CPPU for harvest delay, improved fruit firmness and reduction of preharvest drop in *Prunus domestica* L. (>French= prune), 2007

Kitren Glozer, *Plant Sciences Department, U. C. Davis*

Summary:

Limited testing in 2005 involved a mid-July application of CPPU at 10 and 15 ppm to whole tree rows. Improved firmness, fruit size and reduced drop resulted; there was no benefit in increased concentration. In 2006 and 2007 CPPU (10 ppm) was applied at 4 timings during the growth season beginning at small fruit stage (3-4 weeks after full bloom; Stage I) when fruit averaged 1 cm in diameter and at monthly intervals thereafter. In 2006 the earliest application of CPPU resulted in improved dry yield per tree that may have been due to slightly lower fruit set after early drop. Despite increased early drop, the final number of fruit that dropped cumulatively was lower in this treatment, resulting in lower estimated loss in yield to preharvest drop. Because drying ratio was slightly lower in this treatment than other CPPU treatments (but not the control), the estimated loss was further reduced. Although most results were not significantly different statistically, probably due to small sample size, the numeric differences substantiate results in 2005 that were similar. The percentage of the crop calculated as lost to cumulative drop was 17.7% in the control and 11% in the earliest CPPU timing.

In 2007 the EUP for CPPU had lapsed and crop destruct did not allow a comparison of crop load and yield efficiency. Treatments were similar to those in 2006. Measures of fruit size, firmness, fruit drop, drying ratio and soluble solids indicated benefits similar to those found in previous trials. As crop load was light, there were few limiting factors to fruit quality and preharvest drop, nevertheless, the earliest application of CPPU showed a slight improvement in fresh weight, dry count per pound and firmness. The mid-June application resulted in improved soluble solids, substantially reduced preharvest drop, thus a reduction in estimated yield loss. Applications at 3 to 4 weeks after full bloom appear to improve fruit size and sometimes firmness (possibly due to increased cell number); applications in June to July appear to improve firmness and reduce preharvest drop, allowing harvest delay and reducing yield loss.

Problem and its significance:

In 1997, farm advisors Bill Krueger and Rick Buchner surveyed several orchards in Tehama, Shasta and Glenn Counties on the incidence of fruit drop in >French= prune and found an average range of 11.5-12.5% drop. In orchards under today=s cultural practices a loss of approximately 10% per acre represents a substantial amount of profit. Preharvest drop may be due to several causes, including uneven fruit maturation, heavy set, stress, or endogenous hormonal interactions (Martin, 1981). If preharvest drop were decreased and fruit were held on the tree longer, permitting larger fruit size and higher yield, a significant benefit for the grower would result, both for fresh and dried fruit markets.

Plant growth regulators that improve firmness and slow abscission could be tools to extend harvest in >French= prune, lessening the impact on limited dryer facilities. Growers need an effective, inexpensive strategy for managing production in a climate of decreasing returns. CPPU, a synthetic cytokinin that elicits plant responses at approximately 1/100th the concentration of 6-benzyl adenine, has a variety of uses depending on the species (see Pertinent Literature for an abbreviated list). CPPU is registered in California for use on grapes and kiwifruit. In those crops CPPU enhances fruit size through increased cell division, improves fruit set, reduces fruit drop and improves firmness.

Objectives, 2007:

1. Verify findings in 2005 and 2006 trials

2. Reduce preharvest drop, improve firmness and allow delayed harvest in >French= prune with CPPU

3. Measure fruit size as a result of treatments to determine timing effect on final fruit size

4. Measure fruit firmness and soluble solids at harvest for indication of maturity and treatment effects

5. Measure cumulative fruit drop

6. Estimate benefit in terms of yield

Plans and Procedures, 2007:

Applications were made by airblast sprayer in a commercial orchard near Marysville, Yuba County. Tree spacing was 20' x 20', 109 trees per acre. Trees were mature, flood-irrigated, and moderately vigorous. Treatments were applied to 20 contiguous trees in a total of three tree rows, without randomization; guard trees and rows were between treatments. Ten trees per treatment were sampled for all data. Applications of 10 ppm CPPU (KT-30; 2-chloro-4-pyridyl)-N'-phenylurea) were made with 0.1% Regulaid at 100 gallons per acre, beginning April 10, and at monthly intervals thereafter. Full bloom was on March 18; harvest occurred on August 27. An experimental formulation of CPPU was also applied on April 10 at 10 ppm without Regulaid. CPPU treatments were compared to an untreated control group of 20 trees.

Fruit set was very light due to warm weather during bloom and sampled trees were chosen based on similar cropping and 'best' crop load for current conditions. At sample harvest, 100 fruit were randomly selected from all exposures on each of 10 trees per treatment date, from inside and outside the canopy. These fruit were divided into 90 fruit for calculation of drying ratio after commercial drying and 10 fruit for all other measurements. All dropped fruit were counted under the east half of each tree canopy. Each 90-fruit sample was put into a net bag with fruit was weighed for a 'wet weight' and after drying, for a 'dry weight', from which drying ratio ('dryaway') and number of fruit per pound were calculated. The 10-fruit subsample removed prior to bagging was used for determining individual fruit size, firmness, and soluble solids. Size was determined by weight. Firmness was measured on one cheek per fruit by penetration of flesh after skin removal with a UC penetrometer with a 7.6 mm diameter tip.

Analyses of variance were performed with Proc GLM in SAS (SAS Institute Inc., Cary, NC) and mean separations tested by Duncan=s Multiple Range Test, $P = 0.05$.

Results and Discussion:

Crop load was light, thus fruit quality and fruit retention were not subject to normal limiting resources. Probably as a result, quality improvements and reduction of preharvest drop were less due to CPPU than in more limiting conditions. Most results were slight and non significant, however, trends can be observed (Table 1). Application of CPPU in both formulation on April 10 resulted in improved dry count per pound and firmness compared to the control. The new formulation also improved fresh fruit weight. Applications in mid-June and mid-July improved soluble solids; mid-June application also reduced the number of fruit dropped cumulatively by 26%, thus reduced estimated yield loss by both fresh and dry fruit measures.

Results from three years of limited trials on 'French' prune have shown that early application during Stage I growth tends to improve fruit size and sometimes firmness, probably by enhancing cell division, as is expected for a cytokinin. Greater cell numbers can contribute to firmer fruit. Applications from early June to mid-July have given the best results for decreased fruit drop, improved fruit firmness and estimated yield improvement. Results can be expected to vary year-to-year, with crop load a contributing factor.

Pertinent literature:

Antognozzi, E., A. Battistelli, F. Famiani, S. Moscatello, F. Stanica and A. Tombesi. 1996. Influence of CPPU on carbohydrate accumulation and metabolism in fruits of *Actinidia deliciosa* (A. Chev.). Sci. Hort. 65:37-47.

Flaishman, M.A., A. Shargal, L. Shlizerman, R.A. Stern, S. Lev-Yadun and G. Graft. The synthetic cytokinins CPPU and TDZ prolong the phase of cell division in developing pear (*Pyrus communis* L.) fruit. Acta Hort. (ISHS) 671:151-157.

Iwahori, S., S. Tominaga and T. Yamasaki. 1988. Stimulation of fruit growth of kiwifruit, *Actinidia chinensis* Planch., by N-(2-chloro-4-pyridyl)-N'-phenylurea, a diphenylurea-derivative cytokinin. Sci. Hort. 35:109-115.

Lilleland, O. 1933. Growth study of the plum fruit - I. The growth and changes in chemical composition of the >Climax= plum. Proc. Amer. Soc. Hort. Sci. 30:203-208.

Martin, G.C. 1981. Physiology of fruit set and growth. Pp. 55-60. **In:** Prune Orchard Management. DANR Special Publication 3269 (ed. D.E. Ramos)

Simons, R.K. and M.C. Chu. 1975. Spur/pedicel abscission in plum (*Prunus domestical* L. cv. Stanley) morphology and anatomy of persisting and drop fruits. J. Amer. Soc. Hort. Sci. 100:656-666.

Stern, R.A., R. Ben-Arie, O. Neria and M. Flaishman. 2003. CPPU and BA increase fruit size of 'Royal Gala' (*Malus domestica*) apple in a warm climate. J. Hort. Sci. Biotech. 78:297-302.

Tartini, S., S. Sansavini and M. Ventura. 1993. CPPU control of fruit morphogenesis in apple. Sci. Hort. 53:273-279.

Table 1. Effects on preharvest drop, firmness, size and other quality indices in 'French' prune in 2007 by application of 10 ppm CPPU (2-chloro-4-pyridyl)-N'-phenylurea) at 4 timings during growth season. Full bloom was March 18; harvest occurred on August 27.

Timing	Wt /90 fruit (lb fresh)	Drying ratio	Dry count/lb	% Soluble solids (Brix)	Firmness at harvest (lb)	#Fruit dropped per tree [Y]	Estimated loss to preharvest drop (lb)	
							Wet	Dry
Control	5.3 a [X]	2.6 a	44.8 a	23.5 b	1.7 b	225.8 a	13.3 a	5.1 a
10 April	5.4 a	2.6 a	43.6 a	22.5 b	2.0 a	198.2 a	11.6 a	4.4 a
10 April new formulation	5.6 a	2.7 a	43.7 a	24.0 ab	2.0 a	192.8 a	12.0 a	4.6 a
10 May	5.0 a	2.6 a	47.8 a	24.6 ab	1.7 b	257.6 a	14.1 a	5.3 a
11 June	5.0 a	2.6 a	46.7 a	26.1 a	1.9 ab	168.2 a	9.2 a	3.6 a
11 July	5.3 a	2.7 a	45.6 a	25.8 a	1.8 ab	220.8 a	12.8 a	4.8 a

[X] Mean separation within columns by Duncan's Multiple Range test, P = 0.05; ns = non significant differences.

[Y] Fruit drop per tree based on count made for half of tree.