Establishing and Training Manzanillo Table Olives For Mechanical Harvest

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Table olives in California are hand harvested. In the last two years, harvest labor has been short and cost of harvest has been as much as 50 percent of the gross value of the crop. 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 to 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. Difficulty in removing the fruit and catching the removed fruit resulted in only 54% of the fruit being successfully harvested in one University study. 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 effectively stopped progress toward mechanical harvest with this machinery.

If a tree canopy could be created 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 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 that are being and 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 and temporary fruiting wood extending approximately three feet from the center axis on the east and west side of the canopy is being developed. Large stiff limbs extending into the tree row 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 two wires spaced at 4 and 7 feet and Trellised Tied - where potentially permanent limbs are tied to the wires. A third wire at 10 feet was added to the trellised treatments during the summer of 2005 and is being used to train the trellised treatments as they develop. The treatments are arranged in a randomized complete block design and consist 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 in the future. 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.

Results:

Yields for 2006 ranged from 1.76 tons per acre for the trellised and tied espalier treatment to 2.81 for the conventional treatment (Table 1). As in 2004 and 2005, there were no statistical differences between the treatments. There was a significant correlation between distance from the pollinator and yield. The rows nearest to the central pollinator row (36 ft.) averaged 3.11 tons per acre compared to 1.45 tons per acre for the rows farthest from the pollinator (90 ft.).

Table 1. Nickel's Hedgerow Olive Harvest, 2004-06

	2004			2005			2006			Cum. Yield
Treatment	Tons/Acre	$/Ton	$/Acre	Tons/Acre	$/Ton	$/Acre	Tons/Acre	$/Ton	$/Acre	(Tons/Acre)
Conventional	4.09	539	2204.51	1.75	685	1199	2.81	986	2768	8.65
Free Standing Espalier	3.66	557	2038.62	1.51	656	991	2.26	986	2229	7.43
Espalier, Trellised, Woven	4.21	491	2067.11	1.68	647	1087	2.28	1008	2296	8.17
Espalier, Trellised, Tied	3.58	573	2051.34	3.45	640	2208	1.76	1004	1767	8.79

No significant differences at the 5% level using Fischer's test.

Discussion:

Table olive production in California in 2006 was less than 17,000 tons. This was the lightest crop in California for many years. This light crop was due to a combination of factors including a very heavy crop in the San Joaquin in 2005 which resulted in the expected light crop in 2006 and freeze damage in the Sacramento Valley. Warm weather in February stimulated flower bud development and subsequent freezing temperatures killed developing buds. This was followed by erratic conditions during bloom in May which further reduced fruit set. Developing bloom in Arbuckle looked better and appeared to suffer less freeze damage than commercial production areas to the north in Glenn and Tehama Counties. However, inclement weather during bloom resulted in a variable and, overall, disappointing fruit set.. Despite the fact that the pollinators had developed well and were judged to have sufficient bloom in close enough proximity to the furthest Manzanillos, there was a clear relationship between yield and proximity of pollinators. It is believed that these results are due to 1.) poor pollination conditions during bloom and 2.) lack of a reservoir of olive aerial pollen which would likely exist in areas of commercial olive production such as Glenn and Tehama Counties where Sevillano plantings are commonly interspersed with Manzanillo plantings. This demonstrates the need for cross pollination of Manzanillo in this area. If we look only at the yields nearest the Sevillanos, they would be considered very good for this year. This is encouraging and would indicate that in years of normal fruit set, this type of a planting should be able to yield equal to conventional plantings.

Labor shortages in 2005 and 2006 and increased labor costs have renewed interest in mechanical harvest which is now seen as essential to the survival of the California table olive industry. During 2006, the COC funded research for mechanical harvesting which focused on the development of fruit loosening agents and modification of existing machinery to reduce fruit damage and improve harvest efficiency. The funding will be increased for 2007.

It is hoped that this renewed interest will result in a machine being available for testing at Nickels in the future.

This type of tree configuration would be adaptable to other types of mechanical harvest. Having these trees will allow us to study the performance of table olives in this type of orchard configuration and allow us to quickly take advantage of new developments in mechanical harvest.