DRIED PLUM CULTIVAR DEVELOPMENT AND EVALUATION

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INTRODUCTION

California is the world leader in dried plum production, but is almost entirely dependent on the use of a single cultivar, the Improved French prune. The utilization of this older cultivar and several other mutations from the French type represents 98% of the total dried plum acreage in California. This monoclonal situation with its genetic similarities lends itself to vulnerability of widespread disease and pest outbreaks and state wide yield decline due to the effects of negative weather. In addition to the risks of monoculture, the entire industry needs to harvest and dehydrate the crop within a few weeks since the single cultivar matures around the same time. The development of new acceptable or superior dried plum cultivars will increase the efficiency of California dried plum production and give some protection against the risks involved with a monoculture. The industry will also benefit from the development of new dried plum varieties that have cost saving characteristics in tree structure, processing qualities, and tolerance to pest and disease. There is also the possibility of broadening the consumer base by the introduction of new dried plums that differ in flavor or color to French.

The Dried Plum (*P. domestica*) Development and Evaluation program has enlarged the germplasm and bred new generations of progeny through traditional horticultural breeding methods since its conception in 1985. Through nineteen years of evaluation and selection, the breeding program has increased the variability of desired characteristics in the germplasm. To insure that the germplasm and new cultivars are well adapted to California's dry, hot climate, the program evaluates elite selection blocks at two locations; a northern research station of Wolfskill, in Winters and a southern research station of Kearney, in Parlier. The breeding program is now entering what is expected to be a very productive period for producing new cultivars that are specifically adapted for California growing conditions and markets.

The successful development of the cultivar Sutter Prune came from the earlier stages of the breeding program. Sutter is a productive, high quality drying plum that matures seven to ten days ahead of Improved French. The fruit of Sutter is large, medium dark purple in color and covered with a medium waxy bloom. The fruit resembles French prune in shape and develops about 2 degrees more soluble solids than French when compared at the same location. The tree of Sutter is similar in form and vigor to the French and is a regular bearer. Sutter has been successfully propagated on Marianna, Myrobalan 29C and Myrobalan seedling rootstock. Sutter has been successfully test processed using both the Ashlock and the Sunsweet pitters. Fruit of the new cultivar dries into a very high quality dried plum. Although the external appearance of the Sutter is similar to French, the dried flavor is lighter, with a more complex fruity flavor and sweeter taste. The Sutter cultivar was released from this program in the year 2000 and is now becoming established in the California industry.

Muir Beauty is an excellent dried plum that has been released as a cultivar in 2004. The fruit of Muir Beauty matures in early August about 10 to 15 days before the industry standard Improved French when grown at the same location. The fruit is large, oval in shape, without a neck. The skin is a purple-rose color with a grayish medium thick waxy bloom. The fresh fruit flesh color ranges from a dark gold to a golden-orange. The dried fruit is large, shiny black in color with larger but fewer wrinkles than Improved French. The dried flesh retains the golden color of the fresh fruit. The pit of Muir Beauty is medium size and varies from semi-free to freestone. Limited pitting tests have resulted in easy pit removal. In taste tests, Muir Beauty is described to have a thick, meaty fruit texture with a pleasant well-balanced fruity flavor. The tree is a vigorous grower with an upright form and is a very productive regular bearer. Muir Beauty has been grown successfully on plum rootstocks, Marianna and Myrobalan. The tree is more precocious than Improved French, flowering and fruiting at an early age. Muir Beauty is self compatible and is able set a heavy crop without additional pollination.

We have recently discovered and are evaluating dried plum selections that include a wide variety of flavors and dried fruit characteristics that are superior to the commonly produced French cultivar. These new dried plums have the potential of revitalizing the California dried plum industry.

PROGRAM OBJECTIVES

1.) To develop new dried plum varieties, through traditional horticultural breeding methods, with the following characteristics:
   A) Tree characteristics that reduce labor cost involved in producing dried plums.
   B) Increased fruit quality and improved fruit characteristics that increase efficiency and quality of drying and processing.
   C) New specialty traits; with the dried product being equal or improved in quality to “Improved French”, but differing in taste or color.
   D) Tolerance/resistance to disease.
   E) Earlier/later fruit maturity dates than “Improved French” dried plum.

2.) Test and evaluate advanced selections resulting from the current breeding program at UC and grower locations in the Sacramento and San Joaquin Valleys.

PROCEDURES

Breeding Methods

The breeding strategy of the program is separated into four distinct phases each having a distinct purpose and crossing method. The first phase involved progeny testing of dried plum cultivars, which historically have shown adaptation to California growing conditions. Open pollinated seedling populations derived from each cultivar were screened with the standard fruit evaluation and individuals were identified that expressed precocity of bearing (shortened juvenility), spread of maturity (both early and late), freedom from heat damage (in both fruit and tree) and vigorous

seedling growth. The superior seedlings from Phase 1 were advanced as parents in the next phases.

The purpose of the Phase 2 was to increase the diversity of the germplasm by breeding cultivars that had positive characteristics but had not been used in California production. Superior seedlings possessing commercial cultivar characteristics could have been potentially identified at any point in this program, but because of the diverse parentage of Phase 2, few selections resembled French type prunes. To promote French type characteristics a third phase of breeding began.

In Phase 3, the program used Improved French as a common parent in the majority of its breeding crosses. This phase produced seedling populations that contain at least 50% French genome and have a high potential for producing fruit similar to French on vigorous, precocious and productive trees. The probability of attaining a commercial cultivar in Phase 3 was much greater than in Phase 1 and 2.

New objectives for the breeding program were directed in 1999 to include disease and pest tolerance and in 2004 to include cost saving tree characteristics as a priority. The breeding strategy has changed to include these new characteristics in addition to its goal of superior fruit quality and varying maturity dates. The breeding program's Phase 4 addresses the new objectives and continues to broaden and strengthen the germplasm base. The superior seedlings selected out of Phase 3 and Phase 2 are being used in hybridizations to create new combinations that will be selected for high quality French type characteristics. The breeding phases have created and expanded the UC *Prunus domestica* germplasm into a strong and diverse collection of advanced items and a wealth of seedling families from which to select the next generation of California dried plum cultivars.

Pollination and Seedling Cultivation

The annual workings of the breeding program begin at pollination. A pollination list is planned by selecting the parents from the top selected items that show the potential of becoming new cultivars and from the items that have been selected on their breeding potential but lack the potential of becoming cultivars themselves. Flowers from the pollen parent are collected from the trees at the popcorn stage of bloom. The fully closed flowers are removed from the trees and the stamens are separated by rubbing the flowers over a clean screen. The stamens are dried at ambient temperature to release the pollen. The pollen is stored in vials in the refrigerator. Limbs of the seed parents are chosen for crossing when the flowers have reached 40-50% of full bloom. All of the open flowers are removed from the limbs and discarded. The remaining closed flowers are emasculated (petals and stamens are removed) with tweezers, leaving only the pistil and ovary attached to the tree. The collected pollen is placed on each individual pistil of the selected limbs. Five hundred to fifteen hundred flowers are pollinated for each desired cross to ensure a moderately sized progeny family. The large numbers of pollinations are needed because fruit set can be variable due to a variety of factors; poor weather, pollen non-viability, parental incompatibility, and manual damage. The fruits formed by the pollinations are left to mature on the tree until about 10 days before fruit ripening.

Seedling culture is the care of the seedlings from seed to nursery. The first step is the collection of the fruit from the pollinations. The fruit is stored at 32º F until the time of seed removal. The

seed is removed from the fruit in early fall and placed in plastic bags with moist paper towels that contain antibiotics and fungicide. The seed is then stratified for 2 months at 37-45º F. After stratification the seed coats are peeled off each seed to remove any growth inhibitors that might still be present. The peeled seed is planted in cones filled with potting soil. The planted cones are placed in a greenhouse where they germinate under mist. The mist is removed after germination is complete. The seedlings grow in the greenhouse with ample light, heat, and nutrients until their stems have begun to harden and are about 12 inches tall. They are then acclimatized in a lathhouse before being planted in a commercial nursery. The benefit of a professional nursery is that they grow the seedlings in a healthier and less expensive manner then we are able to do at the university research stations. At the end of the first growing season, the seedlings are undercut and returned to the university where they are planted in the high density seedling blocks at the Davis campus research orchards.

Selection and Evaluation

Selection and evaluations begin with the first time the seedlings bloom. Each tree is noted for precocity and is checked later to see if it successfully set fruit. When a seedling sets its first sizable crop, the fruit is evaluated in the field setting. Maturity date, tree vigor, crop load, fruit size, fruit color, internal flesh quality, pit size, pit type (cling or free), fresh taste, and external flaws are recorded in a field notebook. During this first evaluation, trees can be discarded on the basis of any of these characteristics, except for crop load which is usually only used as a disqualifier after several years of cropping. Some examples of first year disqualifiers are high acidity or astringency, extremely tight pit, large pit size, split pits, gas pockets, lack of firmness in flesh, green or mottled color, small fruit size, deep sutures, cracks on side or ends, heat damage, russet scab, and early fruit drop.

If the field evaluation of a seedling is positive and the fruit quality shows potential, a sample of ten fruit is collected and a secondary fresh evaluation is done in the laboratory. This evaluation is done on the same day as the field evaluation. The fruit is weighed and the average fruit weight (g) is recorded. The maturity of the fruit is estimated by pressure testing the flesh of the ten fruit and recording the average (PSI). The average soluble solids (Brix) are sampled by taking half of each fruit and pulverizing them together in a blender then examining the clear juice with a refractometer. Again, taste and any exterior or internal flaws are recorded. If the sample shows a high soluble solids compared to other samples at that ripening date and the flavor and fruit quality are above average then a larger sample is collected from the seedling for test drying. If the sample shows low soluble solids or poor fruit quality then the seedling is either marked for discard or evaluation in the next year.

The next step in the evaluation system is to test dry the harvested samples. The program uses the UC Davis Pilot Plant facility's 'Harvest Saver' dehydrator to dry the fruit. The samples are placed in net bags and washed before drying. They are dried for two hours at 185º F after which the temperature is lowered to 165º F for the remaining time. Samples are dried between 18 to 24 hours depending on filled drier capacity and individual sample characteristics. The dried plum samples are weighed before and after drying and the fresh to dry ratio is calculated. The dried fruit count per pound is recorded. The samples of dried fruit are stored at 32º F until the late fall when the final evaluation takes place.

The last evaluation for the year is the rehydrated or processed evaluation. The dried plum samples are rehydrated by submerging the fruit in water that is between 185-203 º F for six to eight minutes. The rehydrated dried plums are placed in a plastic bag and stored in a refrigerator until their moisture content has equalized. Ted DeJong, Jim Doyle and Carolyn DeBuse evaluate the processed dried plums. The dried plums are evaluated for fruit size, fruit color, color uniformity, surface wrinkles, skin peel, surface brightness, fruit shape, pit size, pit adherence, flesh color, flesh quality, and taste. Taste and appearance play a large role in the advancement of a seedling selection. Items are discarded if any of these traits do not equally compare to or exceed the standards set by the cultivar, Improved French.

The evaluations described above take place at all four levels of testing but the emphasis on individual traits changes at each level. More emphasis in Level 1 is given to the actual fruit characteristics during the processed evaluation. In Level 2 and 3 testing, the whole tree characteristics are emphasized, such as time of maturity over varying environments, annual bearing habits, crop load, and tree structure. By the time a selection is in a Level 4 test the fruit and tree characteristics have shown to be of cultivar standards and emphasis is given to the commercial growing, handling, and marketing qualities of the selection. This extensive multi-year evaluation system ensures that cultivar releases are of the highest quality.

Levels of Testing

Field testing and evaluation of dried plum selections developed within this program are being carried out at four levels.

Level 1 testing involves evaluations made in the seedling blocks located at UC Davis. The initial fruit evaluation is made on the original self-rooted seedlings in the high density seedling blocks. Primarily, fresh and dried fruit characteristics are evaluated at this level of testing. If a positive evaluation results the seedling becomes a “selection” and is then considered for re-propagation in dried plum selection blocks located at Kearney and at the Wolfskill Experimental Orchard at Winters, CA.

Level 2 testing occurs in the selections blocks at Kearney and Wolfskill. Depending on the perceived potential of the individual selection, from two to four trees of any one selection are established on commercial rootstocks. This level of testing is concerned with fruit characteristics and whole tree characteristics. Variations in fruit size, tree vigor, maturity date and other characteristics may, and often do, occur when the selection is moved onto a rootstock from the original seedling. Most individual selections are re-fruited in the selection blocks prior to advanced testing with growers.

Level 3 testing involves the establishment of advanced selections in grower orchards in various dried plum growing locations. Testing at this level is still somewhat preliminary since these plantings are the first level at which selections are established on varying soil types and in varying climatic regions. Again, depending on the perceived value of the individual item, from two to fifty trees of any one selection are established at any one location. Level 3 grower tests are established in counties throughout the Sacramento and San Joaquin Valleys where dried plums are a commercial crop.

Level 4 testing involves the planting of small test acreage, usually of a single targeted selection. The size of these Level 4 tests depends on the apparent potential of the individual selection and the level of risk that the cooperating grower wishes to assume. Planting size ranges from twenty five up to several hundred trees. Commercial value of an item can be established in test markets with the expanded production of Level 4 testing.

RESULTS

Level 4 Testing

Level 4 testing evaluates the commercial value of advanced selections and looks at the potential markets for the item. The program is evaluating three items at this level. The first is the newly released cultivar, Muir Beauty (UCD # D6N-72), that was released in January 2004. The second is the 2000 released dried plum cultivar, Sutter. The third is Tulare Giant, a 2000 fresh market release.

Muir Beauty (D6N-72)

Muir Beauty is an excellent dried plum that has been released as a cultivar in 2004. This dried plum was developed from a controlled pollination of Improved French to Tulare Giant in the year 1992. It was selected in 1997 from the Davis seedling orchards and propagated both advanced selection research orchards, Wolfskill and Kearney, in the following winter. The fruit of Muir Beauty matures in early August about 10 to 15 days before the industry standard Improved French when grown at the same location. The fruit is large, oval in shape, without a neck. The skin is a purple-rose color with a grayish medium thick waxy bloom. The fresh fruit flesh color ranges from a dark gold to a golden-orange. The fresh fruit soluble solids range from 20.0- 24.0 degrees Brix. The dried fruit is large, shiny black in color with larger but fewer wrinkles than Improved French. The dried flesh retains the golden color of the fresh fruit. The pit of Muir Beauty is medium size and varies from semi-free to freestone. Limited pitting tests have resulted in easy pit removal. In taste tests, Muir Beauty is described to have a thick, meaty fruit texture with a pleasant well-balanced fruity flavor.

The tree characteristics of Muir Beauty are similar to both Improved French and Sutter. The tree is a vigorous grower with an upright form and is a very productive regular bearer. Muir Beauty has been grown successfully on plum rootstocks, Marianna and Myrobalan. The leaves are moderately large in size, deep green in color and relatively shiny. The tree is more precocious than Improved French, flowering and fruiting at an early age. The fruit is born on one-year-old shoots and older spurs. The time of full bloom is 7-10 days before Improved French blooms. Muir Beauty bloom overlaps with the bloom of Tulare Giant very well. Muir Beauty is self pollinating and is able set a heavy crop without a pollinizer cultivar. The fruit hangs well on the tree with no more than normal pre-harvest drop. A small mechanical tree-shaking trial removed all the fruit from the tree with no damage to fruiting spurs or tree structure.

Muir Beauty set a normal crop on all of the mature trees at both Kearney and Wolfskill research plots this year. At the 2002 grafted grower trials, the younger trees set lighter crops which were consistent with their age. This years fruit set indicates that Muir Beauty may be tolerant to hotter drier weather at time of bloom. Table 1 displays the 2004 harvest dates and fresh fruit data for Muir Beauty compared to French.

Sutter

Sutter was released from this program in 2000 and many growers have taken the opportunity to plant acreage of Sutter. The California acreage is small but growing and in the next few years the first crops will be harvested and sent to the processors.

The fruit set this year was light at all trial locations and research stations. This variety seems to share the same vulnerability to hot dry weather at bloom time that Improved French has shown this year and historically. Table 2 displays the 2004 harvest dates and fresh fruit data for Sutter compared to French.

Table 1. Muir Beauty 2004 harvest dates and fresh fruit data.

Location	Selection	Testing Date	Soluble Solids (Brix)	Fresh Fruit Weight (grams)	Crop Size
Kearney Ag. Center	Muir Beauty	7/28	20.5	41.5	Medium
	French	7/28	18.6	25.8	Light
Madera County	Muir Beauty	7/26	21.0	47.5	Light
	French	7/26	18.5	29.8	Light
Winters Research	Muir Beauty	7/27	22.0	42.8	Medium
Orchards	French	7/27	23.5	30.2	Light
Sutter County	Muir Beauty	7/28	22.4	43.6	Light
	French	7/28	20.8	22.4	Light
Tehema County	Muir Beauty	7/28	22.5	42.7	Light
	French	7/28	17.5	27.1	Light

Table 2. Sutter 2004 harvest dates and fresh fruit data compared to French.

Location	Selection	Testing Date	Soluble Solids (Brix)	Fresh Fruit Weight (grams)	Crop Size
Kearney Ag. Center	Sutter	7/26	25.0	33.6	Light
	French	7/28	18.6	25.8	Light
Winters Research	Sutter	7/27	28.0	25.5	Medium
Orchards	French	7/27	23.5	30.2	Light
Davis	Sutter	7/28	25.8	29.7	Medium
	French	7/31	24.0	32.4	Light
Tehema County	Sutter	7/28	26.8	29.5	Light
	French	7/28	17.5	27.1	Light

Tulare Giant

The results of the 2003 pollen self-compatibility experiment showed that Tulare Giant is only partially self-fertile. The cultivar did set a minimal amount of fruit but the reduced set could not be considered an economically profitable crop. Tulare Giant requires another *Prunus domestica* cultivar as a pollinizer to set an economic crop. In 2004, an experiment was conducted to test the compatibility of Muir Beauty as a possible pollinizer for Tulare Giant. Muir Beauty bloom time overlaps Tulare Giant's bloom time quite well and with a large quantity of flowers it would be a very good pollinizer. A pollen isolation cage was placed over a Tulare Giant tree at the Wolfskill orchard and bouquets of Muir Beauty were placed within the cage. The resulting fruit set was very heavy and hand thinning was required to reduce the finally crop size to commercial level. Muir Beauty is now the recommended pollinizer for Tulare Giant.

Level 3 Testing

Level 3 testing is the evaluation of selections that are being grown and tested in grower's orchards. Two new items are to be added to Level 3 tests this year, D6N-103 and 6-21-56. D6N-103 is a high sugar prune that looks very similar to French in shape and color. The dried fruit is a shiny dark brown appearance with a meaty flesh. It is a larger prune than French and may do very well in a specialty market. 6-21-56 is a beautiful, shiny dried fruit with remarkable flavor, scoring in flavor among the top choice in the last three years. Three previous items that have been tentatively identified for Level 3 testing are D9S-95, D9S-61, and D10N-16. D9S-95 is an early maturing, fruity flavored prune. D9S-61 matures a few days before Muir Beauty and has high quality processed appearance. D10N-16 matures between Sutter and French and has a rich flavor. These selections are now being evaluated at the research orchards and will be grafted into grower orchards after the trees are cropped and evaluated for one more year to ensure that they are worthy of the increased investment of a long term grower trial.

Level 2 testing

Level 2 testing evaluates a selection after it has been promoted from the Davis seedling blocks to the advanced selection blocks at Kearney and Wolfskill. Whole tree characteristics along with continued fruit characteristics are evaluated. This year the fruit set at both locations were variable due to the hot weather at bloom time. Many of the selections seemed unaffected by the weather and set large crops while other selections seem to be prone to decreased fruit set similar to Improved French. This gave us an opportunity to collect data on selections that may become heat tolerant cultivars or parents of future progeny that show the same heat tolerant characteristic. Table 3 shows the harvest data of the top elite selections this year.

Table 3. 2004 Harvest data for advanced selections in level 2 testing.

Selection	Harvest Date	Days From French	Soluble Solids %	Fruit Size (ct/lb)	Crop Load
6-22-51	6/30/04	-40	23.0	59	Medium
D4N- 98	7/8/04	-32	26.0	47	Medium
4-6E-6	7/19/04	-21	22.0	57	Heavy
D2N- 76	7/20/04	-20	25.0	41	Medium
D9S- 95	7/20/04	-20	24.5	46	Light
D6S- 87	7/27/04	-13	25.5	46	Light
D10N- 16	8/9/04	0	21.3	53	Light
3-12E-2E	8/9/04	0	27.0	30	Heavy
6-21-56	8/9/04	0	31.2	39	Medium
French	8/9/04	0	26.0	40	Light

Level 1 Testing

Level 1 testing evaluates the young seedling selections at Davis. The young tree fruit sets were also affected by the hot dry weather at bloom similar to the other orchards, where some trees set good crops and others set no crop. This phenomenon suggest that all seedlings evaluated this year probably fall into the category of heat tolerant at bloom time. Table 4 shows the harvest data of the top seedlings evaluated at level one this year. All of these seedlings will be promoted to level 2 testing in 2005.

Table 4. 2004 Harvest data for seedling selections in level 1 testing.

Selection	Harvest Date	Days From French	Soluble Solids %	Fruit Size (ct/lb)	Crop Load
G3S- 2	7/2/04	-42	21.0	67	Heavy
G10S- 22	7/12/04	-32	21.8	57	Medium
F1S- 63	7/15/04	-30	20.0	61	Medium
F5S- 70	7/22/04	-22	26.0	45	Medium
F1S- 50	7/22/04	-22	25.0	53	Medium
F13S- 46	7/30/04	-14	23.0	58	Medium
F11S- 38	7/30/04	-14	30.0	53	Light
F8N- 68	8/4/04	-9	24.0	42	Light
E7S- 72	8/13/04	0	26.0	51	Light
E13S- 60	8/13/04	0	24.6	53	Medium
E7S- 83	8/23/04	10	24.8	68	Medium
E7N-28	8/23/04	10	23.8	73	Medium
F2N- 10	8/26/04	13	25.0	40	Medium

Program Inventory

All the seedling blocks are now located in the UC Davis campus research orchards. The central location of these young blocks has increased the efficiency of the field and lab evaluations and the sample drying process. In the summer of 2004, 1005 seedling trees were discarded because the seedlings showed negative fruit or tree characteristics. This year 558 seedlings new seedlings were added to the youngest block, G, as one-year-old, nursery grown seedlings. One hundred and seventeen fruit samples were processed for the advanced rehydrated tasting evaluation in October. Seventeen selections were promoted to level 2 testing and will be replicated and placed into the elite selection blocks. The seedling current inventory is shown in Table 5.

Table 5. Seedling block inventories located in Davis UC research orchards.

Block	Acres	Year Planted	Seedlings Planted	Seedlings Remaining	Advanced Selections
E	2.2	1999-2000	2,100	1,204	19
F	2.4	2000-2001	2,240	1,292	13
G	5.8	2001-2004	4,554	4,360	2
Nursery	1.0*	2004	905	905	
Seeds		2005	(3309)♦		
Totals	11.4		9,799Δ	7,761	34

*to be planted

♦potential number of seedlings in 2005

Δnot including 2005 seed

The elite selection blocks have a total of 410 trees of selected genotypes and 146 additional rootstock trees for future propagation of selections. Multiple propagations are made of each advanced selection. Between 2 and 10 trees are propagated per selection depending on perceived potential. Of the 410 trees, there are 187 individual scion genotypes, 23 of these are cultivars, 78 are parental breeding stock, and 86 are advanced selections in Level 2 testing.

UTILITY of TREE STRUCTURE

This year growers have shown an interest in selecting new cultivars that have a tree structure that would reduce labor costs involved in pruning and fruit thinning. The tree structure of the common cultivar, Improved French, annually grows a few feet in height and adds a large amount of new fruit wood. Though this growth habit helps in revitalizing fruit wood, it requires annual pruning involving many hours of labor and the use of ladders. The cost of both labor and worker compensation insurance are rising and it would help reduce grower costs if the tree structure of a new cultivar required less annual pruning. Fruit thinning is also an annual expenditure that is commonly done by machine shaking of the tree. If the tree structure had less fruit wood or a lighter bloom with consistent fruit set the operation of fruit thinning could be avoided. This summer, in July, we held a grower field day at Wolfskill to address the question of cost saving tree structure and examine the differences in tree structure characteristics that exist in our elite selection block.

A spur type bearing characteristic may reduce pruning costs and minimize the time needed on the ladder. The spur type bearing characteristic is when the fruit is set on short spurs located directly on the scaffolds or on short branches that derive from the scaffolds (Figure 1). A spur type tree does not grow the numerous, short fruiting branches that is common in French and it also has less of a tendency branch out on top. The reduction of new annual wood reduces the amount of time needed to prune the tree.

a.

b.

Figure 1. A spur type bearing characteristic found in the elite selection UC# 2-6E-9. (a.) whole tree (b.) scaffold.

Columnar tree structure may also reduce pruning cost and make it possible for higher density orchard plantings. Higher density orchards may increase production efficiency and may improve the yield per acre on young orchards. A columnar tree is a tree that has a vertical growth habit for its branches and scaffolds with very little horizontal growth initiated (Figure 2 (a.)). The trees that show this characteristic productively bear fruit with comparable yield per foot of wood as other tree types. The advantage would be that tree spacing could be reduced and once the trees are mature very little lateral pruning is necessary.

a. b.

Figure 2. (a.) Columnar tree structure of UC # 4-8W-55. (b.) Small stature tree UC # D15S-92 compared to the same aged graft grown in the same row behind it.

A final consideration on type of tree structure that would reduce pruning cost would be a small stature tree. A small stature tree which did not need its height reduced by pruning annually could eliminate the use of ladders in the orchard. In the recent years, the elite selection of UC #D15S-92 has scored very high in all the fruit quality evaluations. The newly grafted D15S-92 trees in the research blocks show a tendency to have a smaller stature when compared to equal aged grafted trees (Figure 2 (b.)). This characteristic may lend itself to lowering the height of the mature tree.

The characteristic of lighter bloom on less fruit wood may decrease the need for fruit thinning. A few of the selections in the germplasm show a tendency to have a lighter bloom than French. UC # 4-6E-6 has shown this characteristic of a lighter bloom through out the years and requires no thinning but regularly sets a good crop (Figure 3).

Figure 3. UC #4-6E-6 showing the resulting fruit set without fruit thinning in 2004.

RELATED STUDIES

Temperatures at Bloom Correlated With Fruit Set

The spring of 2004 had abnormally high temperatures and low humidity at the time of bloom across the whole dried plum growing region of California. Historically, it has been shown that high temperatures at the time of bloom have a negative effect on Improved French's fruit set. This year the total crop yield of the state was the lowest reported in history mainly because of these negative effects. The devastating losses may have been avoided or minimized if there were multiple cultivars of dried plums planted that had variation in their response to high temperatures at bloom. To see if genetic variation for this characteristic exists in the germplasm of the Dried Plum Breeding Program we compared fruit set among the elite items and cultivars.

The first step in making the comparisons was to examine the temperatures over the blooming period at Kearney and Wolfskill this year compared with the more normal temperatures of last year (Figure 4). Average maximum air temperatures in 2004 were 13-14°F higher compared to 2003 at both locations. The minimum air temperature difference was only 5°F higher in 2004 than 2003 at both locations. The 2004 maximum temperatures were consistently higher throughout the bloom period than in 2003. This temperature difference and probably an associated low humidity are thought to be the cause of the lower Improved French fruit set in 2004.

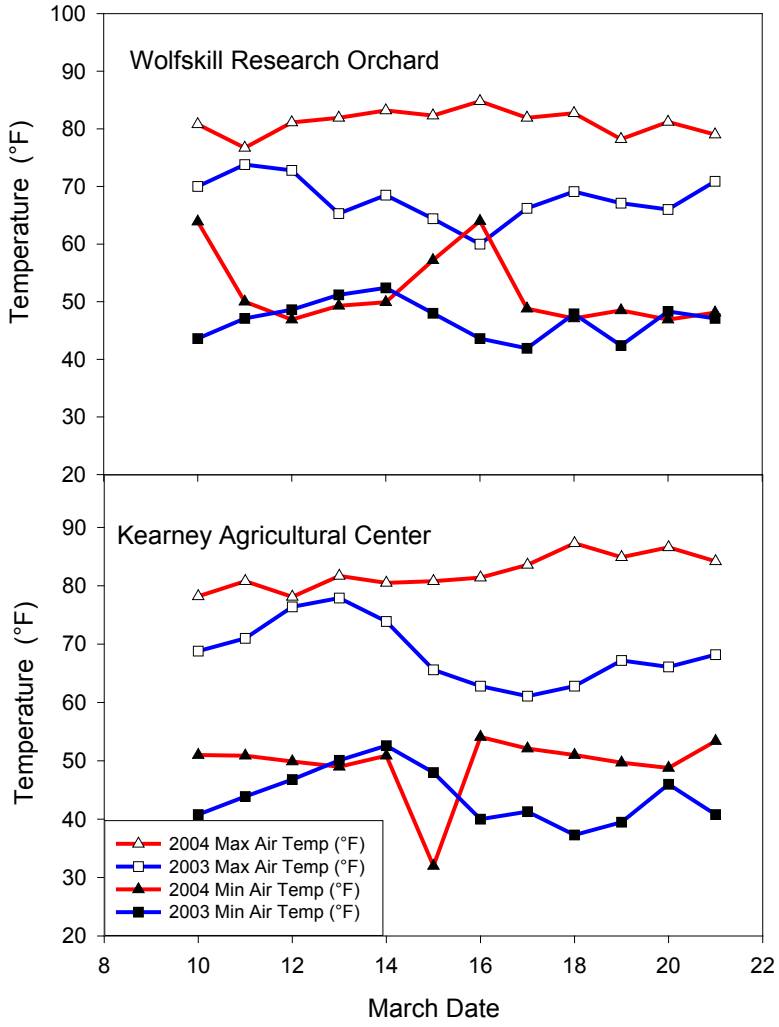

Figure 4. Maximum and minimum air temperatures through the March bloom period at Wolfskill and Kearney for 2003 and 2004.

The recorded date at full bloom and the fruit set were recorded for each selection or cultivar. The hypothesis was that the earlier bloom may have occurred at a time when the temperatures were lower than the later bloom and therefore set a larger crop. There is no correlation between time of bloom and size of final crop in 2004 (Figure 5).

Another characteristic that may affect the size of the final crop is the amount of flowers the tree has at bloom. However there was no correlation between bloom density and final crop in 2004 (Figure 6).

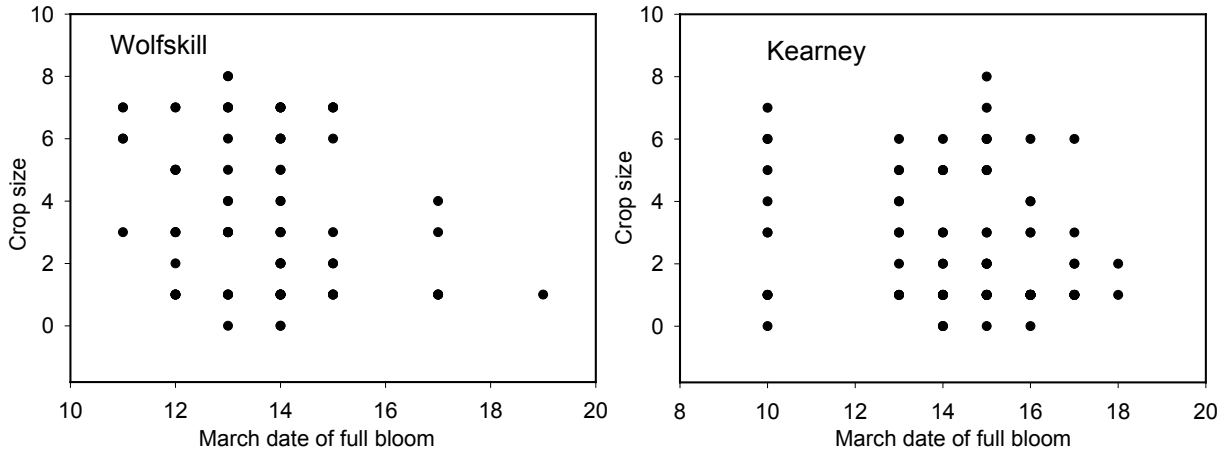

Figure 5. The 2004 crop size compared to full bloom date at the Wolfskill and Kearney selection blocks. Crop size is rated on a scale of 0 -10, 10 being the largest crop.

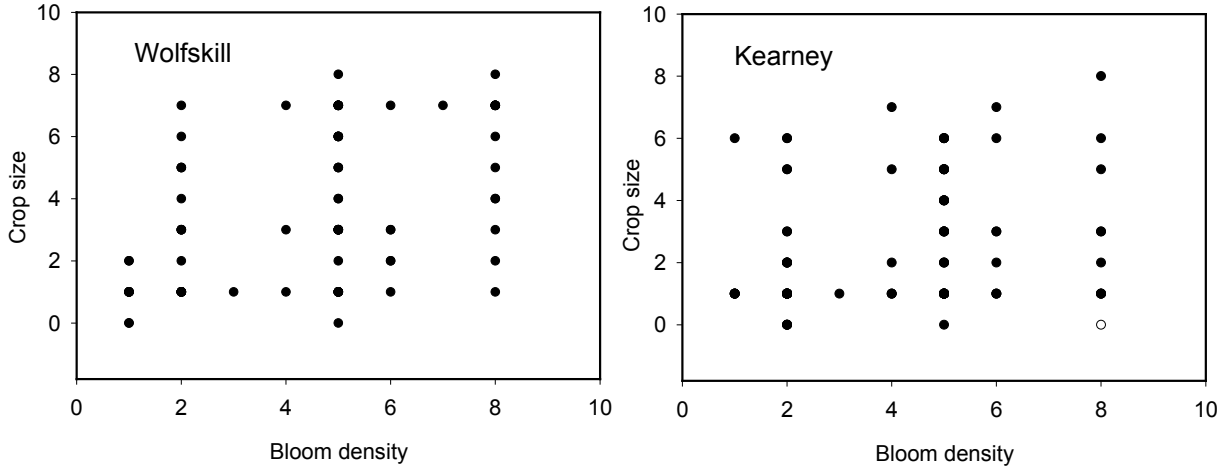

Figure 6. The 2004 crop size compared to the bloom density at Wolfskill and Kearney. Crop size and bloom density were rated on a scale of 0 -10, 10 being the largest crop or largest quantity of flowers.

The conclusion that we can draw from these observations is that the difference in genetic make up of the individual selections and cultivars creates differences in the trees abilities to set fruit when there are high temperatures at bloom time. Within the germplasm, there is apparently a variation in the heat tolerance of the flowers and their ability to set fruit at high temperatures. How this heat tolerance mechanism works is not clear. It could be heat tolerance of the pollen, or the pistil, or the ovary. Or it could be a variation of heat tolerance of all three flower parts. What we have learned is that there is a possibility to breed a heat tolerant cultivar and in so doing we could help growers spread the risk if multiple cultivars were grown in the industry.

SAMPLE NUMBER	SELECTION	HARVEST DATE	Days from FRENCH	LOCATION	CROP	SKIN COLOR	FRUIT SHAPE	WT. GRAMS/ FRUIT	INTERNAL PRESSURE (PSI)	SOLUBLE SOILIDS (FRESH)	DRY RATIO
1	**G3S- 2**	7/2/04	-42	Davis	Heavy	Purple/Rose	Round	24.6	2.55	21.0	3.46
2	**6-22-51**	6/30/04	-40	WEO	Medium	Purple/Rose	Oval	25.2	2.30	23.0	3.49
3	**F1S- 63**	7/15/04	-30	Davis	Medium	Purple	Oval	30.1	missing data	20.0	3.86
4	**F5S- 70**	7/22/04	-22	Davis	Medium	Purple/Rose	±French	31.9	2.80	26.0	2.91
5	**F1S- 50**	7/22/04	-22	Davis	Medium	Purple/Rose	Round	29.3	4.20	25.0	3.14
6	**4-6E-6**	7/19/04	-21	WEO	Heavy	Purple/Green	±French	26.3	3.05	22.0	3.25
7	**D2N- 76**	7/20/04	-20	WEO	Medium	Purple/Rose	Oval	34.2	2.15	25.0	2.68
8	**F13S- 46**	7/30/04	-14	Davis	Medium	Yellow	Oval	28.0	3.55	23.0	3.10
9	**D6N-103**	7/27/04	-13	WEO	Light	Rose/Purple	±French	48.1	5.30	24.9	2.70
10	**Sutter**	7/27/04	-13	WEO	Medium	Purple	Sutter	25.5	4.40	28.6	2.75
11	**Muir Beauty**	7/28/04	-13	KAC	Medium	Purple	Oval	41.3	3.75	20.5	3.39
12	**D6S- 87**	7/27/04	-13	WEO	Light	Rose	±French	31.9	2.00	25.5	3.03
13	**3-12E-2E**	8/9/04	0	WEO	Heavy	Purple/Rose	Oblong Oval	42.8	2.90	27.0	2.77
14	**6-21-56**	8/9/04	0	WEO	Medium	Purple/Rose	Oval	31.7	3.10	31.2	2.48
15	**French**	8/9/04	0	WEO	Light	Rose	French	30.0	3.20	26.0	2.72
16	**E13S- 60**	8/13/04	0	Davis	Medium	Purple/Rose	±French	29.3	2.60	24.6	2.96
17	**E7S- 72**	8/13/04	0	Davis	Light	Rose	±French	27.3	3.20	26.0	2.80
18	**F13N- 24**	8/13/04	0	Davis	Light	Rose/Purple	±French	19.7	1.85	29.0	2.28
19	**E7S- 83**	8/23/04	10	Davis	Medium	Purple	±French	21.1	4.20	24.8	2.93
20	**E7N- 28**	8/23/04	10	Davis	Medium	Purple	Oval	20.2	3.00	23.8	3.09
21	**F2N- 10**	8/26/04	13	Davis	Medium	Rose/Green	Oval	34.0	2.80	25.0	2.87

SAMPLE NUMBER	SELECTION	HARVEST DATE	Average count per pound	DRIED COLOR	SURFACE WRINKLES	SKIN PEEL	SURFACE BRIGHTNESS	PIT SIZE	PIT TYPE	FLAVOR RATING 1=worst 5=best	DRY COMMENTS
1	**G3S- 2**	7/2/04	67	Brown	Large/Average	None	Medium	Large fat	Semi Free	2.8	slightly acid, thin skin, fruity
2	**6-22-51**	6/30/04	59	Light Brown	Average	None	Medium	Medium	Semi Free	3.5	fruity, nice, different flavor than French
3	**F1S- 63**	7/15/04	61	Brown	Average	None	Bright	Medium	Free	3.3	different flavor, solid pit!, carmel baked goods flavor,
4	**F5S- 70**	7/22/04	45	Dark Brown	Average	None	Bright	Medium	Semi Free	3.5	dry flesh, cook more?, nice skin, fruity, Outstanding
5	**F1S- 50**	7/22/04	53	Brown/Black	Fine	Light	Medium	Medium	Semi Free	3.0	rough pit
6	**4-6E-6**	7/19/04	57	Brown	Average	Light	Bright	Small	Semi Free	3.0	slightly acid, prune flavor, spur type tree
7	**D2N- 76**	7/20/04	41	Black	Average	None	Bright	Small	Semi Cling	3.0	fiber around pit, fruity
8	**F13S- 46**	7/30/04	58	Date	Irregular	Light	Bright	Small	Semi Free	3.3	slightly acid, fruity
9	**D6N-103**	7/27/04	27	Brown	Average	None	Bright	Large	Cling	3.3	mild flavor
10	**Sutter**	7/27/04	50	Light Brown	Average	None	Bright	Medium long	Semi Free	4.0	fruity, sweet
11	**Muir Beauty**	7/28/04	37	Brown/Black	Fine/Average	None	Bright	Medium	Free	3.5	Thick flesh, nice appearance
12	**D6S- 87**	7/27/04	46	Brown	Irregular/Ave.	None	Bright	Medium	Semi Free	4.5	looks like French, bleeding? fruity!, Best of show
13	**3-12E-2E**	8/9/04	30	Brown	Board/Average	Light	Medium	Medium	Semi Free	3.5	carmalized, sugar spots
14	**6-21-56**	8/9/04	39	Brown	Average	None	Bright	Medium	Semi Cling	4.0	candy flavor
15	**French**	8/9/04	40	Dark Brown	Average	Light	Bright	Small	Cling	2.7	sugar spots
16	**E13S- 60**	8/13/04	53	Brown/Black	Average	None	Medium	Medium	Semi Free	4.0	taste fruity, slightly carmel
17	**E7S- 72**	8/13/04	51	Black/Brown	Irregular	Light	Medium	Medium long	Free	4.0	fruity
18	**F13N- 24**	8/13/04	59	Date	Average	None	Bright	Small	Semi Free	2.7	less tasty, small pit, poor after taste
19	**E7S- 83**	8/23/04	68	Brown/Black	Average	Light	Bright	Small	Semi Free	3.0	cook more?, nice appereance, thick flesh, slightly bland
20	**E7N- 28**	8/23/04	73	Dark Brown	Average	Light	Bright	Small	Free	3.7	nice pit
21	**F2N- 10**	8/26/04	40	Light Brown	Average	None	Bright	Medium	Semi Free	3.2	low acid, prune flavor