Establishing and Training Manzanillo Table Olives For Mechanical Harvest

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Table olives in California are hand harvested. The cost of hand harvest can be as much as 50 percent of the gross. From 1997 to 2000, the California Olive Committee (COC), the table olive marketing order, sponsored the development of a mechanical harvester for table olives. Prototype machines were developed which had vibrating rods which engaged the tree canopy, resulting in a canopy shake. Although these machines looked promising, they had two major drawbacks: 1.) Efficiency of harvest - when the picking head came into close proximity of the fruit, it was removed. However, leading and trailing canopy edges and inside fruit proved to be problematic because it was difficult to get the head close to fruit located in these positions. Fruit removal was often disappointing. 2.) Fruit damage - The fruit can be damaged in the removal process. While this damage may appear similar to what may occur with hand harvest, the bruises are generally deeper and more severe. One of the major table olive processors quit accepting mechanically harvested fruit due to concerns related to fruit damage. This temporarily stopped progress toward mechanical harvest with this machinery. A continued and increasing need for mechanical harvest has rekindled interest. The COC resumed funding for mechanical harvest research in 2006 and expanded that support in 2007. The focus of the research has been on improvement of the previously developed machinery to increase removal and reduce damage and the development of loosening agents to facilitate mechanical harvest.

If a tree canopy could be developed in which all of the fruit was accessible to the picking head, a much improved harvest efficiency with reduced force and, therefore, reduced fruit damage should be attainable. The ideal tree and orchard configuration would appear to be a close spaced hedgerow system which would present a flat fruiting wall to the harvester with no leading or trailing edge and no inside fruit. A thin fruiting canopy approximately 6 feet in width and approximately 12 to 15 feet high would be appear to be ideal for maximum machine efficiency. With a narrow tree canopy and tree height such as this, narrower row spacing will be necessary to achieve maximum yields. This type of tree architecture should also be more adaptable to other types of mechanical harvesters including existing trunk type shakers and other types of machinery which could be developed.

Objectives:
The objectives of this work are to: 1.) Develop a narrow canopy hedgerow to facilitate mechanical harvest. 2.) Evaluate and demonstrate the feasibility of a high density hedgerow developed specifically for mechanical harvest. 3.) Compare different training methods for developing a narrow canopy hedgerow.

Methods:

In the spring of 2000, Manzanillo variety table olives were planted on 2 acres at the Nickel's Estate in Arbuckle with a north-south row orientation and a tree spacing of 12 feet in the row and 18 feet between rows (202 trees per acre). The selected training treatments included "conventional" and three Espalier treatments. The conventional training consists of thinning out fruit wood and opening up the center of the tree. The trees will eventually have 3 to 5 primary scaffolds. With the Espalier treatments, permanent limbs are being trained parallel to the row in a narrow plane with flexible temporary fruiting wood extending approximately three feet out into the row on either side. Large stiff limbs extending into the tree row are positioned into the permanent limb plane or are removed. The Espalier treatments are: Free Standing - where pruning alone is used to conform the trees to the system, trellised woven - where potentially permanent limbs are woven between three wires spaced at 4, 7 and 10 feet and trellised tied - where potentially permanent limbs are tied to the wires. The treatments are arranged in a randomized complete block design and consist of blocks of three rows of either seven or eight trees. There are four replications of each treatment. Harvest data is being collected from the center row of each treatment. The olives were harvested, weighed and 10 to 12 lb. samples were submitted to Musco Olives for commercial grading. The sample results were used to assign a value to the production.

Originally 6 trees of the Sevillano variety were strategically placed in the planting to provide for cross pollination for the partially self incompatible Manzanillo. Due to disappointing growth of these trees, cross pollination was inadequate. Even though there was a good bloom, the fruit set for 2003 was disappointing and did not warrant harvest. During the summer of 2003, the center row of the planting was top worked to Sevillano to provide for adequate cross pollination. During bloom in the spring of 2004 and 2005, the block was artificially cross-pollinated using Sevillano pollen. The grafted pollinators developed well and artificial pollinization was discontinued in 2006. In the spring of 2007, about two weeks after full bloom, all of the plots were chemically thinned with Napthalene Acetic Acid (NAA). Because the crop appeared light at pruning time in May, the tied Espalier treatment was not pruned.

Results:

Yields for 2007 were very good and ranged from 6.07 tons per acre for the woven Espalier to 7.51 for the tied Espalier with no statistically significant differences between treatments. Value per ton for the tied Espalier was significantly less than the other two treatments (Table1). There were no significant differences in value per acre. Through the seventh year, the cumulative yields are very similar for all of the treatments.

Table 1. Nickel's Hedgerow Olive Harvest, 2004-07

Treatment	2004 Tons/A	2005 Tons/A	2006 Tons/A	2007 Tons/A	2007 $/Ton	2007 $/Acre	Cum. Yield Tons/A
Conventional	4.09	1.75	2.81	6.39	$1,037 A	$6,600	15.04
Free Standing Espalier	3.66	1.51	2.26	6.40	$1,037 A	$6,636	13.81
Espalier, Trellised, Woven	4.21	1.68	2.28	6.07	$1,011 A	$6,153	14.24
Espalier, Trellised, Tied	3.58	3.45	1.76	7.51	$868 B	$6,438	16.30
	NS	NS	NS	NS		NS	

Numbers followed by different letters are significantly different at the 5% level using Fischer's test.

Discussion:

Unlike the previous year, there was no correlation between proximity to the pollinizer row and yield, indicating that pollination (a combination of self and cross) was adequate in 2007.

Fruit values were not different for any of the treatments which were pruned in 2007. The higher yield and smaller value per ton (fruit size) for the tied Espalier was, almost certainly, due to this treatment not being pruned in 2007.Cumulative yields for all treatments are very similar through the first seven years and would be considered good for this area. To date the results indicate that olives trees can be grown and maintained in a narrow canopy hedgerow configuration with no reduction in yield or fruit value.

A comprehensive project aimed at developing mechanical harvest for table olives is currently underway. This project is being headed by Louise Ferguson, UCCE Olive Specialist, and includes collaboration with a University of Florida researcher, UC Davis Department of Agricultural Engineering and Plant Sciences, UCCE Farm Advisors, California State University researchers at Fresno and Chico, farmers and equipment manufacturers and mechanical harvesters. Research is being conducted in the southern producing region (San Joaquin Valley) and the northern producing region (Sacramento Valley). The planting at Nickels is playing an increasingly important role in this effort. Because we collect our yield data from only the center row of the three row plots, we have been able to use the other trees for other things to support this effort. These have included following changes in fruit retention forces from mid season through harvest, testing fruit loosening agents to facilitate harvest and antioxidant treatments to reduce fruit damage. A field meeting was held in October at the end of the table olive harvest season to show the planting and to demonstrate 3 different types of trunk shake harvesters. The meeting was attended by about 40 interested growers and industry personnel.

As the effort to develop mechanical harvest for table olives continues, the planting at the Nickels Estate is positioned to play a critical role. Because it is an established planting it will continue to offer opportunities for research in support of the mechanical harvest project. We will be able to test new developments in machinery as it becomes available. We will continue to follow the development and production of the established treatments.