Complexity of fruit removal problem in citrus is indicated in composite photo above (and cover) showing three-dimensional model of location of oranges on half a tree, to left, and actual photograph of the opposite half of the tree, to right.

The loss of the bracero labor supply has stimulated interest in the status of harvest mechanization of California’s many crops. Solutions to the many unsolved problems of citrus harvesting are made even more difficult because approximately 75% of California citrus is shipped for fresh marketing.

Short-range solutions

It appears that short-range solutions involving (1) picker aids (in terms of improved clippers and man positioners) and (2) fruit handling systems, hold the greatest promise for the near future. Research and development work on man positioners is being actively continued by the University of California and many industrial organizations. The U.C. machine developed by R. J. Smith, Agricultural Economist, U.C., Riverside, was demonstrated, along with six other man-positioning machines, at a recent exhibit.

As with many other agricultural operations, a series of economic-political pressures have left mechanization as the only alternative. Pressures for mechanization of citrus harvesting will most likely increase, and it appears necessary to anticipate changes and consider possibilities for total mechanical harvesting of the citrus crop.

The general trend in mechanization of crop harvesting has been for the systems to evolve, at least in part, from equipment successfully used with other crops. This has been the case for small grain and forage crops as well as certain deciduous fruits. A harvesting system for citrus may develop from successful mechanization of some other tree crops, including shake-and-catch equipment. While such adaptation has been questionable in the past, it may appear more realistic as new research develops.

Research toward total-harvest has been underway for 2½ years by U.C. and USDA agricultural engineers in cooperation with the Departments of Biochemistry and Horticultural Sciences at the Davis and Riverside campuses. The University of California research project, “Development of Mechanized Citrus Fruit Harvesting Systems,” and the USDA research project, “Equipment and Methods for Harvesting and Field Handling of Citrus Fruits,” include studies ranging from basic research on the formation of the abscission layer and on the fruit-bearing habits of a tree, to applied research including the design and testing of specific harvesting components. The tree and fruit must be understood before development work can proceed with assurance.

Tree characteristics

Characteristics of the tree and fruit are being studied to determine those which lend themselves to effective harvesting. For example, the removal force when pulling perpendicular to the core axis for oranges is one-sixth of that when pulling colinear with the core axis. However, pulling perpendicular to the core axis gives a more favorable separation. Other findings indicate that the application of torque about the core axis tends to separate the orange from the tree with some stem. Removal by this latter method may require a destemming operation on the harvester, or a means of protecting fruit from stem punctures if the destemming operation is located remotely.

Bearing zones

Studies are being made to determine fruit-bearing zones within the tree. This knowledge is important both to the development of mechanical harvesting systems and to the development of man-positioning machines. Zones of heavy fruit concentration must be penetrated in both cases; whereas, economics must be considered in zones of extremely light fruit set. Tree training by pruning, shaping, shading, or other methods may be effective in forcing the tree to give an optimum combination of quality fruit in zones compatible with removal and collection systems. Various training methods are being investigated.

The limits of tree injury and leaf removal, without adversely affecting the tree’s future production, are also being studied. It is essential that the allowable
MECHANIZATION OF CITRUS HARVESTING

This article briefly describes the various areas of research presently underway, by University of California and U. S. Department of Agriculture, aimed specifically toward total citrus harvest mechanization. The article considers: (1) the phases of work being performed, (2) the relationships of the phases to the overall objective, and (3) the coordination of the work among the research disciplines. It also points out that at the present stage of research, the total mechanization of California citrus harvesting is not imminent.