on 18 Nov. 2004 and in the 2005-2006 on 29 Nov. 2005. Plants were harvested on 20 May 2005 in the 2004-2005 season and on 26 April 2006 in the 2005-2006 season. Leaf tissue samples were collected on 28 Feb 2005 from a selection of treatments in the 2004-2005 season and on 20 March 2006 from the 2005-2006 experiment.

In 2004-2005 there were nine N treatments from 0-300 lbs/acre as well as a standard formulaic treatment (treatment 10) many growers use. In addition, we evaluated Humate (JTS Natural Products, Marietta, GA), a granular, mined, organic mineral applied in two treatments with and without fertilizer. This product was applied at a rate of 150 lbs/1000 sq. ft. The treatment with fertilizer also received N, P, K, and S.

TurfPro (Organic Products, Claxton, GA) was a humic acid material applied at a rate of 20 gal/acre in a single application on the first application date. The treatment with fertilizer was applied as described for the Humate product.

The Agrotain fertilizer treatments in the first case consisted of regular 10-10-10 fertilizer with 12% sulfur applied at a rate of 500 lbs/acre on the first application date (Treatment 15, Table 1). This was followed by their slow release granular 10-10-10 (J-MAXX 10-10-10, Agrotain Inter. LLC, St. Louis, MO) applied at a rate of 400 lbs/acre on the second application date. Finally, on the third application date their slow release 47-0-0 fertilizer was applied at 100 lbs/acre. The second Agrotain treatment consisted of their 10-10-10 product applied on the first and second application dates at 400 lbs/acre rate, followed by 47-0-0 at 100 lbs/acre (Treatment 24, Table 1).

Nitamin is the trade name for a slow release 30-0-0 liquid fertilizer from Georgia Pacific (Atlanta, Ga.). Nitamin was applied at 100% of the recommended rate of N of 150 lbs/acre as a single application on the first application date. In addition, a treatment of 100% of the N rate of Nitamin was split-applied on the first and third application dates. Similarly, two Nitamin applications were applied at 70% of the recommended N rate (105 lbs/acre N), one treatment as a single application on the first application date and the other treatment with a split-application on the first and third application dates.

A processed poultry litter product (Perdue AgriRecycle, Horsham, PA) with a 4-2-3 formulation was also a treatment. It was split-applied at a rate of 150 lbs/acre N on the dates indicated (Table 1). No other fertilizer (P, K, or S) was applied to this treatment.

The next treatment consisted on 150 lbs/acre N split-applied as $Ca(NO_3)_2$. In addition, S was applied to this treatment, but there was no P or K fertilizer applied.

The Next two treatments consisted of 10-10-10 with 12% S split-applied either in 3 applications or on the first and third application dates.

The 12 treatments in the 2005-2006 season evaluated Nitamin 30L and Nitamin 24% Granular (Georgia-Pacific, Atlanta, GA) at 100% and 70% of the recommended N rate. JMAXX (Agrotain Inter. LLC, St. Louis, MO) was evaluated as part of a formulaic approach that would be familiar to most growers. Nature Safe 9-0-9 (Cold Spring, KY) is an organic fertilizer made from animal by-products that would be suitable for certified organic production (Table 2).

In addition, a formulaic fertilization program was included (Treatment 9, Table 2) as well as a treatment that used a premium grade 10-10-10 that includes 12% S (Treatment 10, Table 2). Finally a treatment was included with 200 lbs/A N.

Results and Conclusions

In the 2004-2005 season, field or total yield ranged from 170 to 1289 50-lb bags/acre (Table 3). The highest yielding treatment was number 22, which applied 150 N/acre in 3 applications of 10-10-10 with 12% S. This treatment did not differ from the next top 7 yielding entries. All of these entries received at least 150 lbs/acre N.

The 3 lowest yielding entries received no N fertilizer. Products such as the TurfPro and Humate performed poorly in this test without the addition of N fertilizer. These humic acid derivative products have never performed well in onion production. The manufacturers of these products have touted their benefits and promoted them for use on turf or pasture where performance would be difficult to objectively assess.

The 4-2-3 pelleted poultry litter did not perform as well as might be expected. It was applied at the 150 lbs/acre N rate, but the actual formulation may be less than the listed 4% N by the time it is used. This product had a strong ammonia odor indicating that N is being lost. In addition, since this is an organic product the N would be in more complex molecules and would have to undergo some mineralization before the N would be in a useable form.

The Nitamin and JMAXX products are relatively new products that offer an alternative for onion fertilization. Both of these products are slow release fertilizer products that give growers the opportunity to reduce the number of fertilizer applications to their crops. In addition, both products are water soluble so they can be tank mixed with other chemicals or injected into irrigation systems. Nitamin is a methylated urea product that is manufactured with various length methyl groups attached to urea. Depending on the length of the methyl chain determines the release characteristics of the N. Plant available N is due to microorganisms in the soil and is therefore temperature dependent. Agrotain's JMAXX product is also a urea product but has urease inhibitors mixed in to prevent product loss due to volatilition and gives it slow release characteristics. This product is not temperature dependent in its release characteristics and according to the manufacturer its performance should be similar regardless of temperature.

Jumbo yields in the 2005-2006 season were a third to a half of the total yield primarily due to late season bacterial diseases putatively identified as sour skin and slippery skin. Late varieties are particularly affected by this problem, but in this case we had gotten behind and these onions were not harvested in a timely fashion consequently there was a greater amount of culls then would be expected. 'Sweet Vidalia' is a mid-season variety in southeast Georgia and would not be expected to suffer greatly from these bacterial diseases if harvested in a timely manner.

Tissue analysis in 2004-2005 among the selected varieties showed tissue N for the 0 lbs/acre N rate significantly lower than all the treatments except treatments 10 and 18 (Table 4). In 2004-2005, the standard had significantly higher leaf tissue P compared to treatments 5, 7, or 8 which had P at rates of 40 lbs/acre compared to the standard (treatment 10) with 157 lbs/acre P. Leaf tissue K ranged from 3.37 to 6.12% with the highest amount with the standard treatment, which had 132 lbs/acre K significantly greater than treatment 1 with 90 lbs/acre K. Leaf tissue Ca was greatest with 300 lbs/acre N (Treatment 9), which did not differ from treatments 6, 7, 8, or 10 all of which had significant quantities of $Ca(NO_3)_2$ applied. Finally the highest leaf tissue S was with the standard treatment, which was greater than treatments 1, 2, 5, and 18 all of which had lower applications of N fertilizer, but the same amount of S applied.

In the 2005-2006 season the greatest total yield was for treatment 12 with 200 lbs/acre N, which was significantly greater than treatment 11, Nature Safe 9-0-9, treatments 6 and 7 Nitamin 24% granular, and treatments 1 and 2 with Nitamin 30L (Table 5). The highest jumbo yield was with treatment 3 (Nitamin 30L + $Ca(NO_3)_2$), which was significantly greater than any of the Nitamin 24% treatments or Nitamin 30L treatments. In addition, treatment 3 was better than the JMAXX or Nature Safe programs for jumbo yields. The percent marketable (jumbo+mediums/total) yields ranged from 56 to 84% with an average of 72% with 9 of the 12 treatments having marketable yields above 70%.

There was no difference for leaf tissue P, K, Ca, or Mg (data not shown). There were differences, however, for N and S. The highest leaf tissue N was with treatment 9, which was significantly greater than treatments 4, 6, 7, 8, and 11. None of the treatments had leaf tissue N below the sufficiency range of 2.0-3.0% (Maynard and Hochmuth, 1997). Leaf tissue S ranged from 0.47 to 0.77% with treatment 12 (200 lbs/acre N) having the highest leaf tissue S, which was significantly greater than treatments 4, 7, 8, 9, and 11. None of the leaf tissue samples were below the recommended range of 0.2-0.6% for S (Maynard and Hochmuth, 1997).

In conclusion, both Nitamin and JMAXX are viable fertilizer products that could be incorporated into an onion fertility program. They do perform well alone or in combination with other fertilizers. They are water soluble giving growers alternative methods of application either through irrigation equipment or as tank mixes. Although Nitamin is a slow release product it cannot be used in a single application. A minimum of two applications is required. Finally, growers should use these products on a limited basis until they feel comfortable with the results. Humic acid based products did not do well in these experiments and mirror past experiments with similar products where their performance was marginal at best. Organic fertilizer can be used in organic onion production, but growers should not expect the products to perform as conventional fertilizers based on the listed formulations. We are telling growers they should use such products at a rate at least 50% greater than what the package formulation would indicate to get comparable performance to conventional fertilizers. These products, because they are organic, do not have nutrients in plant available form when first applied.

## Citations

Maynard, D.N. and G.J. Hochmuth. 1997. Knott's Handbook for Vegetable Growers. J. Wiley & Sons Inc., New York.

**Table 1. Treatment list for fertility experiment, 2004-2005 season.**

| No. | Treatments | Material Applied | Application (lbs/acre N-P-K-S | Date |
|---|---|---|---|---|
| 1 | 0 N | | 0-40-90-60 | |
| | | 0-46-0, 0-0-60, $CaSO_4$ | 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | 0-0-60, $CaSO_4$ | 30 lbs K, 30 lbs S | 1/12/05 |
| | | 0-0-60 | 30 lbs K | 2/16/05 |
| 2 | 25 N | | 25-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 8.3 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 8.3 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 8.3 N, 30 lbs K | 2/16/05 |
| 3 | 50 N | | 50-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 16.7 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 16.7 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 16.7 N, 30 lbs K | 2/16/05 |
| 4 | 75 N | | 75-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 25 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 25 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 25 N, 30 lbs K | 2/16/05 |
| 5 | 100 N | | 100-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 33.3 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 33.3 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 33.3 N, 30 lbs K | 2/16/05 |
| 6 | 125 N | | 125-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 41.7 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 41.7 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 41.7 N, 30 lbs K | 2/16/05 |

| | | | | |
|---|---|---|---|---|
| 7 | 150 N | | 150-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 50 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 50 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 50 N, 30 lbs K | 2/16/05 |
| 8 | 200 N | | 200-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 66.7 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 66.7 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 66.7 N, 30 lbs K | 2/16/05 |
| 9 | 300 N | | 300-40-90-60 | |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 100 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 100 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 100 N, 30 lbs K | 2/16/05 |
| 10 | Standard | | 133-157-132-52 | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400 lbs/A) | 11/24/04 |
| | | 18-46-0 (DAP) | 27N-69P (150 lbs/A) | |
| | | 400 lbs 6-12-18 4% sulfur | 24N-48P-72K-16S | 1/12/05 |
| | | 400 lbs $Ca(NO_3)_2$ | 62N | 2/16/05 |
| 11 | Humate (150 lbs/1000 sq ft) without fertilizer | | Negligible | |
| | | Humate | 150 lbs/A | 11/24/04 |
| 12 | Humate (150 lbs/1000 sq ft) with fertilizer | | 150-40-90-60 | |
| | | Humate | 150 lbs/A | 11/24/04 |
| | | $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 50 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | Ca(NO3)2, 0-0-60, $CaSO_4$ | 50 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | Ca(NO3)2, 0-0-60 | 50 N, 30 lbs K | 2/16/05 |
| 13 | TurfPro Liquid w/o fertilizer | | Negligible | |

| | | | | |
|---|---|---|---|---|
| | | TurfPro | 20 gal/A | 11/24/04 |
| 14 | TurfPro Liquid with fertilizer | | 150-40-90-60 | |
| | | TurfPro, $Ca(NO_3)_2$, 0-46-0, 0-0-60, $CaSO_4$ | 20 gal/A, 50 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, 0-0-60, $CaSO_4$ | 50 N, 30 lbs K, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$, 0-0-60 | 50 N, 30 lbs K | 2/16/05 |
| 15 | Agrotain Fertilizer (10-10-10, J-MAXX 10-10-10 and 47-0-0) | | 137-90-90-60 | |
| | | 10-10-10 (12% S) | 50N-50P-50K-60S (500 lbs/A) | 11/24/04 |
| | | J-MAXX 10-10-10 | 40N-40P-40K (400 lbs/A) | 1/12/05 |
| | | 47-0-0 | 47N | 2/16/05 |
| 16 | Nitamin 100 % of standard (150 lbs N) | | 150-40-90-60 | |
| | | Nitamin 30L, 0-46-0, 0-0-60, $CaSO_4$ | 150 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | 0-0-60, $CaSO_4$ | 30 lbs K, 30 lbs S | 1/12/05 |
| | | 0-0-60 | 30 lbs K | 2/16/05 |
| 17 | Nitamin 100% of standard split-application (1st & 3rd) | | 150-40-90-60 | |
| | | Nitamin 30L, 0-46-0, 0-0-60, $CaSO_4$ | 75 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | 0-0-60, $CaSO_4$ | 30 lbs K, 30 lbs S | 1/12/05 |
| | | Nitamin 30L, 0-0-60 | 75 lbs N, 30 lbs K | 2/16/05 |
| 18 | Nitamin 70% of standard (105lbs N) | | 105-40-90-60 | |
| | | Nitamin 30L, 0-46-0, 0-0-60, $CaSO_4$ | 105 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | 0-0-60, $CaSO_4$ | 30 lbs K, 30 lbs S | 1/12/05 |
| | | Nitamin 30L, 0-0-60 | 30 lbs K | 2/16/05 |
| 19 | Nitamin 70% of standard split-application (1st & 3rd) | | 105-40-90-60 | |
| | | Nitamin 30L, 0-46-0, 0-0-60, $CaSO_4$ | 52.5 lbs N, 40 lbs P, 30 lbs K, 30 lbs S | 11/24/04 |
| | | 0-0-60, $CaSO_4$ | 30 lbs K, 30 lbs S | 1/12/05 |

| | | | | |
|---|---|---|---|---|
| | | Nitamin 30L, 0-0-60 | 52.5 lbs N, 30 lbs K | 2/16/05 |
| 20 | 4-2-3 Pelleted Poultry Litter | | 150-75-112.5 | |
| | | 4-2-3 | 50 lbs N, 25 lbs P, 37.5 lbs K | 11/24/04 |
| | | 4-2-3 | 50 lbs N, 25 lbs P, 37.5 lbs K | 1/12/05 |
| | | 4-2-3 | 50 lbs N, 25 lbs P, 37.5 lbs K | 2/16/05 |
| 21 | 150 N no P or K | | 150-0-0-60 | |
| | | $Ca(NO_3)_2$, $CaSO_4$ | 50 lbs N, 30 lbs S | 11/24/04 |
| | | $Ca(NO3)_2$, $CaSO_4$ | 50 N, 30 lbs S | 1/12/05 |
| | | $Ca(NO3)_2$ | 50 N | 2/16/05 |
| 22 | 10-10-10, 3 applications | | 150-150-150-180 | |
| | | 10-10-10 (12% S) | 50N-50P-50K-60S (500 lbs/A) | 11/24/04 |
| | | | 50N-50P-50K-60S (500 lbs/A) | 1/12/05 |
| | | | 50N-50P-50K-60S (500 lbs/A) | 2/16/05 |
| 23 | 10-10-10, 2 applications (1st & 3rd appl.) | | 150-150-150-180 | |
| | | | 75N-75P-75K-90S (750 lbs/A) | 11/24/04 |
| | | | 75N-75P-75K-90S (750 lbs/A) | 2/16/05 |
| 24 | Agrotain Fertilizer (J-MAXX 10-10-10, J-MAXX 47-0-0) | | 127-80-80 | |
| | | 10-10-10 | 40N-40P-40K (400 lbs/A) | 11/24/04 |
| | | 10-10-10 | 40N-40P-40K (400 lbs/A) | 1/12/05 |
| | | 47-0-0 | 47N | 2/16/05 |

**Table 2. Treatment list for fertility experiment, 2005-2006.**

| No. | Treatment | Material Applied | Application (lbs/acre N-P-K-S) | Date |
|---|---|---|---|---|
| 1 | Nitamin 30L program: 150 lbs/acre | | 150N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 30L | 65 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | Nitamin 30L | 65 lbs N | 2/23/06 |
| 2 | Nitamin 30L program: 115 lbs/acre | | 115N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 30L | 47 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | Nitamin 30L | 48 lbs N | 2/23/06 |
| 3 | Nitamin 30L + CaNO3 150 lbs/acre | | 150N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 30L | 40 lbs N | 1/17/06 |
| | | $CaNO_3$ | 25 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | Nitamin 30L | 65 lbs N | 2/23/06 |
| | | $CaNO_3$ | 25 lbs N | 2/23/06 |
| 4 | Nitamin 30L + CaNO3 115 lbs/acre | | 115N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 30L | 29 lbs N | 1/17/06 |
| | | $Ca(NO_3)_2$ | 19 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | Nitamin 30L | 29 lbs N | 2/23/06 |
| | | | 19 lbs N | 2/23/06 |
| 5 | Nitamin 24% N Gran. 150 lbs/acre | | 150N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 24-0-0 | 30 lbs N | 12/7/06 |
| | | Nitamin 24-0-0 | 70 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | $Ca(NO_3)_2$ | 30 lbs N | 2/23/06 |
| 6 | Nitamin 24% N Gran. 115 lbs/acre | | 115N-40P-100K-25S | |

| | | | | |
|---|---|---|---|---|
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 24-0-0 | 30 lbs N | 12/7/06 |
| | | Nitamin 24-0-0 | 40 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | $Ca(NO_3)_2$ | 25 lbs N | 2/23/06 |
| 7 | Nitamin 24% N Gran. 150 lbs/acre | | 150N-40P-100K-25S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | Nitamin 24-0-0 | 100 lbs N | 1/17/06 |
| | | 0-0-60, $CaSO_4$ | 40 lbs K, 25 lbs S | 1/19/06 |
| | | $Ca(NO_3)_2$ | 30 lbs N | 2/23/06 |
| 8 | JMAXX Program | | 126N-88P-132K-36S-78Ca | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | JMAXX 47-0-0 | 35 lbs N | 12/7/05 |
| | | JMAXX 47-0-0 | 47 lbs N | 1/17/06 |
| | | 6-12-18 (4% S) | 24N-48P-72K-16S (400lbs/A) | 1/17/06 |
| | | $CaCl_2$ | 78 lbs Ca | 2/23/06 |
| 9 | 150 lbs/acre | | 150N-157P-132K-52S | |
| | | 5-10-15 (9% S) | 20N-40P-60K-36S (400lbs/A) | 12/7/05 |
| | | DAP (18-46-0) | 27N-69P-0K (150lbs/A) | 12/7/05 |
| | | 6-12-18 (4% S) | 24N-48P-72K-16S (400lbs/A) | 1/17/06 |
| | | $Ca(NO_3)_2$ | 79 lbs N | 2/23/06 |
| 10 | 10-10-10, 150 lbs/acre | | 150N-80P-80K-96S | |
| | | 10-10-10 (12% S) | 40N-40P-40K-48S | 12/7/05 |
| | | 10-10-10 (12% S) | 40N-40P-40K-48S | 1/17/06 |
| | | $Ca(NO_3)_2$ | 70 lbs N | 2/23/06 |
| 11 | Nature Safe (9-0-9) | | 150N-40P-150K-48S | |
| | | 10-10-10 (12% S) | 40N-40P-40K-48S | 12/7/05 |
| | | 9-0-9 | 110N-0P-110K | 1/17/06 |
| 12 | Nitrogen 200 lbs/acre | | 200N-200P-200K-240S | |
| | | 10-10-10 (12% S) | 40N-40P-40K-48S | 12/7/05 |
| | | 10-10-10 (12% S) | 160N-160P-160K-192S | 1/17/06 |

**Table 3. Fertilizer treatments effect on field and graded yields, 2004-2005.**

| | Treatments | Field Yield | Jumbos | Mediums |
|---|---|---|---|---|
| | | (50-lb bags/acre) | | |
| 1 | 0 N | 170 | 14 | 78 |
| 2 | 25 N | 438 | 152 | 101 |
| 3 | 50 N | 688 | 336 | 58 |
| 4 | 75 N | 827 | 425 | 56 |
| 5 | 100 N | 850 | 420 | 53 |
| 6 | 125 N | 899 | 406 | 43 |
| 7 | 150 N | 934 | 529 | 52 |
| 8 | 200 N | 986 | 490 | 24 |
| 9 | 300 N | 1110 | 583 | 27 |
| 10 | Standard | 1092 | 349 | 99 |
| 11 | Humate (150 lbs/1000 sq ft) without fertilizer | 187 | 18 | 93 |
| 12 | Humate (150 lbs/1000 sq ft) with fertilizer | 1058 | 424 | 23 |
| 13 | TurfPro w/o fertilizer | 191 | 33 | 85 |
| 14 | TurfPro with fertilizer | 1061 | 401 | 20 |
| 15 | Agrotain Fertilizer (10-10-10, J-MAXX 47-0-0) | 1090 | 479 | 22 |
| 16 | Nitamin 100 % of standard (150 lbs N) | 688 | 346 | 74 |
| 17 | Nitamin 100% of standard split-application (1st & 3rd) | 971 | 387 | 28 |
| 18 | Nitamin 70% of standard (105lbs N) | 441 | 185 | 106 |
| 19 | Nitamin 70% of standard split-application (1st & 3rd) | 860 | 380 | 37 |
| 20 | 4-2-3 Pelleted Poultry Litter (150 lbs nitrogen) | 808 | 419 | 51 |
| 21 | 150 N no P or K | 988 | 619 | 35 |
| 22 | 10-10-10 12% Sulfur, 3 applications | 1289 | 354 | 19 |
| 23 | 10-10-10 12% Sulfur, 2 applications (1st & 3rd appl.) | 1061 | 313 | 18 |
| 24 | Agrotain Fertilizer (J-MAXX 10-10-10, J-MAXX 47-0-0) | 1230 | 526 | 31 |
| | CV | 15% | 28% | 71% |
| | LSD (p=0.05) | 239 | 187 | 68 |

**Table 4. Tissue analyses for N, P, K, Ca, and S for selected treatments 2004-2005**.

| No. | Treatment | Nitrogen | Phosphorus | Potassium | Calcium | Sulfur |
|---|---|---|---|---|---|---|
| | | | | (%) | | |
| 1 | 0 N | 2.14 | 0.43 | 3.37 | 1.05 | 0.37 |
| 2 | 25 N | 3.57 | 0.38 | 5.11 | 1.11 | 0.54 |
| 3 | 50 N | 3.68 | 0.35 | 5.68 | 1.20 | 0.57 |
| 4 | 75 N | 3.61 | 0.35 | 6.03 | 1.23 | 0.58 |
| 5 | 100 N | 3.55 | 0.33 | 4.54 | 1.07 | 0.52 |
| 6 | 125 N | 4.06 | 0.39 | 6.10 | 1.51 | 0.68 |
| 7 | 150 N | 3.95 | 0.33 | 5.79 | 1.41 | 0.65 |
| 8 | 200 N | 3.79 | 0.34 | 5.62 | 1.49 | 0.64 |
| 9 | 300 N | 3.91 | 0.37 | 5.82 | 1.72 | 0.72 |
| 10 | Standard | 3.23 | 0.49 | 6.12 | 1.32 | 0.83 |
| 16 | Nitamin 100 % of standard (150 lbs N) | 3.48 | 0.41 | 5.63 | 1.19 | 0.73 |
| 17 | Nitamin 100% of standard split-application (1st & 3rd) | 3.67 | 0.38 | 5.40 | 1.24 | 0.64 |
| 18 | Nitamin 70% of standard (105lbs N) | 2.82 | 0.44 | 5.01 | 1.05 | 0.53 |
| 19 | Nitamin 70% of standard split-application (1st & 3rd) | 3.92 | 0.41 | 5.11 | 1.28 | 0.61 |
| | CV | 17% | 20% | 18% | 17% | 22% |
| | LSD (p=0.05) | 1.18 | 0.14 | 1.87 | 0.43 | 0.26 |

**Table 5. Treatment effects on yield, and leaf tissue analyses, 2005-2006.**

| No. | Treatment | (50-lb bags/acre) Total Yield | Jumbos | Mediums | Marketable (%) | (%) Nitrogen | Sulfur |
|---|---|---|---|---|---|---|---|
| 1 | Nitamin 30L, 150 lbs/acre | 1053 | 804 | 11 | 77% | 2.92 | 0.72 |
| 2 | Nitamin 30L, 115 lbs/acre | 1053 | 789 | 10 | 76% | 2.69 | 0.64 |
| 3 | Nitamin 30L + $Ca(NO_3)_2$, 150 lbs/acre | 1109 | 926 | 6 | 84% | 2.93 | 0.73 |
| 4 | Nitamin 30L + $Ca(NO_3)_2$, 115 lbs/acre | 1124 | 797 | 12 | 72% | 2.50 | 0.61 |
| 5 | Nitamin 24% N Gran., 150 lbs/acre | 1124 | 620 | 8 | 56% | 2.76 | 0.74 |
| 6 | Nitamin 24% N Gran., 115 lbs/acre | 878 | 602 | 17 | 71% | 2.51 | 0.63 |
| 7 | Nitamin 24% N Gran., 150 lbs/acre, 1 appl. | 1065 | 720 | 7 | 68% | 2.48 | 0.62 |
| 8 | JMAXX Program | 1123 | 774 | 13 | 70% | 2.59 | 0.59 |
| 9 | 150 lbs/acre | 1184 | 849 | 7 | 72% | 3.03 | 0.58 |
| 10 | 10-10-10, 150 lbs/acre | 1187 | 883 | 7 | 75% | 2.99 | 0.77 |
| 11 | Nature Safe (9-0-9) | 810 | 542 | 21 | 69% | 2.06 | 0.47 |
| 12 | Nitrogen 200 lbs/acre | 1200 | 924 | 5 | 77% | 2.84 | 0.77 |
| | CV | 6% | 11% | 64% | | 9% | 15% |
| | Fisher's Protected LSD (p=0.05) | 96 | 116 | 9 | | 0.34 | 0.14 |