Investigation of Pruning Strategies for Dried Plums Including Hand, Mechanical and Combinations

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Introduction:

Prune trees are pruned to thin fruitwood, improve fruit size, reduce alternate bearing and control tree size and shape. Hand pruning with ladders and loppers has long been thought to be the best alternative for pruning because of the selective nature of the pruning which cannot be matched by mechanical pruning. Previous studies of mechanical pruning have shown the limitations of mechanical pruning. In a study conducted in Glenn County during the 1990's, pruning severely enough mechanically to achieve equal fruit size and value per ton as hand pruned treatments resulted in reduced yield. New developments in mechanical pruning equipment have made different types of mechanical pruning possible. Because of the cost and availability of labor, growers have continued to look for strategies to reduce pruning costs while maintaining yield and quality. These have included pruning from the ground without ladders using pneumatic pruners, pole chainsaws and long handled loppers and different types and timings of mechanical pruning and combinations of various strategies.

Objectives:

The objectives of this study were to compare different pruning strategies including hand and mechanical at different times and in various combinations to see if these strategies can be incorporated into prune production without reducing returns to a greater extent than the potential cost savings. We realized that the results would be affected by growing conditions during the season and that what was the best treatment one year may not be the best in a different year. Our plan was to initially select a pruning strategy and then use the available tools such as mechanical thinning to optimize that treatment.

Methods:

During the winter of 2005-2006 a mature highly productive block of French Prunes was selected. The block was a north-south planting with a spacing of 14 X 17 ft. or 183 trees per acre. In the winter, 2006, prior to the beginning of the trial, the trees were 17-18 ft. tall. A total of 9 different pruning strategies were selected and applied in a randomized complete block design with 3 replicates. Each replicate consisted of an entire row of 33 trees.

The hand pruned treatment with ladders and loppers (Std) has remained constant during the four years of the trial and is intended to represent a typical dormant hand pruning. The other treatments, in addition to the mechanical treatments, have been hand pruned from the ground without the use of ladders using a combination of pneumatic pole pruners, pole chainsaws and long handled loppers. This pruning has generally, been a less detailed type of pruning that removes fewer larger branches to allow for light

penetration into the canopy. The differential mechanical pruning treatments have included; flat topped (T) at approximately 15 feet, "roof topped" (RT) at 12 feet on the outside of the tree and 15 feet in the row center, "V" by making a slanted cut on the east and west side of the tree row to form a V in the center of the tree 12-14 feet at the bottom center and 17 feet at the top on the outside and a "Mohawk"(MH) where slots were cut in the shoulder of the canopy on both sides of the row, leaving the center uncut. Mechanical pruning timings included, dormant (D), summer (S) in June and post harvest (PH) in September. After the first year, because of an excessively vigorous response to the dormant mechanical pruning and research by others which indicated a less vigorous response when the mechanical pruning was done immediately post harvest, we shifted from the dormant timing to post harvest. Table 2 summarizes the mechanical pruning treatments and timings. The post harvest treatments listed in the table were done the fall before the crop year.

Each year, the plots were harvested and green weights were determined using a load cell attached to the forks of the receiver. Two samples (approximately 100 fruit each) were collected from each plot. Sample weights were obtained before and after commercial drying (courtesy of Sunsweet Dryers, Hamilton City). Screen sizes were determined by running the samples through a sample shaking table at UC Davis. Drying ratio, dry count pound and dry yield per acre were determined. Current PBA prices (2006-2007) and projected Sunsweet prices (2009) were used to calculate value per ton and value per acre based on the sample screen sizes.

Results:

In 2009 the dry yield varied from 5.56 dry tons per acre for the standard pruned treatment to 7.61 dry tons per acre for treatment 7 (summer V in 2007 and 2009) (Table 1.). The average was 6.91. Dry count per pound and value per ton were not improved for standard pruning treatment. Consequently, the reduced yield resulted in the lowest value per acre. Over the four years of the trial the standard pruned treatment had the lowest cumulative yield and value per acre (Table 2.). There were no statistically significant differences in cumulative value per acre between any of the other treatments. Treatment 4 (summer V) and treatment 7 (post harvest V) had cumulative yields that were significantly higher than treatment 1 which was mechanically pruned only in the dormant season of 2006.

Discussion:

During the four years of the trial there have been two years of moderate crop (2006 and 2008) and two years of heavy crop (2007 and 2009). In the first year of the study (2006), all of the treatments had a higher yield and value per acre than the standard pruning treatment (Table 2). This was due to a moderate fruit set overall which resulted in good fruit sizes with no differences in value per ton between treatments. The standard pruning reduced yield without improving fruit size and value per ton. In 2007, fruit set was heavy and all of the treatments required intervention in addition to mechanical pruning. Treatments to size the fruit and prevent tree damage included, mechanical thinning, skirt pruning, cluster thinning with poles, mechanically cutting a narrow alley way (1 to 2 feet) in the row middle and propping as needed. In 2008 all treatments had a moderate crop set and no thinning or additional pruning treatments were necessary. In 2009 the overall

heavier set required mechanical thinning for all of the treatments. Fruit set was reduced from approximately 13,000 fruit per tree to 7 to 8,000 fruit per tree. In July a narrow alley way (approximately 2 feet wide) was mechanically cut into the tree alley to keep the trees from opening up with the heavy crop load.

Throughout the trial the ladder and lopper treatment was often observed to have a better appearance than the other treatments. Leaf size appeared to be larger and the tree color appeared to be a little darker. This did not translate into larger yields or higher value fruit. Over the course of the trial these trees appeared to be getting smaller and to have less fruit wood than the other trees, indicating that they were being over pruned. This probably would not have been noticed without the other treatments for comparison. It is important to note that all of the other treatments were managed to maximize yield and quality according to the fruit set. All of mechanically pruned treatments were pruned from the ground and crop control measures which included mechanical thinning, thinning clusters with PVC pipe, propping and mechanically cutting an alley way to keep the trees from opening up were practiced as needed. These practices resulted in good yields and quality with the less detailed pruning. With the exception of the standard pruned trees, it was often observed that the higher yielding treatments one year would be lower yielding the next year. This resulted in an evening out of the cumulative yield and value over the course of the trial.

In 2006 through 2009, the estimated cost for the hand pruning was $3.25/tree or $594/acre with overhead (workers comp. etc.) included. The dormant pole saw and ground lopper pruning ranged from $1.09 to $2.00 per tree or $200 to $370 per acre. The mechanical pruning was estimated to cost about $40/acre. So, the mechanical plus dormant pole saw and ground lopper pruning ranged from $240 to $410 per acre. As an example, in 2008 the ground hand pruning consisted of 10-20 cuts per tree with pole loppers and 12-24 cuts per tree with long handled loppers. The cost was approximately $2.00 per tree or $370 per acre with overhead.

It should be noted that the trees in this trial are quite tall in comparison to many prune trees (more than 20 feet before mechanical pruning in some cases). It is believed that this height and the resultant higher than average per cent canopy cover help explain the very high yields obtained in this trial. This block was in a wind protected area and despite some concern with the trees in the treatment with the tallest trees (treatment 1 which was mechanically topped only the first year) we did not experience significant blowover problems. It is recognized that this may be a limiting factor for tree height in some locations. However, it believed that many of benefits of the mechanical and ground pruning treatments seen in this trial could be achieved in properly spaced shorter trees.

Conclusions:

Mechanical pruning can be used in combination with less detailed pruning from the ground without ladders using pole pruners, loppers or saws and other cultural practices such as mechanical thinning without reducing yield and crop value while offering significant savings compared to standard ladder and lopper hand pruning.

Table 1. 2009 Yield and Quality Summary

Trt.	09 Mech. Trt.	Drying Ratio		Count / Lb		$ / Ton		Dry Tons / Ac		$ / Ac	
1		3.03	a	60	a	1309	ab	7.15	ab	9424	a
2	S RT	3.21	bcd	64	bc	1232	bcd	7.27	ab	8947	a
3	**Std**	**3.24**	**cd**	**63**	**abc**	**1225**	**cd**	**5.56**	**c**	**6827**	**b**
4	SV	3.05	ab	62	ab	1280	abc	6.72	ab	8635	a
5		3.08	abc	65	bc	1191	d	7.38	ab	8795	a
6	PH T	3.21	bcd	66	c	1189	d	7.27	ab	8711	a
7	PH V	3.15	abcd	64	abc	1202	cd	7.61	a	9188	a
8	PH RT	3.28	d	67	c	1221	cd	6.84	ab	8330	ab
9	PH MH	3.03	a	62	ab	1358	a	6.42	bc	8715	a

Table 2. Treatment and Yield Summary 2006-2009

Mechanical Pruning Treatments					Dry Yield/ac as % of Standard					$/ac
Trt.	2006	2007	2008	2009	2006	2007	2008	2009	Cum 06-09	% of Std Cum 06-09
1	D T				166 a	97 cd	80 c	129 ab	113 bc	117 a
2	D T	S RT		S RT	145 ab	110 abcd	112 b	131 ab	121 ab	122 a
3	**Std**	**Std**	**Std**	**Std**	**100 c**	**100 bcd**	**100 bc**	**100 c**	**100 c**	**100 b**
4	D V	SV		S V	136 abc	114 abc	147 a	121 ab	127 a	129 a
5	D V		PH RT		160 ab	117 a	81 c	133 ab	121 ab	121 a
6	S V		PH T	PH T	166 a	114 abc	100 bc	131 ab	124 ab	122 a
7			PH V	PH V	169 a	116 a	109 bc	137 a	129 a	127 a
8	D RT	SV		PH RT	158 ab	100 cd	113 b	123 ab	118 ab	118 a
9	D MH	S MH		S MH	125 bc	114 ab	115 b	116 bc	116 ab	121 a

D = Dormant, Summer, PH = Post Harvest, Std = Standard or Ladder and lopper, RT = Roof Top, T = Flat Top, V = V cut, MH = "Mowhawk". Numbers followed by different letters are statistically different at the 5% level using Fishers test.