Drip application of nitrogen is efficient

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Fertilizer uptake by irrigated plants is influenced considerably by fertilizer placement and timing and by water application methods. Because some fertilizer elements move with water in the soil, these plant nutrients must remain or arrive within the sphere of the plant roots after fertilizer and water are applied. The goal is to develop cultural practices by which crop nutrient needs are satisfied by maximum uptake from a minimum quantity of applied fertilizer.

To determine the percentage of nitrogen uptake from fertilizer applied by drip irrigation, an experiment was conducted in 1975 with tomatoes on Pancho clay loam at the West Side Field Station. Methods of applying fertilizer nitrogen through a drip irrigation system were compared with other methods of application and irrigation. Soil tests before planting showed 19 to 24 ppm of nitrate-nitrogen in the surface 30 cm of soil and only trace amounts below.

Experimental methods

Fresh-market tomatoes (Cal Ace) were planted April 10 on about 1/3 hectare. The experimental plots were 4.57 meters (15 feet) wide and 9.14 meters (30 feet) long, with three planted beds (one row per bed) per plot. Six treatments, replicated six times, consisted of selected combinations of furrow and drip irrigation plus varied placement and timing of nitrogen as ammonium sulfate. Eighty kilograms of nitrogen per hectare (71 pounds per acre) were applied to all plots except the check plots, which received no nitrogen. All plots received a uniform application of P₂O₅ at 80 kg per hectare at planting time.

The differences in the nitrogen treatments were in application method and distribution (timing). Some plots received nitrogen banded 10 cm (4 inches) deep and 20 cm (8 inches) to the side of the row at planting and then were furrow or drip irrigated. The remainder received nitrogen through the drip irrigation system at specified times during the growing season.

Although both treatments 1 and 2 received nitrogen in bands at planting time, treatment 1 was furrow irrigated, and treatment 2 was drip irrigated throughout the growing season. Treatments 3, 4, and 5 all received a total of 80 kg per hectare of nitrogen solution pumped directly through emitters about 1 meter apart within the plant row, but differed from each other in the time and amount of each application. Treatment 3 received all the nitrogen through the emitters at planting time. Treatment 4 received 30 kg per hectare at planting time and 50 kg at flowering. Treatment 5 received 10 kg per hectare at planting, 20 kg at thinning, 40 kg at flowering, and 10 kg at first fruiting. All fertilizer applications were made immediately after plant samples were taken.

Nitrogen-15-depleted nitrogen fer-

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<th>Mean yield of tomatoes under various fertilization and irrigation treatments</th>
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* Values are calculated from mean plot weights based on six replications.
† Banded 10 cm deep and 20 cm to the side of the row.
PLANT SAMPLING DATES

Fig. 1. Relation between soil- and fertilizer-nitrogen content in tomato plants at different plant sampling dates for all treatments. Numbers along abscissa indicate time and amount of fertilizer nitrogen in applied kilograms per hectare.

Tomato yields

The table shows average tomato yields obtained with various irrigation and nitrogen combinations. Except for treatment 2, which reduced yield, there was no statistically significant treatment effect on total yields (ripe plus green tomatoes).

Analysis of soil samples from treatment 2 indicated that much of the banded nitrogen fertilizer was moved away from the plants during water applications because of the placement of the fertilizer in relation to the emitters within the row. Nitrogen accumulated at the perimeter of the wetted zone and was less available to the plant. When nitrogen was applied through the drip system this problem was not encountered: total yield was maintained and fruit maturity was enhanced.

Plant nitrogen

Figure 1 shows the percentage of nitrogen in tomato plants from both the soil and the applied fertilizer. In all treatments, nitrogen concentration in plants (upper N curves) increased after the first sampling. Total nitrogen percentage was initially greater in treatments 0 and 1 than in the other treatments, because furrow irrigation moved the soil-surface nitrogen of treatment 0 and the soil-surface nitrogen and banded fertilizer nitrogen of treatment 1 toward the center of the beds, where nitrogen was readily available to the plant roots.

Thereafter, total nitrogen concentration differed only slightly for all treatments except treatment 1 on August 12 and treatment 2 on July 24. Furrow irrigation apparently helped maintain a higher percentage of nitrogen in treatment 1 than in the other treatments. Drip irrigation in treatment 2 moved some of the soil and fertilizer nitrogen away from the plant row, decreasing plant nitrogen content slightly, especially after the
Research briefs
Extending storage life

University of California plant physiologists are investigating new techniques of temperature management, modified atmospheres, and special packaging to extend the storage life of commodities, such as oranges.

Studies to evaluate the effects of low temperatures during storage and after transfer to a warmer atmosphere showed that oranges lost little quality when they were washed, waxed, held at 41°F for 12 weeks, and then transferred to 68°F. Fruit stored at lower temperatures (32°F), however, suffered chilling injury, manifested by increased volatile content, rind breakdown, and development of off-flavors.

Plant physiologists also found that Valencia oranges stored in polyethylene bags for four months at 41°F were in excellent condition and had lost an average of only 1.7 percent weight compared with 9.5 percent lost by fruit in paper bags. Other crops have been successfully stored by enclosing entire pallets of boxes in polyethylene. Researchers are now attempting to extend the technique to citrus on a commercial scale to maintain fruit quality over long periods. (BCH 2771)

Summary

Application of nitrogen fertilizer through a drip irrigation system is efficient regardless of timing. Nevertheless, when nitrogen fertilizer is banded beside the plant row, furrow irrigation is the superior method of irrigation. Fertilizer use is more efficient when nitrogen is applied through the drip system than when banded and furrow irrigated or banded and drip irrigated.

For high efficiency, fertilizer nitrogen should be placed carefully with respect to the plant roots, taking into consideration the direction of water movement during irrigations. When soil-nitrogen levels are relatively high, fertilizer use efficiencies are expected to be relatively low, with negligible crop yield increases from applied nitrogen fertilizer.

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Research by plant physiologist J. L. Eaks at U.C., Riverside, shows that quality of citrus fruit can be maintained for long periods by storage in polyethylene bags.