Efficiency of applied N for crops grown on sandy soils under high rainfall or irrigated conditions is low. Crop responses to reduction of N leaching or other means, have been dramatic. Because of its cationic nature and retention by soil colloids, N\textsubscript{H}_4-N may be more efficient than N\textsubscript{03}-N on soils subject to leaching losses. Arrival of K\textsubscript{2}SO\textsubscript{4} in the soil can be further reduced through the stabilization of N in the soil with muriate of potash (50% K), and micro nutrient frit (FTE 503, and 1.12 kg/ha, during 2 seasons. During a wet 1976 summer season, total yield was 65% higher with N applied as (NH\textsubscript{4})\textsubscript{2}SO\textsubscript{4} than as Ca(NO\textsubscript{3})\textsubscript{2}. Total yield increased linearly from 6.1 to 9.8 MT/ha with an increase in N rate from 56 to 224 kg/ha as (NH\textsubscript{4})\textsubscript{2}SO\textsubscript{4}. With Ca(NO\textsubscript{3})\textsubscript{2}, total yield averaged 4.9 MT/ha and was not influenced by N rate. During the drier 1977 spring season, marketable yield was not influenced by N source. Total yield increased linearly from 9.1 to 14.6 MT/ha with an increase in N rate. In the wetter season, the application of N in split rather than single applications as Ca(NO\textsubscript{3})\textsubscript{2} increased yield. During the dry season, timing of N application had no effect on yield with either N source. The suppressing action of NH\textsubscript{4}-N absorption on the absorption of other cations was evident but was not consistent throughout the study. The application of (NH\textsubscript{4})\textsubscript{2}SO\textsubscript{4} as compared to Ca(NO\textsubscript{3})\textsubscript{2} resulted in higher plant dry weights at an early sampling stage in the wet season but not during the dry season. Higher soil N (NH\textsubscript{4}-N + NO\textsubscript{3}-N) levels were maintained above a 20-cm soil depth with (NH\textsubscript{4})\textsubscript{2}SO\textsubscript{4} than with Ca(NO\textsubscript{3})\textsubscript{2} during the wet season.

Materials and Methods

Field experiments were conducted near Gainesville on a Kanapaha fine sand (loamy, siliceous hyperthermic G Paleaquult) during the summer of 1976 and the spring of 1977. The soil areas were not cropped during the previous seasons and had an initial pH of 5.5. 1.0% organic matter, 2.0 meq/100g CEC, and were low in double acid extractable K (17 ppm) and high in P (51 ppm). The soil pH was 6.5 after the application of dolomitic limestone at 2.2 MT/ha. A 3 x 3 x 2 factorial in a randomized complete block design with 4 replicates was used with (NH\textsubscript{4})\textsubscript{2}SO\textsubscript{4} as the N source during both seasons. Factors were three N rates (56, 112, and 224 kg/ha); 3 nitrification inhibitor rates (0, 0.56, and 1.12 kg/ha); and 2 application times (100% preplant, and 50% preplant with 50% sidedressed). In a second and adjacent experiment, the same factors were used with Ca(NO\textsubscript{3})\textsubscript{2} as the N source with the exception that 2 nitrapyrin rates, 0 and 1.12 kg/ha, were used in the 1976 study and no nitrapyrin was applied in the 1977 study.

Nitrapyrin (N-Serve 24) formulated as 184 g nitrapyrin/liter, was diluted to 60 g/liter with acetone, pipetted onto the N fertilizer, and then mixed with the other fertilizer ingredients. Formulated fertilizers were either immediately applied in the field or sealed into plastic bags for the sidedress application. Phosphorus as concentrated superphosphate (25% P), K as muriate of potash (50% K), and micronutrient frit (FTE 503, Ferro-Corporation) were mixed with the N fertilizer at 112, 112, and 45 kg/ha, respectively. Fertilizer treatments were applied in bands 10 cm to the side of the crop and 10 cm below the soil surface on plots that were 7.6 m long x 1.2 m wide. ‘Silver Queen’ sweet corn was planted 0.3 m apart on beds. In the 1976 study, sweet corn was seeded on June 16 and first harvested on August 24. In the 1977 study, sweet corn was planted on March 9 and was first harvested on June 13. The second application of fertilizer for the split treatments was applied 5 weeks after seeding during both studies.

Soil samples were taken at depths of 0–10, 10–20, 20–30,
and 30–50 cm in the area of the banded fertilizer for determination of NH$_4$-N and NO$_3$-N. In the 1976 study, all plots were sampled 2, 4, 6 and 8 weeks after initial fertilizer application. In the 1977 study, all plots were sampled 2 and 11 weeks after fertilizer application.

Plant tissue samples were taken twice during each experiment and analyzed for N, K, Ca, and Mg. In the 1976 study, whole plant samples were taken at 5 and 11 weeks after seeding. In the 1977 study, whole plant samples were taken 5 weeks after seeding and ear leaves were sampled 11 weeks after seeding. Sweet corn was harvested twice during each experiment and graded by size as either marketable or cull. A 1:2:1 water solution was used for all soil determinations and NO$_3$-N and NH$_4$-N were determined by use of Orion specific ion electrodes. For tissue analyses, N was determined by the microKjeldahl method (9), Ca, and Mg were determined by atomic absorption spectrophotometry, and K was determined by flame photometry.

### Results and Discussion

Sweet corn growth and response to N source was different for the 2 seasons (Table 1). The highest yield obtained during the summer season was 9.8 MT/ha while a high yield of 14.6 MT/ha was obtained during the spring season. A major climatic difference between seasons was rainfall, resulting in different leaching conditions. There was an average of 4 cm rainfall per week in the 1976 summer season with as much as 8 cm in 1 day, while there was only an average of 0.4 cm rainfall per week in the 1977 spring season with supplemental irrigation required. In the wet season, sweet corn yield was 65% higher with (NH$_4$)$_2$SO$_4$ as the N source than Ca(NO$_3$)$_2$ and increased quadratically with an increase in applied N from (NH$_4$)$_2$SO$_4$. The Ca(NO$_3$)$_2$ treatments appeared to be subject to N stress. Split applications of N as Ca(NO$_3$)$_2$ were more efficient than single applications but yield was not influenced by N rate. Applications of NH$_4$-N are more efficient than NO$_3$-N on sandy soils subject to leaching conditions (2, 15). During the drier season, sweet corn yield was not affected by N source, or time of N application. Total yield increased linearly from approximately 9 to 14 MT/ha with an increase in the rate of N applied from both sources. These results are similar to other work where sweet corn yield on sandy soil was not influenced by N under nonleaching conditions (11, 12).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>(NH$_4$)$_2$SO$_4$</th>
<th>Ca(NO$_3$)$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (kg/ha)</td>
<td>(No./ha) (MT/ha)</td>
<td>(No./ha) (MT/ha)</td>
</tr>
<tr>
<td>56</td>
<td>4292 6.1</td>
<td>3450 4.6</td>
</tr>
<tr>
<td>112</td>
<td>5343 8.4</td>
<td>3716 5.3</td>
</tr>
<tr>
<td>224</td>
<td>5887 9.8</td>
<td>3736 5.0</td>
</tr>
<tr>
<td>F value</td>
<td>L<strong>Q* L</strong>Q**</td>
<td>NS NS</td>
</tr>
<tr>
<td>Nitrapyrin (kg/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4939 7.8</td>
<td>3799 5.0</td>
</tr>
<tr>
<td>0.56</td>
<td>5299 8.4</td>
<td>3736 5.0</td>
</tr>
<tr>
<td>1.12</td>
<td>5283 8.1</td>
<td>3468 4.9</td>
</tr>
<tr>
<td>F value</td>
<td>NS NS</td>
<td>NS NS</td>
</tr>
<tr>
<td>Time of application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>5218 8.4</td>
<td>3247 4.6</td>
</tr>
<tr>
<td>Split</td>
<td>5130 7.8</td>
<td>4020 5.3</td>
</tr>
<tr>
<td>F value</td>
<td>NS NS</td>
<td>** NS</td>
</tr>
<tr>
<td>Mean*</td>
<td>5175* 8.1**</td>
<td>3628 4.9</td>
</tr>
</tbody>
</table>

Supplementary Table 1. Main effect of N source, N rate, nitrapyrin rate, and time of application on yield of sweet corn during 2 seasons.

<table>
<thead>
<tr>
<th>N source and rate (kg/ha)</th>
<th>5 weeks after fertilization</th>
<th>11 weeks after fertilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry wt (g)</td>
<td>Tissue composition (% dry wt)</td>
<td>Dry wt (g)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>(NH$_4$)$_2$SO$_4$</th>
<th>Ca(NO$_3$)$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer, 1976</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N source</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Supplementary Table 2. Main effects of N source and rate on plant dry weight and tissue composition 5 and 11 weeks after fertilizer application, summer 1976 and spring 1977.

2F values were significant at the 5% (*) or 1% (**) levels or were not significant (NS). Significant rate effects were linear (L) or quadratic (Q).
Application of nitrapyrin did not influence sweet corn yield during either season. The effect of nitrapyrin on crop yields has not been consistent in the southeastern part of the USA (3, 4, 5, 8).

An early plant growth response to (NH₄)₂SO₄ during the wet season was evident (Table 2). Plant dry weight was higher with the application of N from (NH₄)₂SO₄ than Ca(NO₃)₂. Plant dry weight was less affected by N source during the drier season. Tissue N levels were higher with the application of N as Ca(NO₃)₂ than (NH₄)₂SO₄ 11 weeks after seeding during both seasons. Similar results were reported where higher N levels were present in corn grown with NO₃-N than NH₄-N and were attributed to a "dilution effect" in which plant growth was increased with NH₄-N (16).

The suppressing action of NH₄-N absorption by the plant on the absorption of other cations has been shown (2, 7, 16). Tissue K and Mg concentrations were generally slightly lower in plants that received N from (NH₄)₂SO₄ than Ca(NO₃)₂. Tissue Ca concentrations were consistently higher in plants that received Ca(NO₃)₂. Increases in N application from (NH₄)₂SO₄ generally decreased tissue Ca and K concentrations during both seasons. Increases in the rate of Ca(NO₃)₂ applied reduced K concentrations in the drier 1977 season.

During the rainy 1976 season, the majority of soil N had leached below a 30 cm depth 2 weeks after fertilization with Ca(NO₃)₂ (Fig. 1). In the dry season, the majority of soil N from both N sources was maintained above the 20 cm soil depth (Fig. 2). This was an indication of NO₃-N potential for leaching and the benefits obtained by the use of NH₄-N sources under leaching conditions.

![Figure 1](image1.png)

**Fig. 1.** Effect of Ca(NO₃)₂ and (NH₄)₂SO₄ on combined soil N levels (NH₄-N + NO₃-N) at various soil depths at 2, 4, 6, and 8 weeks after fertilizer application, summer 1976.

![Figure 2](image2.png)

**Fig. 2.** Effect of Ca(NO₃)₂ and (NH₄)₂SO₄ on combined soil N levels (NH₄-N + NO₃-N) at various soil depths at 2 and 11 weeks after fertilizer application, spring 1977.

The effect of nitrapyrin on soil N and plant tissue macro-nutrient concentrations was minimal and was not effective in increasing N efficiency of sweet corn under the conditions of the experiment. The lack of nitrapyrin response was possibly related to the differential movement of NH₄-N away from the nitrapyrin placement and its nitrification (13) or to the rapid breakdown of nitrapyrin at high soil temperatures (3).

**Literature Cited**

Nutrition of Japanese Holly during Propagation and Production

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Abstract: Slow-release nutrient sources produced larger, higher quality Ilex crenata Thunb. 'Hetzi' plants than liquid fertilization at the same rates. Salable quality plants were produced in one growing season by using Osmocote in the propagation medium and incorporating slow-release diurea (IBDU) and fritted potassium (K-frit) or Osmocote plus dolomite, single-superphosphate, and micronutrients into the container-growing medium prior to transplanting liners. A wide range of IBDU,K-frit gave satisfactory results. Nutrition during propagation was essential for best growth and utilization of subsequent container nutrition. Cuttings from plants grown with IBDU, K-frit rooted better than those grown with Osmocote or liquid fertilizer.

The development of mist propagation represented a major contribution to vegetative plant propagation. Numerous advantages of intermittent mist over constant mist have been recognized (21), however, nutrient and metabolite leaching is a major disadvantage of mist propagation (1, 3, 9). Since nutrient mists have not been entirely successful (5) the use of slow-release fertilizers incorporated into the rooting medium has been investigated (8, 11, 16, 20).

Soluble fertilizers must be applied frequently to containers thus increasing labor costs. Overhead liquid fertilizer applicators stimulate weed growth in aisles and roadways and much fertilizer is wasted. Osmocote (Sierra Chemical Co., Milpitas, Cal.), is a slow-release fertilizer containing N, P, and K, produced by coating various water-soluble fertilizers with plastic polymers. Isobutylidene diurea (IBDU) (Swift Agricultural Chemical Corp., Chicago, 111.) is a synthetic organic nitrogen (31N-0P-0K) containing 27.9% water-insoluble N. Variation in release rates are obtained through particle size and hardness, and irrigation water application. Potassium glass frits (0-0-27) or K-frit (Frit Industries, Inc., Ozark, Al.) which release primarily by weathering have been shown to be a suitable slow-release K source (6, 12, 14, 15, 23). The objective of this study was to compare growth of cuttings rooted with or without Osmocote during propagation. In addition, cuttings were grown in containers with 3 fertilizer sources and 3 levels of each. Following one growing season, cuttings were taken from all container plants and rooted under mist and evaluated.

Materials and Methods
Osmocote 18N-3P-10K was surface applied to the growing medium in April, June, and August. IBDU brickeets (about 1 g) plus K-frit were incorporated into the growing medium prior to transplanting. An ammonium nitrate and KNO₃ solution was applied weekly to provide the same amounts of actual N and K per plant as the other 2 sources. All sources were used at a 3N:1.7K (3N:2K₂O) ratio.

The experiment was designed as a randomized block with a 2 x 3 x 3 factorial set of treatments. The sequence of events was as follows:

- Cuttings from uniform stock plants
- Treatment during propagation (6 replications and 24 subsamples)
  1. No fertilizer added to rooting medium
  2. Osmocote 18-3-10 @ 400 g/35.2 liters
- Treatment during production (3 x 3 factorial, 6 replications)
  1. IBDU,K-frit
  2. Osmocote 18-3-10
  3. Liquid fertilizer applied weekly

At the end of the growing season cuttings were taken from all 18 treatments (2 x 3 x 3) and rooted under mist (6 replications and 2 subsamples)

Terminal unbranched cuttings of Japanese holly were taken November 15 from 1-year old stock plants propagated from a single plant. Rooting medium was sphagnum peat and perlite in equal proportion with no nutrients added or with 400 g Osmocote 18-3-10 per 35.2 liter. One tray of 24 containers (6 cm diameter, 7 cm deep) was used as the experimental unit and replicated 6 times. On April 1, 9 uniform liners were selected from each experimental unit to constitute 1 replication of the production portion of the study.

The growing medium during production was 2 pine bark: 1 peat:1 builders sand. Perk (a micronutrient fertilizer manufactured by Kerr McGee Chemical Co., Jacksonville, Fla.), dolomite, and single-superphosphate were incorporated into the medium at 2.4, 4.8 and 2.4 kg/m³. All plants were grown in 2.5 liter containers under 20% shade and watered as needed.

On August 15, bud breaks were counted. On November 1, each plant was visually graded on a scale of 1 (poorest) to 10 (best) by 4 persons. Reference standards of 1, 4, 7 and 10 were used to increase accuracy. Fresh and dry top and root weights were measured.