EFFECTS OF CPPU ON MATURITY DELAY, FRUIT FIRMNESS AND FRUIT DROP IN 'FRENCH' PRUNE, 2005

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Abstract

We evaluated the effects of CPPU (2-chloro-4-pyridyl)-N'-phenylurea) on fruit firmness, fruit drop, fruit size, soluble solids and drying ratio in 'French' prune in a commercial orchard in the area of Linda, CA. Applications of 10 and 15 ppm CPPU in a carrier volume of 100 gallons per acre were made on July 14 by commercial orchard sprayer, when fruit was at 6.25 lb pressure, 20.1% soluble solids (%SS, Brix) and at a size of 30 fruit per pound. CPPU treatments were compared to an untreated control; plot size was approximately ½ acre per treatment, using a single tree row per treatment. After approximately 8 weeks, we found that 10 ppm CPPU improved fruit size, dry count per pound, and reduced fruit drop. Both 10 and 15 ppm CPPU improved fruit firmness without reducing Brix. This preliminary study suggests that CPPU may be used to delay maturity, improve fruit quality, increase salable fruit yield and reduce drop.

Objectives and Background

Our objectives for 2005 were to reduce or prevent preharvest drop, improve firmness and allow delayed harvest in 'French' prune with CPPU without negative effects. We tested two concentrations to determine best concentration for desired results, measured fruit firmness and %soluble solids at application as a reference for 'best' time to spray, based on physiological maturity. If CPPU is found to improve firmness and delay maturity, we intend to establish recommendations for effective application rates and dates based on fruit maturity (firmness and soluble solids) for the purpose of spreading out harvest over a longer time period to better utilize limited dryer space. 'Stop drop' trials in 'French' prune conducted throughout the 1990's by Southwick, Glozer, Yeager and various cooperators, concentrated on GA (Ralex®) and ReTain® (Valent BioSciences), an ethylene synthesis inhibitor. Ralex was found to improve firmness and best time of application was at Brix = 12-14%, or slightly higher with a heavy crop load. The best firmness increase was approximately 0.8 lb pressure (Southwick et al., 1999). The best harvest extension was three days, however, fruit drop was unaffected, as were fruit size and yield. ReTain® did not decrease drop of either normal or blue prunes during the last 2.5 weeks prior to harvest, did not affect soluble solids, fresh weight, dry weight, count/lb, but did increase fresh yield (and higher dryaway) and increased firmness at two days prior to the conventional harvest. The beneficial effect on firmness was not apparent until two weeks post-application, and potential for delayed harvest can only be estimated as the commercial harvest could not be delayed.

Plans and Procedures

Single tree rows were used compare an untreated control to single applications of either 10 or 15 ppm CPPU, + adjuvant (0.1% Regulaid) on 14 July, 2005. The trial was conducted in Linda, CA

on ‘French’ prune on either Myrobalan (P. cerasifera) seedling rootstock or on Myrobalan 29C rootstock. Trees on seedling rootstock were planted in 1983, the trees on 29C rootstock were planted in 1997-1998, in a 20' x 20' spacing (108 trees/acre). The soil type was Valdez silt loam. Typical yield is 1.5 tons per acre. Treatments were applied by the grower in cooperation with Glozer and Niederholzer, using an orchard sprayer (Nelson Manufacturing Hardi PTO 4000P) and a carrier volume of 100 gallons per acre. CPPU (KT-30) had been solubilized 24 hours prior to use in 100% isopropanol; solutions were tank-mixed immediately prior to usage. Ten fruit per tree were randomly selected from four trees with typical crop load in the trial tree block and size, firmness and Brix determined at time of treatment. Firmness was 6.25 lb, Brix was 20.1% and size was 30 fruit/lb. Commercial harvest was delayed until 7 September and experimental harvest occurred on 2 September. Six single tree replicates were selected from each treatment row as having a crop load representative of the orchard overall, with similar crop load between younger and older trees. Dropped fruit were counted from 1/4 of the area under each tree. 100 fruit per replicate tree were randomly selected from all exposures, representing inside and outside areas of the canopy and fruit from low positions to approximately 2 meters from the soil surface. These fruit were weighed before and after drying to calculate fresh weight, dry weight, count per lb and dryaway (drying ratio). An additional 25 fruit were similarly sampled for fruit weight as a combined sample, then 10 were subsampled for Brix as a combined sample and the remaining fruit were evaluated for fruit firmness with a Magness-Taylor type penetrometer with a tip of 8 mm diameter and a reference mark at a depth of 7.5 mm. Fruit were dried commercially by the grower. Analysis of variance and mean comparison tests were used to compare treatments effects.

Results and Conclusions

The application date of July 14 was in anticipation of an early commercial harvest, however, fruit maturation slowed and the grower was able to harvest our trial block at the end of all his prune harvests in order to maximize ‘time to hang’ for a critical test of harvest delay. We found that Brix was not different among treatments (Table 1); Brix surpassed the normal limitation of 24%SS (Miller, 1981), probably due to some dehydration, although the fruit did not appear to be senescent in that no browning was observed. Brix is one of three maturity indices and may be considered the least desirable index of maturity (Miller, 1981), although it, with size, best predicts yield. Pigmentation, a second index of maturity, appeared to be the same among treatments, although this was not critically measured by instrumentation as fruit were all clearly ripe. Color tends to be the best indicator of maturity in prune as green color is undesirable. Firmness, the second best maturity index, is typically used with Brix by growers to determine ripeness. However, if treatment, crop load or irrigation practices change either of these indices, the decision of when to harvest is less clear-cut. In this case, when one of the goals was to increase firmness with respect to physiological maturity, one might expect that all three indices should be used, as well as the amount of preharvest drop.

We found that both CPPU treatments improved firmness significantly, compared to the control, and that the improvement was by more than ½ lb. The control fruit averaged 1.3 lb and the CPPU-treated fruit averaged 1.9 lb, both well below the optimum of 3-4 lb (Miller, 1981), due to the harvest delay. Fruit were significantly larger in 10 ppm CPPU treatments. Fresh weight per 100 fruit was approximately ½ lb improved by treatment with 10 ppm CPPU, individual fruit

weight was improved by approximately 30% by 10 ppm CPPU, and dry cont per pound was 83 vs 108 in 10 ppm CPPU vs the control, respectively. Drying ratio was statistically equal among treatments. This size improvement, in addition to a significant reduction in fruit drop (30% less fruit lost calculated as dry yield), would significantly improve yield and fruit quality (size). In all cases 15 ppm CPPU gave results intermediate to those of the 10 ppm treatment and the untreated control, thus, no benefit to increased concentration was found. This is an important finding as it gives us an idea of upper limit that is useful and decreases the potential cost to the grower. No evidence of phytotoxicity was observed.

While CPPU, as a cytokinin, might be expected to improve fruit size when applied shortly after bloom, it is unanticipated that it would improve fruit size when applied well into Stage III of fruit development. The outcome of this preliminary study is that CPPU shows promise as an agent for delaying maturity in 'French' prune, reducing drop, increasing size and maintaining firmness. The improvements in this trial were substantially better than those in previous trial with GA or an ethylene-synthesis inhibitor. CPPU is currently registered in California for use on kiwifruit and table grapes under the trade name PrestigeJ (Valent Biosciences).

References

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Southwick, S., R. Moran, J. Yeager, K. Glozer and A. Bonin. 1999. Use of Ralex® (gibberellin) for delay of fruit maturity, improved dry ratio and larger fruit size 'French' prune. Report to California Dried Plum Board.

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Table 1. Effects on firmness, size and other quality indices in 'French' prune in 2005 by application of CPPU (2-chloro-4-pyridyl)-N'-phenylurea).

Treatment	Wt /100 fruit (lb fresh)	Drying ratio	Dry count/lb (size count)	Fruit weight (g)	%Soluble solids	Firmness (lb)	#Fruit dropped cumulatively[Y]	Calculated yield lost to preharvest drop (lb)
Control	2.58 b [X]	2.69 a	107.5 a	18.7 b	29.5 a	1.30 b	1175.2 a	10.9 a
10 ppm CPPU	3.10 a	2.55 a	83.0 b	22.9 a	28.4 a	1.89 a	651.2 b	7.8 b
15 ppm CPPU	2.89 ab	2.66 a	91.8 ab	21.8 ab	28.3 a	1.88 a	756.8 ab	8.2 ab

[X] Mean separation within columns by Duncan's Multiple Range test, P = 0.05.
[Y] Actual fruit drop was taken on 1/4 of ground below tree, thus this number represents a whole-tree estimate.