



# *Productivity*

# FOR

## • *Labor carriers*

Vine lifter is visible in photo above of two pickers seated on labor carrier in tests with picking aids for grape harvesting.

Productivity, measured in terms of tonnage of grapes picked in a given amount of time, can be increased by use of equipment that will transport the picker, improve picking visibility, and move the fruit into containers. These tests with a mobile platform for transporting grape harvest workers along the row indicated that the degree of improved efficiency possible depends largely on the quality of the labor and crew size.

**S**INCE THERE IS no commercially available equipment for mechanically separating grape clusters from the conventionally trained and pruned vines, the grape harvest worker performs a critical function. However, in conventional hand harvesting, the picker is actually involved with other jobs in addition to the vital functions of searching for, picking and dropping the clusters. The picker is also required to transport himself and his primary picking container into, and out of, the vine, and to transport the container to and from a bulk container such as a gondola or tub into which he deposits the fruit.

### **Object**

The object of tests described in this article was to analyze methods of transporting and positioning the picker, trans-

porting the clusters after cutting, and measuring the picker's output under these new conditions (in which the picker was concerned only with the search, pick and drop functions).

### **Grenache vineyard**

A Grenache vineyard near Manteca, owned by Robert E. Goodwin, was selected for the experiment. Vines in an 8-ft × 12-ft planting were trained to bilateral cordons with each cordon about 3½ ft long and about 30 inches above the ground. The rows were approximately 145 vines long and were oriented in an east-west direction. The prevailing winds from a northwest direction tended to force the shoots to the southeast. Thus, while the fruit was better exposed on the north side, more of the vine crop was found on the south side of the vine.

### **Test machine**

The test machine was a steel frame supported by four automotive wheels with wooden platforms extending along each side, parallel with the row. The lateral and vertical position of the platform could be adjusted to place the picker in the best position relative to the vine. A 30-inch-wide roll of paper was continuously unwound beneath the platform and close to the vine trunks as the machine moved along the row. The pickers dropped the clusters of grapes onto this strip and the fruit was picked up in a subsequent operation, placed in tubs and weighed. Collecting the fruit on paper was a temporary expedient for this trial, but mechanical means of collecting and elevating the fruit could be substituted.

The machine was towed along the row by a tricycle-wheeled tractor with the

*improvement with . . .*

## PICKER AIDS

# GRAPE HARVESTING



- *Vine lifters*
- *Fruit handlers*

H. E. STUDER · J. J. KISSLER · COBY LORENZEN · R. R. PARKS

front wheel castored to follow a shallow trench previously cut between the rows.

Vine entanglement with the pickers was reduced by equipping the carrier with a shoot lifter positioned parallel to the row. Shoots were lifted at the front of the machine by a downwardly curved steel rod and carried on the horizontal portion of the lifters as the machine moved along the row. The pickers worked beneath this raised canopy of shoots with the exposed fruit directly in front of them.

### **Pickers**

Either one or two pickers was used in each test. When a single picker was riding on the platform, he cut and dropped all of the fruit located on one side of the vine. The fruit on the other side of the row was cut on the return pass. When two pickers worked on the platform, one was positioned ahead of the other. The first, or leading, picker cut the fruit from the lower and middle section of the vine. The second, or trailing, picker cut the remainder and cleaned up any fruit missed by the first. All vines were cleaned in two passes, one on each side of the row, with the pickers removing approximately half of the fruit on each pass.

The pickers were domestic laborers except in one test where a two-man crew of

Mexican green card holders was used. Forward travel speed on the machine was adjusted according to the activity of the trailing picker.

### **Position choice**

The pickers were allowed to select their own working positions. At the beginning of the tests, they chose to stand or squat facing the row. Subsequently, one picker tried using knee pads. This kneeling position proved comfortable and convenient, if not held for extended periods of time. Changing to another position after kneeling tended to be awkward and to disrupt the picking activity. Lug boxes used as simple seats proved the most popular. Again the picker chose to face the row. The shoot lifter proved an invaluable aid, not only by improving fruit visibility, but also by keeping shoots away from the picker's head and shoulders. However, the lifter was much less effective on the leeward side of the vine than on the windward. The shoots on this side were often bunched and tangled due to wind action. Thus, the lifter was often ineffective and at times became a disadvantage since the matted shoots tended to cover the fruit, making it difficult to see and cut the clusters. This difficulty could only be overcome during the experiment by con-

stantly hand-positioning the shoots onto the lifter when picking the leeward side.

The first, or leading, picker cut the greatest amount of fruit. He tended to cut the most accessible fruit. Thus, he could cut very rapidly and efficiently. The second, or trailing, picker cleaned up the vine and generally picked fruit which was less easily accessible. He was forced to manipulate the shoots more than the first picker and hence picked less fruit, although he appeared to be working much harder.

### **Sitting position**

The sitting position was most popular and appeared to be a good position for the first picker. However, the second picker should be able to move easily along the platform as the situation dictates. The average production for a single worker on the machine was 0.66 ton per man-hour. The data indicated that greatest efficiency would be realized by using only one picker. Placing two pickers on the machine resulted in reduced production per man. This was due primarily to variations in fruit load and concentration from vine to vine. However, the reduced production was still considerably higher than that achieved from conventional harvesting with pans. The average production

# NITROGEN . . .

JOHN C. LINGLE

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.

*Henry E. Studer is Assistant Specialist; Coby Lorenzen is Professor of Agricultural Engineering; and Ralph R. Parks is Extension Agricultural Engineer, Department of Agricultural Engineering, University of California, Davis. James I. Kissler is Farm Advisor, San Joaquin Co.*

*Robert E. Goodwin, Manteca; the Oneto-Gotelli Company, Stockton; and George R. Giannini, Department of Agricultural Engineering, U. C. Davis, also assisted with these experiments.*

**P**REVIOUS 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.

