New projects:

Development of pest pathogens

Development of resistance to pesticides in many insect and mite populations makes it imperative that alternative control methods be found. The goal of a new project by B. A. Federici, U.C., Riverside, is to discover new pathogens and develop these and other known pathogens for use in pest management programs. Fungi, bacteria, microsporidia, rickettsia, and viruses will be studied and evaluated for use against medically and agriculturally important pests. Development of insect viruses as pesticides will be emphasized. (BIC 3800)

Genetic insect control

To overcome drawbacks of conventional control methods, researchers are focusing on genetic techniques for the suppression of insects. The use of temperature-sensitive mutants probably offers the best method of control to date, because it relies solely on the climatic environment of the insect population and eliminates the need for any chemical. The objective of a new project by L. E. Kelly, U.C., Berkeley, is to find a way to isolate temperature-sensitive paralysis mutants in the fruitfly, with future application to other insect pests. (GEN 3807)

Interaction of wool with sodium hypochlorite

An economical bleach commonly used in laundering, sodium hypochlorite can also severely damage protein fibers, especially wool. This project by H. P. Lundgren, U.C., Davis, is designed to find conditions and treatments that will permit the advantages of hypochlorite to be realized while minimizing fiber damage. (TXC 3423)

Tomato cell genetics

Studies of tomato genetics are conducted principally with whole plants. With its economic importance as a crop plant, tomato is an obvious choice for cell genetic techniques, which permit much larger numbers of cells to be handled and screened for genetic variability. Objectives of this study by D. Pratt, U.C., Davis, are to isolate haploid tomato plants, establish suspension cell cultures, and regenerate plants from mutant cells to obtain herbicide-resistant plants and study "whole plant" genetics of the mutations. (BAC 3422)

Drip application of nitrogen is efficient

Robert J. Miller ■ Dennis E. Rolston ■ Roy S. Rauschkolb ■ David W. Wolfe

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 Panoche 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 P_2O_5 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-

MEAN YIELD OF TOMATOES UNDER VARIOUS FERTILIZATION AND IRRIGATION TREATMENTS

Treatment	Irrigation method	N placement	Timing	Mean tomato yield*: Ripe	Mean tomato yield*: Ripe + green
				metric tons per hectare	
0	Furrow	—	—	52.0	82.0
1	Furrow	Band†	Planting	58.9	86.0
2	Drip	Band†	Planting	55.1	69.0
3	Drip	Drip	Planting	68.1	84.4
4	Drip	Drip (split)	Planting Flowering	65.2	80.6
5	Drip	Drip (split)	Planting Thinning Flowering Fruiting	65.0	77.1

* Values are calculated from mean plot weights based on six replications.

† Banded 10 cm deep and 20 cm to the side of the row.

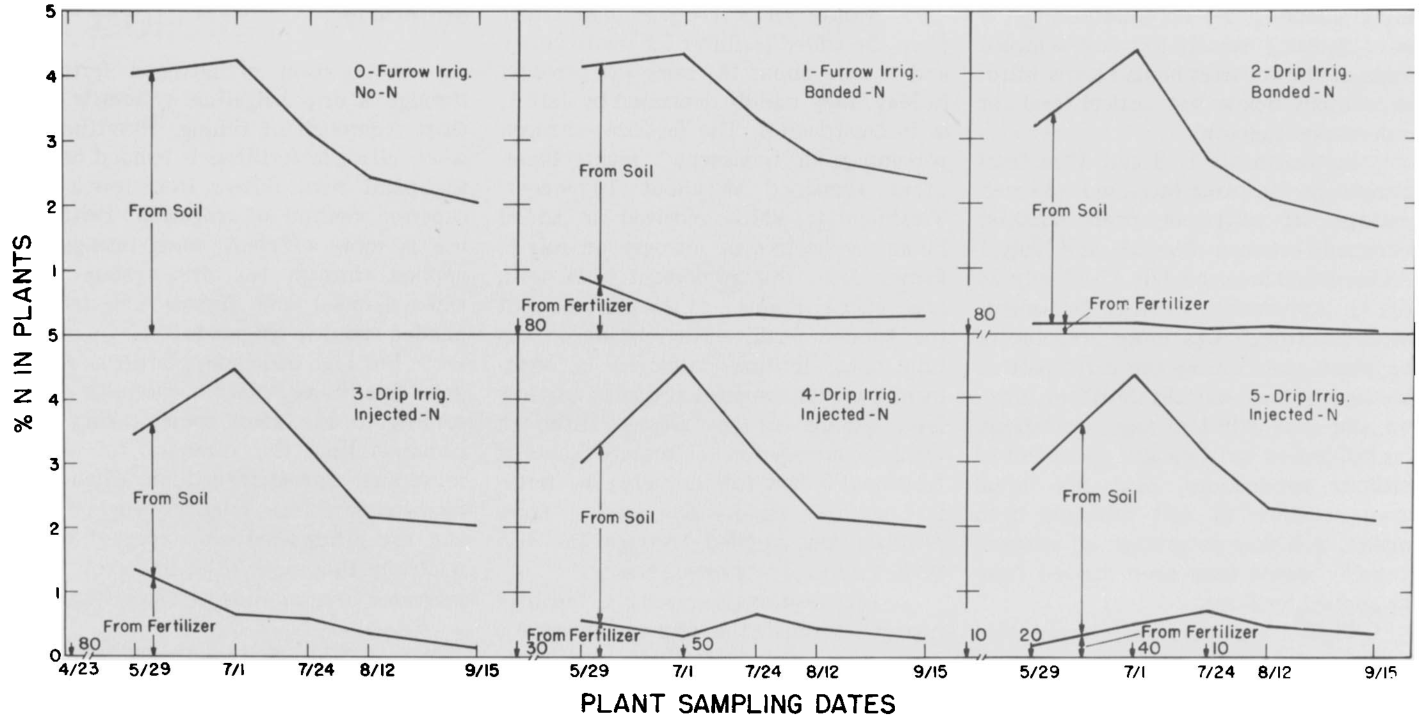

Fig. 1. Relation between soil- and fertilizer- nitrogen content in tomato plants at different plant sampling dates for all treatments. Numbers along abscissa indicate time and amount of fertilizer nitrogen in applied kilograms per hectare.

tilizer (0.00 percent ^{15}N) as ammonium sulfate was applied to the center row of each three-row plot; ammonium sulfate of natural abundance (0.36 percent ^{15}N) was applied to the two outside rows of each plot. The ^{15}N-depleted fertilizer was used as a tracer to determine the percentage of nitrogen uptake from the applied fertilizer. Tomato plants were sampled at thinning (May 29), flowering (July 1), first fruit (July 24), full fruit (August 12), and near harvest (September 15). Whole plant samples were taken only at thinning; leaf and petiole samples were taken thereafter.

The furrow-irrigated treatments received a total of 91 cm (36 inches) of water during the growing season. Almost one-third of the water was needed to sub-over the plant beds to ensure uniform germination and emergence. Drip irrigations were applied daily until plant emergence, and then three times a week for 4 to 6 hours throughout the season, for a total of 71 cm (28 inches) of water. Tensiometers were installed within the plant beds, but, because many exceeded the air entry value, only those close to the emitters of the drip irrigation treatments could be used. Pressure-bomb readings of the plant leaf petioles were made periodically to confirm that the plants were not under undue water stress.

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

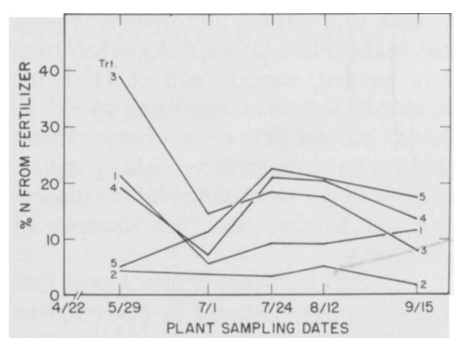

Fig. 2. Percentages of nitrogen from fertilizer in tomato plants at different sampling dates for all treatments.

July 1 sampling. At no time during the active growing season did any sampled plants of the six treatments have a nitrogen content below the critical level for fresh-market tomatoes.

In treatments 1, 3 and 4, as total nitrogen in the plant increased, the percentage of nitrogen from fertilizer decreased between May 29 and July 1 and increased between July 1 and July 24 (fig. 1). Apparently, in some treatments the soil nitrogen was more available to the plant roots during the early part of the season than was the fertilizer nitrogen, and after July 1 nitrogen availability was influenced by time and placement of fertilizer applications. Had the initial concentration of soil nitrogen been smaller, a higher percentage of nitrogen probably would have been derived from the applied fertilizer.

Figure 2 shows the portions that can be attributed to the fertilizer source, given in percent of the total nitrogen (considered 100 percent at any one sampling date). The 80 kg per hectare of nitrogen applied at planting in treatment 3 resulted in the greatest amount of fertilizer nitrogen in the plants at first sampling (May 29).

Although nitrogen percentages from the added fertilizer for treatments 1 and 4 were about the same (20 percent) in May, they rapidly decreased by July 1, as in treatment 3. The fertilizer-nitrogen percentage in treatment 1 plants thereafter remained at about 10 percent. Treatment 4, which received an added 50 kg per hectare of nitrogen on July 1, increased to the 20 percent level again after July 1. Because of the placement of the banded fertilizer in relation to the drip lines, fertilizer nitrogen in treatment 2 plants remained at a relatively low level throughout the season. Although fertilizer nitrogen in the tomato plants of treatment 5 was low initially, the fertilizer nitrogen rapidly increased as more fertilizer was applied through the drip system during the growing season.

All treatments receiving fertilizer nitrogen through the drip system gave a higher percentage of fertilizer nitrogen in plants—except treatment 3 at harvest—regardless of time of fertilizer application (fig. 2). This indicates nitrogen is used more efficiently when applied through the drip system than when banded and furrow irrigated or banded and drip irrigated.

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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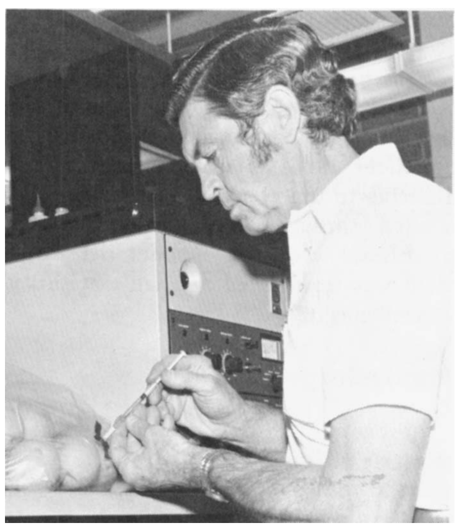
Research briefs

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° 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)



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

Genetic advising program

The rapid expansion of knowledge about human genetic disease and the advances in the technology for recognition, therapy, and prenatal diagnosis have led to public demands for service. Birth defect centers have tripled in the last five years. Afflicted persons and their families require skilled counseling in addition to medical diagnosis and therapy in order to cope with emotional, social, and economic problems.

The Genetic Advising Program initiated at the University of California in an attempt to meet these needs is currently the only training program of this kind in California. The program has three components: diagnostic (by a medical doctor at the U.C. School of Medicine in San Francisco); counseling (including in-