per worker based on results from four days with a two-man crew was 0.554 ton per man-hour compared to 0.268 ton per man-hour for one member of the crew in a conventional gondola–picking-pan operation. However, the gondola was always within 8 to 10 ft of the picker—a rather ideal situation uncommon in many normal commercial harvest operations. This represents an increase in output of 108%. However, it should be emphasized that 0.268 ton per man-hour is based on total time spent in the vineyard, excluding the lunch break, while 0.554 ton per man-hour is based on actual working time and includes no allowance for breaks or rest periods. If a 10-minute break every hour is included, this figure would be readjusted to 0.461 ton per man-hour indicating a 70% increase in productivity.

Productivity

The productivity of the Mexican crew was about 70% greater than the domestics when working with the conventional gondola–picking-pan system. Their productivity did not show a striking increase when working on the picking platform. The time spent by the Mexican crew in working on the platform was much less than that of the domestics. With more experience in using the platform, this crew might have further increased their productivity. However, it appears that a definite upper limit exists on the productivity of a picker, and that the Mexican crew was working much closer to this limit, under conventional conditions, than were the domestics.

Picker productivity, measured in terms of tonnage picked per unit time, can be increased by use of equipment which transports the picker, improves visibility and transports the fruit away from the picker. Greater efficiency is achieved by using one picker, but two pickers working together on one side of the vine can significantly increase their output. Low normal productivity of a worker can be substantially increased. High normal productivity is less easily improved.

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NITROGEN . . .

JOHN C. LINGLE

PREVIOUS FIELD STUDIES of soil fertility effects on the processing quality of tomatoes have been inconclusive. To adequately assess the relationship of various nutrients to fruit quality, it is necessary to more closely control the nutrition of the plant. Therefore, techniques were developed and a series of experiments were initiated in the greenhouse to study the effect of individual nutrients on pH, soluble solids, and color, as well as on yield. This article analyzes the effect of one nutrient—nitrogen—on tomato processing quality.

Nitrogen (N) is the nutrient most frequently associated with quality and yield. The supply of this element in the soil is also the most difficult to control. In the present experiments, sand culture—the growth of plants in chemically inert pure quartz sand irrigated daily with nutrient solutions containing all the known essential elements—was used to control the N supply of the plant.

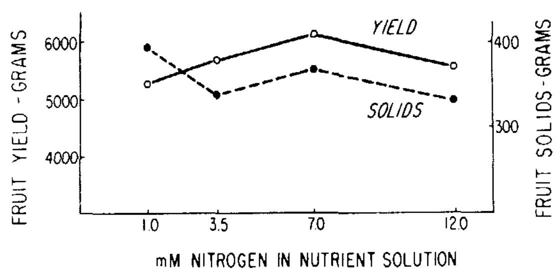
Tomatoes used were 63-L-1 (a dwarf inbred breeding line), grown with full-strength complete nutrient solution (Hoagland's #2) until the first cluster of fruit had reached the mature green stage. About seven clusters of fruit had been "set" by this time. The N level of the nutrient solution then was changed to provide 1.0, 3.5, 7.0, or 12.0 millimoles (mM) N for the balance of the fruit maturation period. There was one plant per pot, four pots in each treatment, and two replications of each treatment.

Harvest

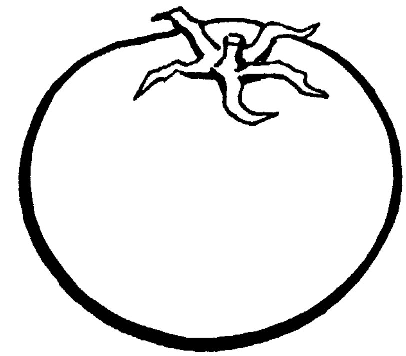
Harvest was started two weeks later, when the first cluster of fruit had reached the canning-ripe stage, and succeeding clusters were picked at weekly intervals after that. Weight, color, and number of fruit were recorded, after which pH and soluble solids were determined.

No significant difference in yield occurred as the result of the several N treatments (graph 1). Total yield with the lowest level of N was about 5200 g. This

GRAPH 1. EFFECT OF NITROGEN LEVEL IN THE NUTRIENT SOLUTION, DURING FRUIT MATURATION, ON YIELDS OF FRESH FRUIT AND FRUIT SOLIDS OF TOMATOES.



in relation to tomato quality



compares with a yield of slightly over 6000 g for the 7.0 mM treatment. Since all harvested fruit were "set" prior to the initiation of differential treatments, differences in yield were due to variations in fruit size and not to number of fruits.

pH of fruit

The pH of the fruit is important to the processor because of the relationship of pH to the development of spoilage organisms. These organisms are more likely to develop at pH values above 4.5 than at values below this level. There was little difference in the pH of fruit from the different treatments at the first harvest date (graph 2). This was expected, since these fruits were essentially mature when the different N levels were imposed. However, as each succeeding cluster matured, fruits from the low N treatments were progressively lower in pH, while fruits from later clusters of the two high N treatments had pH values near that of the first cluster.

Most of the tomatoes grown in California are processed into concentrated products—catsup, paste, or puree. Since the removal of water from the tomatoes requires heat energy, fruits with high-solids are more economically reduced to concentrates than those with low-solids. In the present study, as the nitrogen stress in the plant increased under the various N treatments, concentration of soluble solids increased proportionately (graph 3).

Fruit solids

Fruit solids yields (the dotted line in graph 1) were calculated from the fruit-yield data of graph 1 and the calculated total solids determined from tabular comparisons of the soluble solids data of graph 3. Even at the expense of a slight reduction in fruit yield, total fruit solids were highest in the low N treatment.

Growers of tomatoes to be mechanically harvested should carefully control the nitrogen fertilization of their plants. Prevention of over-fertilization will reduce the "setting" of late clusters of flowers which develop into green fruit that must be removed from the harvester belt during harvest. Growers frequently are reluctant to limit the N supply for fear of loss in yield. The nitrogen stresses developed under the low N treatments of this experiment closely simulated what should happen in the field. Ample nitrogen should be provided to produce maximum vine growth and fruit set in a relatively short period of time. However, the supply of available nitrogen should be nearly exhausted as the major portion of the fruit on the plant approaches maturity. Nitrogen stresses developing after this will increase solids and fruit acidity with little sacrifice in yield—resulting in a higher quality product for processing.

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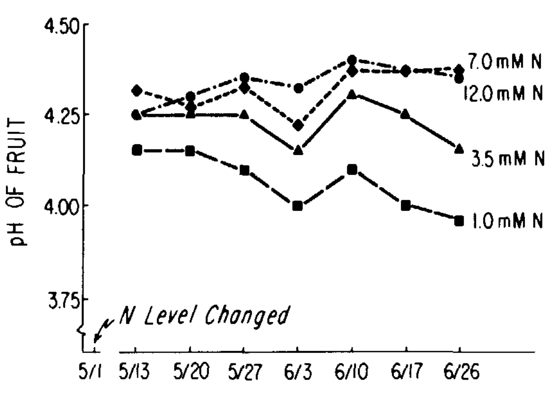
GRAPH 2. EFFECT OF NITROGEN LEVEL IN THE NUTRIENT SOLUTION, DURING FRUIT MATURATION, ON THE pH OF RIPE TOMATOES.



GRAPH 3. EFFECT OF NITROGEN LEVEL IN THE NUTRIENT SOLUTION, DURING FRUIT MATURATION, ON THE SOLUBLE SOLIDS OF RIPE TOMATOES.