WALNUT IMPROVEMENT PROGRAM 2007

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ABSTRACT

The goal of the Walnut Improvement Program is to provide new cultivars of walnut to the California walnut industry while developing new knowledge and maintaining a breeding population. We also work with collaborators to develop new rootstocks and propagate them. This year we have 40 selections and over 12 thousand seedlings and selections in the breeding program. Almost 10,000 are half sibs from selections at the Kearney selection block. Early harvest is a primary goal and several selections with Payne-time harvest dates are promising. Controlled crosses between Idaho and Chandler were made again this year to increase the population for developing a DNA map of traits of walnuts.

OBJECTIVES

The objectives of the Walnut Improvement Program are:

- to provide the California walnut industry with genetically superior walnut cultivars and rootstocks
- to develop knowledge that will increase the efficiency of walnut breeding
- to develop and maintain an array of traits available for breeding in the future

The program consists of several projects with specific objectives:

- The classical cultivar breeding project uses traditional methods to develop and release new cultivars that combine precocity (high early yield) and early harvest date with kernel quality, in-shell traits, and disease resistance.
- The backcross breeding project is designed to introduce resistance to blackline disease from the Northern California black walnut into a commercially acceptable English walnut cultivar.
- Rootstock improvement objectives include development of selections with genetic resistance to Phytophthora, nematodes, and crown-gall. This is done in conjunction with the clonal rootstocks improvement project.
- New technologies that increase the efficiency of breeding and the scope of genetic material available for walnut improvement continue to be evaluated and adapted to walnut breeding as opportunities arise.
- Germplasm collections are maintained and augmented when possible for future breeding use and are available for other researchers.

PROCEDURES

Breeding program.

The procedures for the breeding program have changed as the advanced generation selections have matured and become available as parents. In 2004 and 2005 we collected nuts from the selected

parents at the Kearney Agricultural Center to produce half sib families. In 2006 and 2007 we made controlled crosses instead of collecting open-pollinated (OP) seed because the family size required for OP seedlings is prohibitive. The crossing design is shown and consists of crossing our best high quality selections with our earliest harvesting selections:

Crossing design 2007-2009 with nuts harvested, 2007

Early harvesting

High quality	91-77-6	91-77-40	91-90-41	91-96-3	92-80-11	94-19-85	94-20-5	94-20-28	95-7-13	95-11-14	95-18-23
90-31-12	45				42		12		91		
92-70-12											
93-28-20	34	29		76	83	11	17		6		
94-19-29	19		45		22		31				
94-19-45			96	50			2				
95-11-22	48						32		71		
95-26-16											
95-26-17					22						
95-26-22				29	23		37				
95-26-37									138	17	

In all cases, the seedlings are close planted and any that appear to be terminal bearers or have any of the signs of inbreeding (dwarfs, extra lates etc.) are culled at about age 3. If no nuts have been produced by age 5 (under good growing conditions) they are also cut down. Full evaluations are only done on precocious and laterally fruitful individuals. This is similar to the methods we used for the supplemental pollination families (see previous reports). Surviving seedlings are evaluated for phenology (leafing, flowering and harvest dates), precocity, lateral fruitfulness, estimated yield, blight incidence, and crack-out characteristics (shell shape, texture, thickness and strength, kernel weight, percent kernel, and kernel color, fill, plumpness and ease of removal in halves).

Data is evaluated at the annual crackout evaluation meeting that includes growers, processors, nurserymen, and farm advisors. Participants inspect kernel boxes and data sheets to identify possible selections. Data available includes current year field and crack-out data, performance data from past years, Diamond evaluations and computer-assisted selection. Team evaluations are followed by a general group discussion of each team's recommendations.

Promising individuals are repropagated into three selection blocks (Chico, Kearney and Davis) and grower trials where evaluations continue. The off-campus selection blocks are under the control of Bill Olson (Chico) and the Kearney field staff. Grower field trials are an essential component of releasing a new cultivar. We have increased the number of field trials in the last few years. (See "Description of Selections" in this report).

Backcross breeding for hypersensitivity to cherry leafroll virus.

The backcross breeding project is designed to introduce resistance to blackline disease from the Northern California black walnut into a commercially acceptable English walnut cultivar. Crosses are conducted using the same methods as in conventional cultivar breeding but the selection process is different. The first backcross cull is based on shell thickness and percent kernel; those exhibiting the black walnut shell characteristics are discarded. Those that are promising are tested by PCR for

hypersensitivity to the cherry leafroll virus as reported in Walnut Research Reports (1998) and modified recently (see WRR 2003).

Marker selection has been improved but has a 10% chance of error. As potential parents and selections advance in the program, there is a need for more stringent testing for hypersensitivity. The screening method used is as described in previous papers: a selection is grafted on both black and English rootstock (two each); after the graft is established, bark from our CLRV-source trees is patched into the English rootstock or into the selection depending on the rootstock species. If the selection is hypersensitive it will survive on the black rootstock because the inoculum patch was rejected, and die (exhibiting a black line) on the inoculated English rootstock. Confirmed hypersensitive, thin-shelled individuals with the best commercial traits are then used as parents for the next generation of backcrosses to an English walnut parent.

Rootstock improvement

Rootstock breeding is aimed at producing selections with genetic resistance to Phytophthora, nematodes, crown-gall, and environmental stress while retaining or enhancing the vigor of hybrid rootstock. The limiting factor in developing improved rootstocks had been the absence of a commercially viable clonal propagation method but this has been overcome for many rootstock selections (see Clonal Propagation report). The procedures and results of screening for traits of interest are reported separately: nematodes - Mike McKenry; Phytophthora – Greg Brown; crown gall – Dan Kluepfel and Janine Hasey.

New technology for genetic improvement of walnut

This part of the Walnut Improvement Program includes tissue culture, PCR, and isozyme analysis in support of genetic improvement as well as gene transfer and field-testing of transgenic plants. Current laboratory work includes micropropagation, use of DNA marker selection in backcrossing, improvements in storage of long-term cultures, efficiency of introducing material to culture, and improvements in somatic embryogenesis.

In 2005 vector pDE00.0201, developed by Matt Escobar in the Dandekar lab and designed to silence the gall forming ipt and iaaM genes of wild-type *Agrobacterium*, was used in our lab to insert crown gall resistance into somatic embryos of three paradox genotypes (J1, J21 and RR4). Transformants were selected and germinated to generate microshoot lines. Plants of forty independent transformed lines plus controls were generated from rooted microshoots for use in greenhouse testing and for a 2008 field trial on campus.

We continue to maintain somatic embryo and microshoot cultures of 12 genotypes exhibiting altered expression of shikimate dehydrogenase (SDH), an enzyme in the shikimate pathway that regulates gallic acid production. This gene is of interest for its effect on aflatoxin resistance. Rooting and acclimatization of these genotypes in the greenhouse is complete and they will be maintained in large pots in a lath house.

Transgenic trees in field trials or in large pots are now at bearing age and transgenic trees with the following genes continue to be observed and evaluated:

- Bt - insect resistance (inoculation with codling moth)
- FAD - altered oil composition to avoid rancidity.
- PPO - altered phenolic composition to improve rooting and kernel traits.

NOTE: Transgenic walnuts are only grown on campus under USDA guidelines and catkins and nuts are removed. They are grown for proof of concept experiments.

Germplasm resources

Germplasm collections are maintained and augmented when possible for future breeding use and are available for other researchers. Current collections at Wolfskill and Davis include a diversity of California cultivars, leading cultivars and selections from around the world, material with unusual traits, and germplasm of interest for rootstock development. It differs in emphasis, content, distribution policy, and cultural practices from the USDA Germplasm Repository collection.

RESULTS AND DISCUSSION

Cultivar breeding

Three new walnut cultivars (varieties) were patented in 2006: 'Sexton', 'Gillet' and 'Forde'. These are characterized by high early yields, harvest dates before Chandler, low blight scores and large light-colored kernels. They are described in more detail in a separate Walnut Research Report (2004) and brief descriptions are included in the Descriptions of Selections at the end of this report.

Data on the selections are provided in Tables1-4. A description of each selection can be found at the end of this report. There are now over 12,000 seedlings under evaluation and 40 selections as follows:

Year	Crosses (n)	Original Seedlings (n)	Selections (n)	Under Evaluation (n)
1990	15	591	2	2
1991	18	493	3	3
1992	15	243	1	1
1993	14	116	2	2
1994	15	587	6	6
1995	15	758	10	10
1996	7	333	1	1
1997	13	611	7	8
1998	5	1759	7	102
1999	1	993	1	9
2000	12	2503	-	205
2001	16	210	-	68
2002	5	1200	-	431
2003	11	4608	-	2875
2004	7 hs**	6000	-	3518
2005	9 hs	3332	-	3332
2006	22	954	-	954
2007	27	1090	-	1090

**hs denotes half sib families

Backcross breeding for hypersensitivity to cherry leafroll virus.

Backcross breeding to develop an English walnut with a hypersensitive response to the cherry leafroll virus is proceeding. We continue to test backcross seedlings for both nut quality and virus resistance and currently have approximately 600 seedlings under active evaluation. Attributes of the most commercially viable of the current backcross selections are listed in Table 5. Three backcross hypersensitive selections (92-16-1, 94-22-24, and 97-27-55) have been established in a field trial with Janet Caprile in Contra Costa County. Bill Coates in San Benito County has these selections as well as 87-41-2, 87-262-4, 93-45-1, 94-026-20, 95-027-11, 95-27-19, 95-027-23, 95-27-38, 96-17-12, 96-27-8, 97-27-24, and 98-17-44. They will be used to evaluate hypersensitivity after exposure to CLRV-infested pollen as well as commercial traits. One selection, 95-29-4, was put in both trials based on the DNA test but has tested tolerant in the bark patch test and should be removed from the trials.

In 2001 we started the current backcross selection testing block for final confirmation of hypersensitivity by bark patch testing. Additional selections were added in 2002-2005 to a total of 81. Patches were checked the last two years for blackline formation. To date 14 have tested hypersensitive, 6 were questionable and the remainder was tolerant. Only one selection that had tested hypersensitive by DNA appeared to be tolerant in the patch test.

Additional backcross trees that have been identified as hypersensitive by DNA testing will be grafted into a new patch test block to confirm the DNA results.

Rootstock improvement

A number of potential rootstock selections have been identified in the past and are maintained and micropropagated in the laboratory for confirmation testing and field trials (See Clonal Propagation report). This material includes tolerant backcross selections (vigorous, CLRV tolerant), several Phytophthora survivors from growers' orchards, PDS selections for crown gall, nematode, and Phytophthora resistance.

Two new paradox genotypes were introduced into tissue culture this year. RX032 is a J. microcarpa paradox selected by Mike McKenry for its nematode resistance traits and Trammel was an old and very large paradox tree that was introduced for its possible vigor and endurance traits. Microshoots of the paradox UZ229, introduced last year for its nematode resistance traits, were successfully rooted this year and 60 plants were acclimated in the greenhouse for further testing in nematode trials.

Gene insertion

Plants of 40 independent lines expressing the construct for crown gall silencing in three separate background genotypes (J1, J21, and RR4) and control plants were produced and grown in the greenhouse for further testing. Results of crown gall resistance tests are reported separately in this volume by Kluepfel and Hasey. We are in the process of grafting Chandler scions onto potted plants of these rootstock lines for use in testing for any movement of DNA, RNA, or other macromolecules across the graft union from the rootstock and to test that the horticultural traits of the scion material on these rootstocks are not altered. In addition, a one-acre block has been methyl bromide-treated and a USDA permit has been obtained for a field trial of these rootstock lines in the spring of 2008.

Genotypes exhibiting altered expression of shikimate dehydrogenase (SDH), an enzyme that regulates the production of gallic acid which plays a role in aflatoxin resistance, have been rooted and grown in large pots in the greenhouse so they can be used to study gallic acid production in nuts and its role in insect and disease resistance. Mature Chandler trees expressing the BT gene have shown good efficacy in tests conducted by the USDA. The trees in the UC collection continue to be hedged to prevent flowering and are being held on campus to be available for future work if desired. Transgenic lines expressing or silencing the polyphenol oxidase gene, thought to play a role in disease resistance and kernel color traits, FAD genes modifying oil composition, and genes regulating adventitious shoot and somatic embryo production are being maintained for use in further studies.

Genomics

This year we began phenotyping the oldest individuals of a population of Chandler x Idaho seedlings that we have been generating over the last five years. Data collected on this population, including leafing, flowering, and harvest dates, yield, disease, and insect resistance traits, and nut and kernel characteristics, will be critical to the success of the new walnut genomics initiative.

The parents were chosen to develop a very large seedling population that segregates for as many important traits as possible (kernel color, phenology, lateral bearing, shell appearance, protogyny/protandry, insect resistance, blight response, etc.). Trees from this cross will continue to be evaluated for horticultural traits as they mature over the next several years. Additional trees have been germinated from this year's cross will be planted in the spring. DNA from these trees will eventually be used to map each of the traits in the walnut genome and to develop markers for more efficient selection in breeding.

Germplasm resources and maintenance

We continue to maintain a collection of in vitro germplasm for use by the Walnut Improvement Program, other cooperating researchers, and commercial labs and nurseries. We also maintain in vitro nematode population for use in nematode resistance research by the Dandekar lab and others.

Maintaining an in vitro germplasm collection is labor intensive and repetitive. We continued efforts this year to reduce the time and expense of this activity. We were successful in developing a procedure to extend the transfer interval needed for routine maintenance of somatic embryo cultures four-fold by keeping cultures long-term at 5C instead of at room temperature. This allowed monthly transfer instead of weekly transfer of the material and cultures have remained in good condition during a 6 month trial.

For shoot cultures we tried a similar approach to reduce the labor and it looked promising for a while. Although we were able to extend the transfer interval for shoots from one month to three months for many genotypes, others began to exhibit poor growth and poor survival in the cold after several repetitions and the lack of uniform response causes additional management problems. We are now testing an alternate strategy of maintaining reserve shoot cultures on half strength medium of double volume so that minimum necessary media volume is maintained for a longer period of time as evaporation occurs, to prevent excess salt concentration during this process, and to slow shoot growth. So far this strategy appears to be working well for maintaining shoots.

To determine the feasibility of long-term cryostorage of embryos in liquid nitrogen we sent a set of Chandler somatic embryos to David Ellis and Maria Jenderek at the USDA-ARS cryopreservation facility at Ft. Collins, Colorado. They employed a cryopreservation protocol for somatic embryos and returned the material. This year we evaluated survival, multiplication, and germination rates of somatic embryos from cultures that been had through this procedure. Cryopreservation did not adversely affect embryo performance. In addition, we sent Chandler tissue culture shoot material to Ft. Collins to see if they can also develop a reliable method to cryopreserve shoot cultures.

As part of this cryopreservation work and in the interest of developing a backup method for the USDA walnut collection at the National Clonal Germplasm Repository – Davis we also sent dormant field-grown buds of Chandler and Franquette to Ft. Collins. In preliminary work, these were used to see if walnut buds could survive the initial desiccation step generally used prior to the actual cryopreservation. Following treatment of the buds at Ft. Collins they were sent to Burchell Nursery which generously provided grafters and rootstock for the post-treatment viability testing. Results were sufficiently encouraging to continue and Tom Burchell has offered to help us with this work again this year.

Table 1. Cultivar and Selection Evaluations at Davis (Spring 2007)

	Seedling or	Leafing		Pollen Shedding				Pistillate Bloom				
	Grafted	Date	DAP[a]	1st	Peak	Last	Abund.[b]	1st	Peak	Last	% Lateral	Yield[b]
Cultivars												
Payne	G	3/15	0	3/20	3/25	4/8	7	3/27	4/1	4/9	100	7
Hartley	G	3/27	12	3/25	4/7	4/18	7	4/11	4/16	4/25	0	6
S. Franquette	G	4/8	24	4/5	4/18	4/30	6	4/24	4/29	5/4	0	5
Vina	G	3/20	5	3/24	3/31	4/7	7	4/3	4/8	4/16	100	7
Serr	G	3/16	1	3/19	3/25	4/6	8	3/30	4/3	4/9	100	4
Chandler	G	3/29	14	3/30	4/8	4/18	8	4/11	4/18	4/26	100	6
Howard	G	3/26	11	3/27	4/3	4/9	7	4/8	4/15	4/25	100	7
Tulare	G	3/21	6	3/26	4/4	4/14	7	4/4	4/8	4/18	100	7
Sexton	G	3/19	4	3/21	3/29	4/8	7	3/26	4/1	4/9	100	6
R. Livermore	G	3/28	13	3/29	4/5	4/14	6	4/5	4/12	4/20	100	5
Gillet	G	3/18	3	4/2	4/6	4/17	5	3/21	3/26	4/1	100	7
Forde	G	3/23	8	4/5	4/9	4/13	5	3/25	3/30	4/4	100	7
Selections												
59-124	G	3/15	0	3/20	3/25	4/4	7	3/28	4/2	4/7	100	7
64-057	G	3/20	5	4/2	4/6	4/18	8	3/24	3/30	4/9	100	6
77-012	G	3/28	13	4/9	4/16	4/23	4	3/30	4/7	4/16	100	7
90-023-11	G	3/24	9	3/27	4/4	4/11	7	4/1	4/6	4/17	100	6
90-023-37	G	3/25	10	3/30	4/6	4/26	7	4/6	4/12	4/19	100	6
90-027-21	G	3/16	1	3/19	3/24	4/6	7	3/31	4/3	4/8	100	7
90-027-23	G	3/29	14	4/2	4/8	4/20	7	4/7	4/13	4/22	100	6
90-031-12	G	3/17	2	3/22	3/30	4/7	7	3/28	4/2	4/11	100	6
91-076-24	G	3/20	5	4/3	4/8	4/18	7	3/23	3/29	4/3	100	7

[a]Days after Payne leafing date at Davis
[b]1=low, 9=high

Table 1. Cultivar and Selection Evaluations at Davis (Spring 2007) – (cont.)

	Seedling or	Leafing		Pollen Shedding				Pistillate Bloom				
	Grafted	Date	DAP[a]	1st	Peak	Last	Abund.[b]	1st	Peak	Last	% Lateral	Yield[b]
91-077-6	G	3/23	8	3/25	3/31	4/8	8	4/2	4/6	4/16	100	6
91-077-33	G	3/19	4	3/30	4/6	4/17	7	3/21	3/29	4/12	100	7
91-077-40	G	3/28	13	4/6	4/16	4/22	6	3/28	4/4	4/16	100	8
91-088-7	G	3/22	7	4/5	4/14	4/19	7	3/24	3/31	4/6	100	7
91-090-41	G	3/25	10	3/27	4/3	4/9	7	4/6	4/14	4/19	100	6
91-094-18	G	3/26	11	3/29	4/5	4/11	7	4/6	4/12	4/17	100	7
91-096-3	G	3/30	15	4/1	4/7	4/17	7	4/8	4/18	4/26	100	6
92-068-2	G	3/20	5	4/5	4/12	4/19	4	3/26	3/30	4/4	100	5
92-080-11	G	3/17	2	4/1	4/7	4/11	7	3/19	3/24	4/3	100	7
92-081-17	G	3/22	7	3/31	4/3	4/10	4	4/4	4/8	4/13	100	5
93-026-6	G	3/21	6	4/2	4/7	4/16	5	3/22	3/29	4/5	100	7
93-028-20	G	3/21	6	3/24	4/1	4/13	7	4/7	4/11	4/18	100	4
94-019-29	G	3/19	4	3/24	4/2	4/9	7	4/1	4/5	4/10	100	6
94-019-45	G	3/23	8	3/31	4/4	4/14	7	4/4	4/8	4/15	100	5
94-019-85	G	3/16	1	3/19	3/25	4/5	6	3/27	4/1	4/5	100	
94-020-5	G	3/16	1	3/24	3/31	4/8	5	4/1	4/4	4/7	100	5
94-020-19	G	3/22	7	3/30	4/2	4/8	3	4/5	4/9	4/17	100	5
94-020-35	G	3/17	2	3/19	3/27	4/4	7	3/30	4/4	4/7	100	7
94-020-72	G	3/17	2	3/22	3/29	4/8	7	4/2	4/6	4/11	100	6
95-007-5	G	3/31	16	4/10	4/17	4/23	3	4/2	4/8	4/11	100	5
95-007-13	G	3/17	2	3/20	3/28	4/6	7	4/2	4/5	4/9	100	7
95-011-14	G	3/16	1	3/30	4/3	4/14	7	3/18	3/23	3/29	100	6
95-011-15	G	3/18	3	3/21	3/29	4/7	7	3/31	4/3	4/9	100	7

[a]Days after Payne leafing date at Davis

[b]1=low, 9=high

Table 1. Cultivar and Selection Evaluations at Davis (Spring 2007) – (cont.)

	Seedling or	Leafing		Pollen Shedding				Pistillate Bloom				
	Grafted	Date	DAP[a]	1st	Peak	Last	Abund.[b]	1st	Peak	Last	% Lateral	Yield[b]
95-011-16	G	3/20	5	3/30	4/2	4/7	2	4/2	4/9	4/18	100	6
95-011-22	G	3/17	2	3/18	3/23	4/2	7	3/24	3/30	4/4	100	6
95-013-6	G	3/19	4	3/22	3/30	4/4	7	4/3	4/5	4/13	100	7
95-013-12	G	3/25	10	3/27	3/31	4/7	3	4/4	4/8	4/12	100	6
95-018-23	G	4/1	17	3/31	4/4	4/13	5	4/11	4/16	4/20	100	7
95-026-15	G	3/20	5	4/5	4/11	4/20	7	3/22	3/26	4/2	100	7
95-026-16	G	3/19	4	4/3	4/7	4/13	6	3/21	3/26	4/3	100	6
95-026-17	G	3/26	11	4/5	4/11	4/18	4	3/28	4/3	4/8	100	7
95-026-22	G	3/24	9	3/27	4/1	4/8	6	4/3	4/7	4/14	100	6
95-026-24	G	3/21	6	4/3	4/8	4/14	4	3/25	3/29	4/4	100	7
96-013-13	G	3/18	3	4/3	4/8	4/14	3	3/20	3/24	3/28	100	7
97-003-11	G	3/24	9	3/30	4/5	4/14	7	4/6	4/11	4/16	100	5
97-003-23	G	3/29	14					4/6	4/14	4/25		5
97-003-40	G	4/2	18	4/17	4/23	4/29	3	4/12	4/14	4/18		
97-003-65	G	3/19	4	3/22	3/26	4/7	3	4/3	4/6	4/12	100	5
97-003-79	G	3/22	7	3/24	4/1	4/7	3	4/8	4/13	4/18	100	7

[a]Days after Payne leafing date at Davis

[b]1=low, 9=high

Table 2. Cultivar and Selection Harvest Evaluations at Davis (Fall 2007)

		Harvest			Shell			Average Wt.					Color %			
	[a]Seedling or Graft	Date	DAP	Seas Lgth	[c]Seal	[d]Strgth	Thick mm	Nut (g)	Kernel (g)	% Kernel	[e]Kernel Fill	[f]Ease of Removal	Extra Light	Light	Light Amber	Amber
Standards																
Payne	G	9/15	0	167	5	5	1.4	15.2	7.6	49.8	5	5	0	100	0	0
Hartley	G	10/3	18	170	5	6	1.4	15.3	7.1	46.3	5	5	22	78	0	0
S. Franquette	G	10/10	25	164	5	6	1.4	13.6	6.0	44.2	4	5	33	67	0	0
Vina	G	9/22	7	167	5	5	1.3	17.0	8.4	49.5	5	5	0	60	40	0
Serr	G	9/19	4	169	5	5	1.2	17.1	9.7	56.6	5	5	10	90	0	0
Chandler	G	10/5	20	172	5	5	1.4	16.2	7.6	46.8	4	4	60	40	0	0
Howard	G	9/26	11	164	5	5	1.3	15.2	7.8	51.4	5	5	10	90	0	0
Tulare	G	9/25	10	170	5	5	1.3	17.3	9.2	53.3	6	5	20	80	0	0
R. Livermore	G	9/28	13	169	5	6	1.4	14.3	7.0	48.9	6	5		red		
Sexton	G	9/28	13	180	5	5	1.4	19.6	9.5	48.3	6	5	0	40	60	0
Gillet	G	9/23	8	181	4	5	1.4	19.5	9.3	47.5	4	4	0	100	0	0
Forde	G	10/2	17	186	5	6	1.4	18.2	9.3	51.0	5	4	56	44	0	0
Selections																
59-124	G	9/16	1	167	5	7	1.5	19.9	10.0	50.6	6	5	0	70	30	0
76-080	G	10/3	18		4	5	1.3	16.5	8.2	49.9	4	4	90	10	0	0
77-012	G	9/16	1	162	5	5	1.3	13.9	6.8	49.0	6	5	0	56	44	0
90-023-37	G	9/28	13	169	5	5	1.2	13.8	7.9	57.1	5	5	0	80	20	0
90-027-21	G	9/17	2	167	5	6	1.5	16.1	7.6	47.0	5	5	0	100	0	0
90-027-23	G	9/20	5	160	5	5	1.3	15.2	8.0	52.5	6	5	0	100	0	0

[a] S = seedling, G= grafted
[b]="DAP" denotes "Days after Payne harvest at Davis
[c]=Shell seal: 3 - poor, 5 - good, 7 - very strong

[d]=Shell strength: 3 - poor, 5 - good, 7 - very strong
[e]=Kernel fill: 3 - poor, 7- well
[f]=Ease of Removal: 3 - easy, 7 - difficult

Table 2. Cultivar and Selection Harvest Evaluations at Davis (Fall 2007) – (cont.)

		Harvest			Shell			Average Wt.					Color %			
	[a]Seedling or Graft	Date	DAP	Seas Lgth	[c]Seal	[d]Strgth	Thick mm	Nut (g)	Kernel (g)	% Kernel	[e]Kernel Fill	[f]Ease of Removal	Extra Light	Light	Light Amber	Amber
90-031-12	G	9/28	13	179	5	5	1.2	16.6	9.6	57.8	5	5	0	80	20	0
91-076-24	G	9/11	-4	166	5	4	1.2	16.5	8.8	53.2	4	5		60	30	10
91-077-6	G	9/19	4	166	4	5	1.2	19.3	10.5	54.4	5	4	0	90	10	0
91-077-33	G	9/26	11	181	5	5	1.2	18.0	7.8	43.5	3	4	0	0	100	0
91-077-40	G	10/2	17	181	5	6	1.4	17.5	8.9	51.0	6	5	50	50	0	0
91-088-7	G	9/24	9	177	5	6	1.4	19.3	9.9	51.5	5	5	11	89	0	0
91-090-41	G	9/26	11	165	4	4	1.1	13.5	7.9	58.7	5	4	70	30	0	0
91-094-18	G	9/23	8	164	5	5	1.2	15.6	8.4	54.1	5	5	0	67	33	0
91-096-3	G	9/21	6	156	5	5	1.3	12.8	6.8	53.1	6	6	50	50	0	0
92-068-2	G	9/17	2	171	4	4	1.1	18.5	10.6	57.5	4	5	0	78	11	11
92-080-11	G	9/17	2	177	5	5	1.3	21.1	10.8	51.2	4	5	0	70	10	20
92-081-17	G	9/23	8	168	5	5	1.2	17.7	10.4	58.7	6	5	11	78	0	11
93-026-6	G	9/18	3	173	5	5	1.3	20.7	10.7	51.5	5	5	0	90	10	0
93-028-20	G	9/27	12	169	5	5	1.3	17.2	9.2	53.4	5	5	40	60	0	0
94-019-29	G	9/24	9	172	5	5	1.3	17.4	9.0	51.7	5	4	33	56	11	0
94-019-45	G	9/23	8	168	5	5	1.2	18.3	9.3	50.9	5	4	0	90	10	0
94-019-85	G	9/12	-3	164	5	5	1.2	16.8	10.0	59.6	5	5	0	89	11	0
94-020-5	G	9/26	11	175	6	6	1.5	19.4	9.8	50.7	6	5	22	78	0	0
94-020-19	G	9/25	10	169	5	5	1.4	20.1	9.8	48.9	5	5	0	56	44	0
94-020-35	G	9/18	3	167	5	6	1.4	19.8	9.7	49.2	6	6	0	80	20	0

[a] S = seedling, G= grafted
[b]="DAP" denotes "Days after Payne harvest at Davis
[c]=Shell seal: 3 - poor, 5 - good, 7 - very strong

[d]=Shell strength: 3 - poor, 5 - good, 7 - very strong
[e]=Kernel fill: 3 - poor, 7- well
[f]=Ease of Removal: 3 - easy, 7 - difficult

Table 2. Cultivar and Selection Harvest Evaluations at Davis (Fall 2007) – (cont.)

		Harvest			Shell			Average Wt.					Color %			
	[a]Seedling or Graft	Date	DAP	Seas Lgth	[c]Seal	[d]Strgth	Thick mm	Nut (g)	Kernel (g)	% Kernel	[e]Kernel Fill	[f]Ease of Removal	Extra Light	Light	Light Amber	Amber
94-020-72	G	9/25	10	172	5	6	1.5	19.0	9.2	48.5	6	5	0	67	33	0
95-007-5	G	9/18	3	163	5	5	1.3	19.4	10.4	53.5	5	5	0	100	0	0
95-007-13	G	9/14	-1	162	5	5	1.2	18.2	9.9	54.0	5	5	0	100	0	0
95-011-14	G	9/11	-4	172	4	4	1.1	15.0	8.7	58.1	5	4	70	0	10	20
95-011-15	G	10/4	19	184	5	5	1.3	15.6	7.5	47.8	4	5	70	30	0	0
95-011-16	G	9/20	5	164	5	5	1.3	17.7	9.8	55.5	5	5	20	70	10	0
95-011-22	G	9/24	9	178	6	5	1.4	16.1	8.2	50.9	5	5	10	90	0	0
95-013-6	G	9/20	5	168	5	6	1.5	17.5	8.3	47.4	6	5	0	100	0	0
95-013-12	G	9/25	10	170	5	6	1.4	21.3	10.4	49.0	5	5	0	40	60	0
95-018-23	G	9/23	8	160	5	4	1.1	16.3	8.7	53.4	4	5	30	60	10	0
95-026-15	G	9/24	9	182	5	6	1.5	14.8	6.7	45.5	5	5	20	60	20	0
95-026-16	G	9/16	1	174	5	5	1.4	16.6	8.8	53.3	6	5	0	100	0	0
95-026-17	G	9/26	11	176	5	6	1.4	17.9	8.8	49.4	6	6	0	100	0	0
95-026-22	G	9/23	8	169	5	6	1.7	21.2	9.9	46.7	7	6	40	60	0	0
95-026-24	G	9/27	12	182	5	5	1.3	17.4	8.9	51.1	5	5	30	70	0	0
96-013-13	G	9/29	14	189	5	5	1.2	14.3	7.4	51.9	5	5	0	67	33	0
97-003-11	G	9/24	9	166	4	5	1.2	17.3	9.8	56.6	5	5	30	70	0	0
97-003-23	G	9/25	10	164	5	6	1.5	21.6	10.1	46.8	5	4	30	70	0	0
97-003-65	G	9/25	10	172	5	5	1.3	16.8	8.9	53.0	6	5	0	100	0	0
97-003-79	G	9/20	5	160	4	5	1.3	21.4	11.1	51.9	4	5	0	70	30	0

[a] S = seedling, G= grafted
[b]="DAP" denotes "Days after Payne harvest at Davis
[c]=Shell seal: 3 - poor, 5 - good, 7 - very strong

[d]=Shell strength: 3 - poor, 5 - good, 7 - very strong
[e]=Kernel fill: 3 - poor, 7- well
[f]=Ease of Removal: 3 - easy, 7 - difficult

Table 3. 2007 UCD Cultivar/Selection Evaluations by Diamond Walnut Growers Inc.

Cultivar	Location	Sample Wt	# Nuts per sample	Avg nut wt (g)	% Large	% Med	% Baby	% Large Sound	% Stain	% Broken	% Adh Hull	% External Damage
Payne	Davis	1000	74	13.51	99%	1%	0%	83%	1.3%	0.0%	0.0%	1.1%
Payne	Chico	1000	87	11.49	91%	8%	1%	83%	1.0%	0.1%	0.0%	1.0%
Hartley	Davis	1000	76	13.16	100%	0%	0%	91%	1.3%	0.0%	0.0%	1.2%
Hartley	Chico	1000	94	10.6	57%	28%	15%	62.4%	0.6%	0.3%	0.2%	0.7%
Hartley	KAC	1000	68	14.71	100%	0%	0%	100%	1.5%	0.0%	0.0%	1.5%
Vina	Davis	1000	67	14.93	100%	0%	0%	98%	1.5%	0.0%	0.0%	1.5%
Vina	Chico	1000	86	11.63	87%	10%	2%	89%	1.0%	0.1%	0.0%	1.0%
Serr	Davis	1001	63	15.89	100%	0%	0%	94%	1.6%	0.0%	0.0%	1.5%
Tulare	Davis	1000	65	15.38	100%	0%	0%	95%	1.5%	0.0%	0.0%	1.5%
Tulare	KAC	1000	71	14.08	100%	0%	0%	99%	1.4%	0.0%	0.0%	1.4%
Chandler	Davis	1000	73	13.70	100%	0%	0%	98%	1.4%	0.0%	0.0%	1.3%
Chandler	Chico	1000	84	11.90	80%	13%	7%	85%	0.9%	0.2%	0.1%	1.0%
Howard	Davis	1000	74	13.51	96%	3%	1%	97%	1.3%	0.0%	0.0%	1.3%
Howard	Stolp	1000	66	15.15	100%	0%	0%	100%	1.5%	0.0%	0.0%	1.5%
Sexton	Davis	1000	58	17.24	100%	0%	0%	98%	1.7%	0.0%	0.0%	1.7%
Sexton	Chico	1000	64	15.63	100%	0%	0%	98%	1.6%	0.0%	0.0%	1.5%

Table 3. 2007 UCD Cultivar/Selection Evaluations by Diamond Walnut Growers Inc.

Cultivar	Location	Sample Wt	# Nuts per sample	Avg nut wt (g)	% Large	% Med	% Baby	% Large Sound	% Stain	% Broken	% Adh Hull	% External Damage
Gillet	Davis	1000	48	20.8	100%	0%	0%	100.0%	2.1%	0.0%	0.0%	2.1%
Gillet	Chico	1000	71	14.1	100%	0%	0%	95.0%	1.4%	0.0%	0.0%	1.3%
Forde	Davis	1000	57	17.5	100%	0%	0%	100.0%	1.8%	0.0%	0.0%	1.8%
Forde	Chico	1000	66	15.15	100%	0%	0%	97%	1.5%	0.0%	0.0%	1.5%
Forde	Stolp	1000	76	13.2	100%	0%	0%	88.9%	1.3%	0.0%	0.0%	1.2%
91-076-24	Davis	1000	64	15.6	100%	0%	0%	95.1%	1.6%	0.0%	0.0%	1.5%
91-077-6	Davis	1000	55	18.2	100%	0%	0%	91.2%	1.8%	0.0%	0.0%	1.7%
93-026-6	KAC	1000	58	17.2	100%	0%	0%	99.4%	1.7%	0.0%	0.0%	1.7%
93-026-6	Davis	1000	58	17.2	100%	0%	0%	97.7%	1.7%	0.0%	0.0%	1.7%
94-019-85	Chico	1000	78	12.8	100%	0%	0%	97.0%	1.3%	0.0%	0.0%	1.2%
94-019-85	KAC	1000	75	13.3	100%	0%	0%	98.3%	1.3%	0.0%	0.0%	1.3%
95-007-13	KAC	1000	65	15.4	100%	0%	0%	98.7%	1.5%	0.0%	0.0%	1.5%
95-007-13	Davis	1000	60	16.7	100%	0%	0%	98.5%	1.7%	0.0%	0.0%	1.6%
95-11-14	S505	1000	74	13.5	100%	0%	0%	93.5%	1.4%	0.0%	0.0%	1.3%
95-11-14	Chico	1000	78	12.8	100%	0%	0%	99.1%	1.3%	0.0%	0.0%	1.3%

Table 3. 2007 UCD Cultivar/Selection Evaluations by Diamond Walnut Growers Inc.

Cultivar	Location	% Insect	% Mold	% Shrivel	% Offgrade	% Edible Yield	% Total Yield	Extra Light	Light	Light Amber	Amber	RLI	Relative Value
Payne	Davis	9.5%	2.7%	2.7%	10.2%	48.4%	53.9%	32%	44%	4%	0%	49.8	0.88
Payne	Chico	5.7%	0.0%	3.4%	5.0%	49.7%	52.3%	0%	67%	20%	3%	50.5	0.91
Hartley	Davis	7.9%	0.0%	2.6%	7.4%	45.2%	48.8%	63%	20%	3%	0%	56.3	0.93
Hartley	Chico	0.0%	0.0%	0.0%	0.0%	47.0%	47.0%	49%	46%	6%	0%	54.1	0.93
Hartley	KAC	0.0%	0.0%	0.0%	0.0%	45.6%	45.6%	18%	72%	7%	4%	54.4	0.90
Vina	Davis	3.0%	0.0%	0.0%	2.2%	48.9%	50.0%	19%	68%	9%	0%	50.5	0.90
Vina	Chico	0.0%	0.0%	1.2%	0.2%	48.6%	48.7%	0%	78%	22%	0%	49.7	0.88
Serr	Davis	6.3%	0.0%	0.0%	5.8%	53.9%	57.2%	37%	44%	9%	5%	53.9	1.06
Tulare	Davis	3.1%	0.0%	6.2%	3.2%	51.3%	53.0%	29%	53%	15%	0%	55.8	1.04
Tulare	KAC	0.0%	0.0%	2.8%	0.7%	53.5%	53.9%	30%	51%	12%	5%	51.6	1.00
Chandler	Davis	1.4%	0.0%	1.4%	1.8%	49.0%	49.9%	85%	11%	0%	0%	58.2	1.04
Chandler	Chico	0.0%	0.0%	1.2%	0.2%	48.4%	48.5%	85%	12%	3%	0%	56.7	1.00
Howard	Davis	0.0%	0.0%	1.4%	0.2%	49.7%	49.8%	57%	36%	6%	0%	56.6	1.02
Howard	Stolp	0.0%	0.0%	0.0%	0.0%	54.2%	54.2%	32%	39%	26%	2%	54.8	1.08
Sexton	Davis	0.0%	0.0%	3.4%	0.4%	46.8%	47.0%	29%	50%	14%	5%	52.8	0.90
Sexton	Chico	0.0%	0.0%	6.3%	0.9%	45.9%	46.3%	36%	56%	4%	2%	53.9	0.90

Table 3. 2007 UCD Cultivar/Selection Evaluations by Diamond Walnut Growers Inc.

Cultivar	Location	% Insect	% Mold	% Shrivel	% Offgrade	% Edible Yield	% Total Yield	Extra Light	Light	Light Amber	Amber	RLI	Relative Value
Gillet	Davis	0.0%	0.0%	0.0%	0.0%	46.7%	46.7%	37%	48%	9%	5%	54.8	0.93
Gillet	Chico	2.8%	0.0%	5.6%	3.9%	48.7%	50.7%	34%	50%	5%	3%	55.0	0.97
Forde	Davis	0.0%	0.0%	0.0%	0.0%	51.2%	51.2%	60%	38%	3%	0%	56.3	1.05
Forde	Chico	0.0%	3.0%	0.0%	3.4%	51.1%	52.9%	54%	34%	5%	0%	55.9	1.04
Forde	Stolp	0.0%	13.2%	0.0%	10.5%	56.4%	63.0%	52%	11%	16%	0%	56.1	1.15
91-076-24	Davis	3.1%	0.0%	3.1%	3.2%	54.7%	56.5%	0%	42%	44%	8%	47.9	0.95
91-077-6	Davis	9.1%	0.0%	0.0%	9.4%	53.9%	59.5%	9%	33%	35%	3%	50.7	0.99
93-026-6	KAC	0.0%	0.0%	1.7%	0.2%	49.7%	49.8%	7%	48%	39%	5%	50.7	0.92
93-026-6	Davis	1.7%	0.0%	1.7%	1.8%	50.4%	51.3%	25%	51%	19%	2%	54.9	1.01
94-019-85	Chico	0.0%	1.3%	3.8%	2.0%	54.7%	55.8%	0%	40%	45%	11%	47.2	0.94
94-019-85	KAC	0.0%	0.0%	4.0%	0.5%	58.2%	58.5%	5%	46%	44%	3%	49.1	1.04
95-007-13	KAC	0.0%	0.0%	3.1%	0.2%	52.9%	53.0%	0%	30%	60%	9%	45.6	0.88
95-007-13	Davis	1.7%	0.0%	0.0%	1.6%	55.3%	56.2%	33%	59%	3%	2%	52.2	1.05
95-11-14	S505	1.4%	4.1%	4.1%	5.7%	54.9%	58.2%	37%	37%	15%	0%	54.8	1.10
95-11-14	Chico	0.0%	0.0%	2.6%	0.2%	56.2%	56.3%	20%	56%	21%	3%	53.5	1.09

Table 4. Male and female bloom dates at UC Davis. 2007

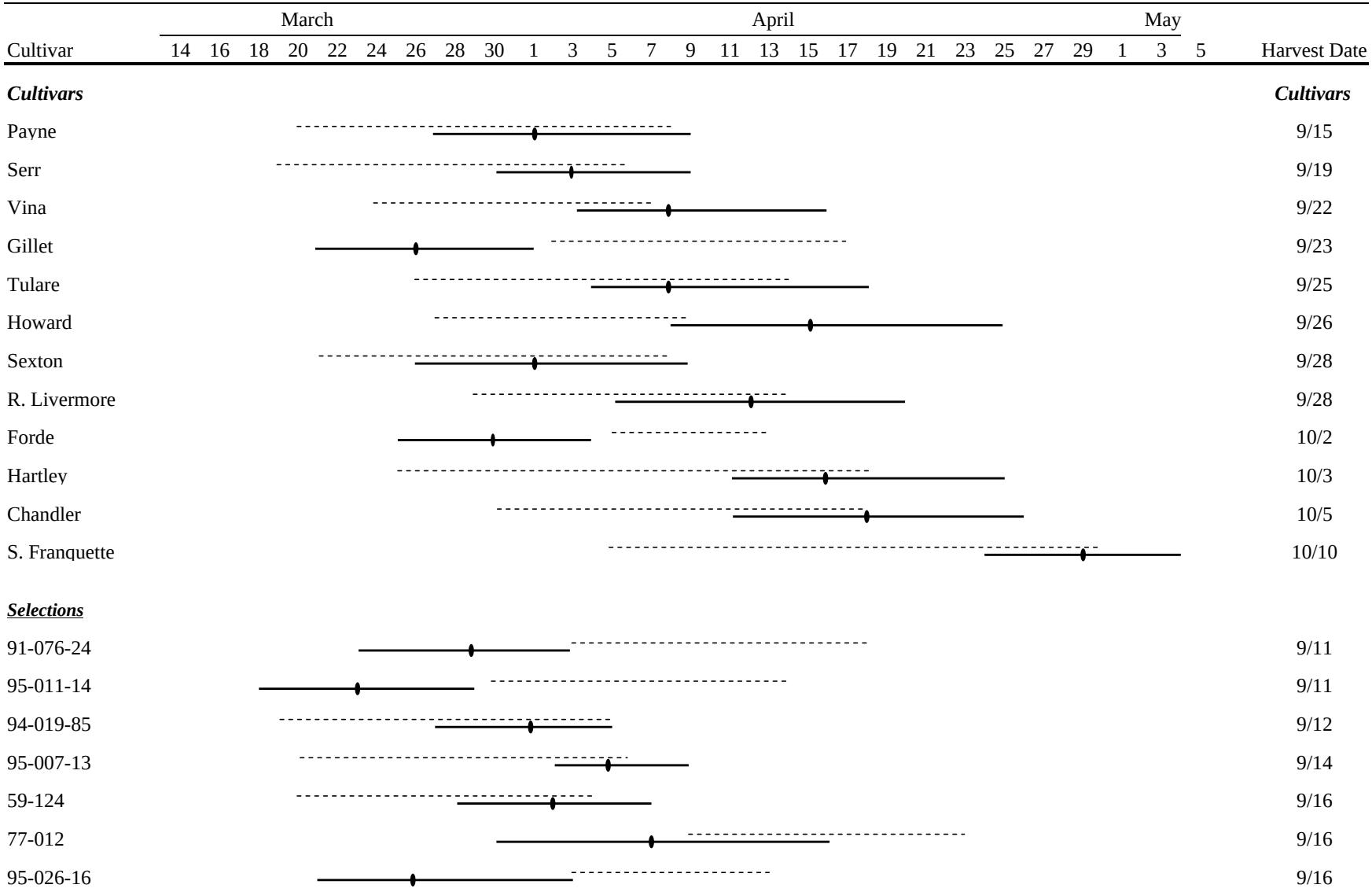


Table 4. Male and female bloom dates at UC Davis. 2007

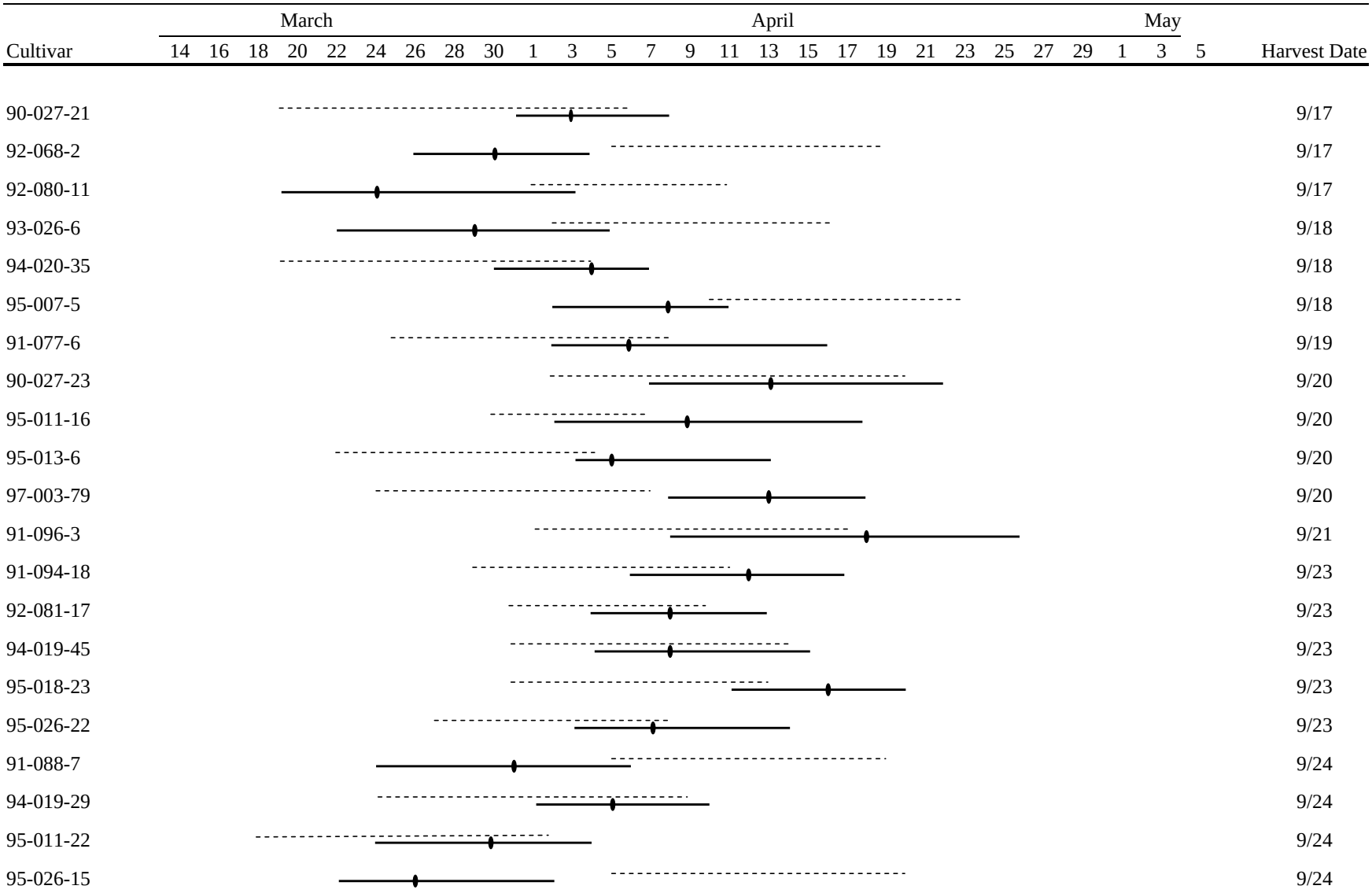
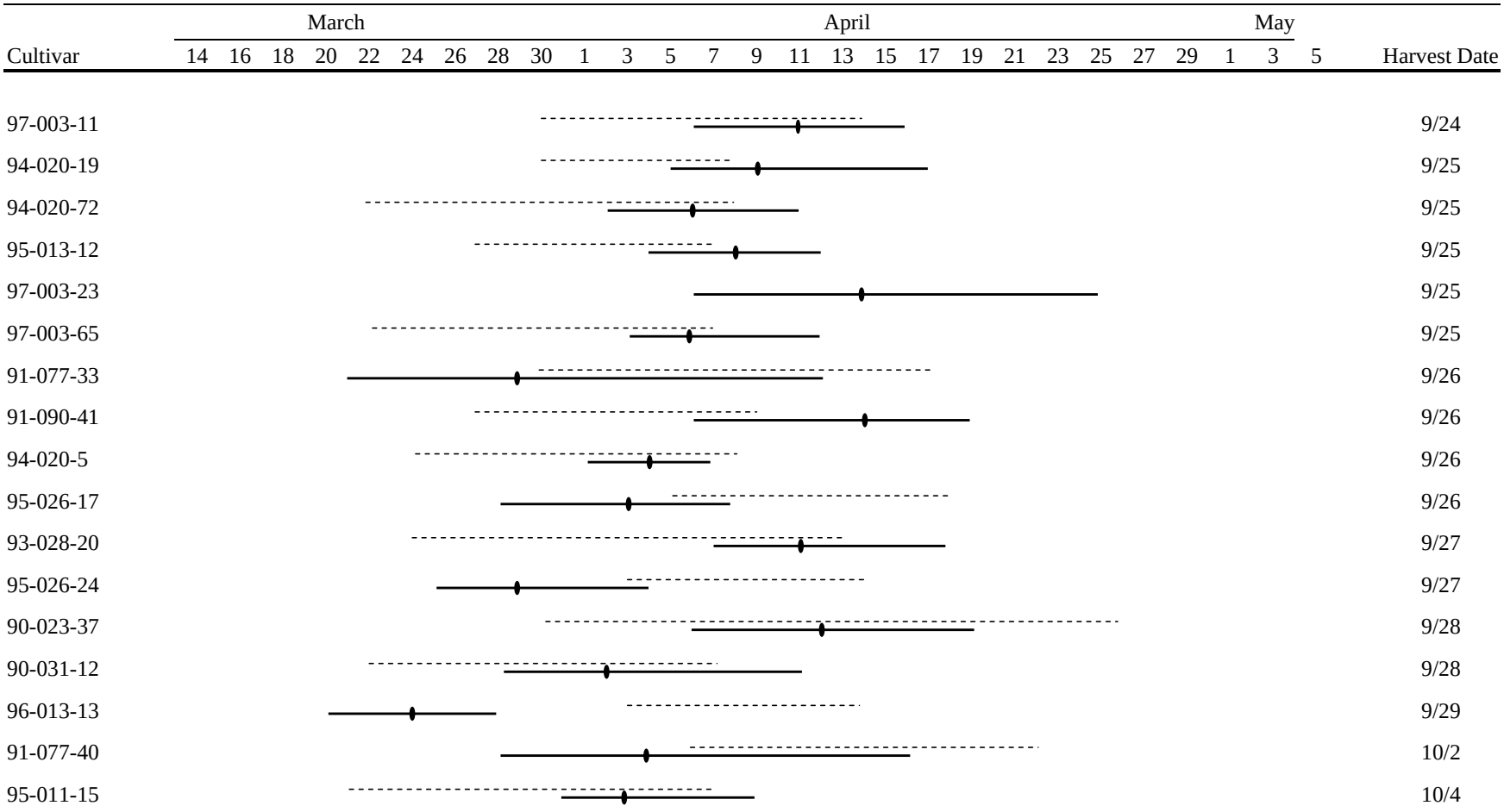


Table 4. Male and female bloom dates at UC Davis. 2007



Male Bloom ----------
Female Bloom_____

Table 5. Hypersensitive[a] backcross selections with commercial quality nut traits in 2007.

	Kernels		Harvest			% Color			% Shrivel		%
Accession	Ave wt (g)	%	Date	DAP[b]	Yield[c]	Ex Lt	Light	Lt Ambr	Tip	Blank	Veins
93-045-1	7.7	58.5	9/20	5		13	88	0	13	20	75
95-027-15	7.5	52.3				0	86	14	14	30	29
92-016-1	7.4	53.0				0	100	0	0	10	78
95-027-27	7.3	51.3				0	100	0	0	30	0
95-027-9	7.1	54.2				0	100	0	0	10	11
97-027-55	7.1	52.3				0	89	11	0	10	67
95-030-10	6.8	53.1				0	90	0	0	10	0
95-027-19	6.7	51.6	9/14	-1	5	0	100	0	0	0	0
95-027-33	6.5	47.7				0	25	75	0	20	38
95-027-33	6.2	54.0	9/23	8	7	0	38	63	0	20	63
95-027-25	6.3	47.4				0	89	11	11	10	11
95-029-41	6.3	44.1				0	70	30	30	0	20
95-027-8	6.1	49.3				0	100	0	0	0	10
96-023-16	5.9	54.9				0	80	20	0	0	90
96-019-3	5.8	54.2				0	100	0	0	10	22
95-027-23	5.7	46.3	9/30	15	5	0	60	30	0	10	30

[a] = resistant to virus by DNA and bark patch testing testing; [b]=Days after Payne; [c] 3 = low, 7 = high

Description of Selections 2007. (*indicates most promising, indent indicates probable discard)

Sexton (90-031-10) (Chandler x 85-008) (selected 2000): Kernels of this very precocious offspring of a Chandler x Chinese cross average 8.6 g. Color has been very good most years averaging 16% extra light. Nuts have smooth, round, solid shells and yield 53% kernel. Shells and seals can be weak in younger trees but were very good this year. The tree leafs a few days after Payne and harvests a week before Chandler. Yield has been excellent with little blight observed most years. Tree tends to have neck buds and narrowly forked branches. Pruning will be needed to set tree structure and to prevent possible stunting from early over-cropping. It maybe suitable for hedgerows where limb structure is less critical, heavy early yield is an objective, and limited tree size is an advantage. Its pollen shed overlaps the female bloom very well and it can have some 2nd flowering like Chico, resulting in some small and late harvesting nuts. Released 2004. (Trials: Deseret, Lang, Conant, Sierra Gold, Scheuring, Grunder, Crane, Driver, Crane Jr., Modesto JC, Swall, Taylor)

Gillet (95-022-26) (76-80 x Chico) (selected 2002): This protogynous selection has good yield, 8.0 g kernels, and harvests mid-season, about two weeks earlier than Chandler. Nuts average 51% kernel and yield halves easily. Kernels have had excellent color, little shrivel and few veins or blanks. Seals and shell strength appear adequate but may not be sufficiently strong for in-shell use. Seals should be watched, particularly in young trees. This is a large and vigorous tree that has had very little blight. Watch for a possibility of alternate bearing. Released 2004. (Trials: Conant, Scheuring, Grunder, Crane Jr., Modesto JC, Swall, Taylor)

Forde (95-026-37) (Lara x Chico) (selected 2001): This selection has had great color and excellent yield but harvests very close to Chandler. It has large, plump 8.6 g kernels, protogynous bearing habit, and 53% kernel yield. This is a large vigorous tree with little blight. Its strength, seal, fill, plumpness, percent kernel, and yield on young trees are better than Chandler and kernels show an absence of shrivel. Its protogynous flowering suggests its additional potential as a pollenizer for Chandler. Released 2004. (Trials: Conant, Driver, Scheuring, Grunder, Modesto JC, Crane Jr., Swall, Stolp, Taylor)

90-027-21 (Tulare x Sinensis #5) (selected 1998): We are interested in this selection for its apparent resistance to boron. Yield is very good and this could be used as an early in-shell producer. It is a protandrous, upright, vigorous tree that leafs out and harvests close to Payne. The shells are strong, well sealed, and shaped like Vina. Nuts yield only 48% kernel and kernels average 7.0 g. Kernel color has been mostly light but not excellent. Blight has been severe on unsprayed trees in wet years but little blight has been observed in sprayed blocks even though it leafs early. Nuts tend to have a white interior lining on the shell, sometimes don't fill well at the blossom end, and have packing tissue with a rather woody center. Tree is upright and branchy with a dense canopy and is likely easy to train. Kernel weight and percent are concerns but this selection continues to produce excellent yields. Possible discard. 2003 (Trials: Deseret, Stuke, Conant, Deardorff, Scheuring)

90-027-23 (Tulare x Sinensis #5) (selected 1998): This short-season sibling of the previous selection leafs out close to Chandler but harvests about two weeks earlier. It exhibits good shell strength and kernel color. Kernels average 7.6 g and nuts average 52% kernel. Nuts are Vina shaped and have a striped appearance. This is a vigorous, thrifty tree that consistently harvests about a week after Payne with good yield. (Trials: Deseret, Stuke, Conant, Deardorff, Carriere)

91-077-6 (Howard x 85-008) (selected 2000): This protandrous tree harvests close to Payne time but leafs about a week later than Payne. Yield has frequently been huge on this precocious selection. The large 8.9 g kernels have shown consistently excellent color with easy removal of halves. The large, round, smooth-shelled nuts average 56% kernel but shell strength and seal may prove insufficient and it often shows problems with incomplete shells although this was not seen this year. Not for in-shell use and shows boron sensitivity, but could be an early cracking selection if shell strength is adequate. (Trials: Conant, Sierra Gold, Scheuring, Bonturi, Deardorff)

91-077-40 (Howard x 85-008) (selected 2001): This is a rather small tree characterized by precocity, excellent yield, protogynous bearing habit, and large kernels averaging 8.2 g. Color continues to show a pattern of excellence at Davis but not at other locations. Nuts are well sealed with 51% kernel and strong shells. Harvest averages a week before Chandler and yields have been consistently huge. The large yields can stall growth. This selection may be of interest under power lines or in hedgerows.

***91-090-41** (87-009 x Chandler) (selected 1999): This early to mid-season harvesting selection is notable for its light color relative to other selections in locations with generally poor color. It has an attractive shell appearance and growth appears to be upright. The nuts have thin shells and average 59% kernel. Seals and strength are not adequate for in-shell use. Yields have consistently been very strong, and color of the 8.0 g kernels has been mostly light to extra-light with easy recovery of halves. Harvest is about two weeks before Chandler and blight has been low. Grower comments and Diamond data suggest consideration for release but shells and seals are rather in many cases and remain a concern. (Trials: Deseret, Stuke, Conant, Sierra Gold, Deardorff,)

92-070-12 (Soleze x Chandler) (selected 1999): Attributes of this selection include excellent kernel color, easy removal of halves, excellent shell appearance, 7.3 g kernels, and 54% kernel yield. This harvests a little earlier than Chandler and blight incidence has been low. Shells are very smooth textured and light colored but seals and shell strength are rather weak. Great nut appearance and very high value scores from Diamond crackout in multiple years and locations. Nut size is larger and more consistent than Chandler with less variability, a greater percent kernel, and fewer small nuts. Possible discard 2003. (Trials: Deseret, Stuke, Conant, Deardorff, Crane Jr.)

93-026-6 (Chandler x Sinensis #5) (selected 2001): Good yield with harvest averaging about a week after Payne or two weeks before Chandler. This protogynous selection has large Hartley-shaped nuts with solid shells and seals that yield 50 % kernel. The large 8.7 g kernels have had mostly light to extra light color. Stem end holes should be watched but have been mostly acceptable. Although rather Hartley-shaped and large, the shells can be irregular and are probably not be consistent enough in appearance for in-shell use. Veins and tip shrivel are consistent defects. (Trials: Driver, Deseret, Stuke, Crain, Conant, Noreen, Sierra Gold, Scheuring)

93-028-20 (Chandler x PI 159568) (selected 2001): Tulare timing with large, oval, very attractive nuts. This selection leafs a few days before Chandler but harvests about two weeks earlier and has had little blight. The smooth, attractive, solid shells have good seals and 55% kernel. The very plump, Sunland-shaped kernels average 8.7 g and color is excellent. Yield has been very good the last two years but was weak as a younger tree and needs to be watched further. (Trials: Conant, Sierra Gold, Spanfelner)

94-019-29 (Vina x 67-013) (selected 2001): This tree was selected for its great yield, harvest 2 weeks before Chandler, and shell traits suitable for in-shell use. Kernel color has been excellent but shells have been dark in some cases. This tree has shown severe blight susceptibility when not sprayed but has been blight free in selection blocks. Tree is upright and vigorous. Nuts average 53% kernel and average kernel size is 8.0 g. (Trials: Noreen)

94-019-45 (Vina x 67-013) (selected 2001): A large, vigorous, branchy, and heavy cropping selection with moderate blight susceptibility and 8.0 g kernels. Leafing date is similar to Chandler but it harvests early to mid-season with nut traits suitable for in-shell use. Nuts yield 53% kernel. Color has been good but shrivel is a concern some years and harvest date may be spread out. (Trials: Conant)

94-019-85 (Vina x 67-013) (selected 2001): This selection could serve as an early Hartley with a harvest date similar to Payne and a Hartley-shaped nut. Kernel color has been good at Davis but shows problems at KAC and Chico. The shell remains thin and a bit rough but has relatively good strength, resembling Serr in this regard. Yield has been good, nuts contain 60% kernel with easy halves, and kernels average 8.4 g. Consider for release as an early variety. Watch the yield consistency. Also the leaves don't abscise normally in some years. Continue to watch. (Trials: Bonturi)

94-020-5 (Vina x PI159568) (selected 2001): This was selected as a good yielding early in-shell with excellent color. It averages 7.9 g kernels and has great shell strength. It harvests within a week of Payne and averages 51% kernel. The tree is large and vigorous. Watch for spreading or sweepy growth habit, consistency of yield, and stem end opening. (Trials: Stolp, Conant, Sierra Gold)

94-020-28 (Vina x PI159568) (selected 2005): This protandrous potential in-shell selection has Payne-time harvest date with good yield. The nuts contain 54% kernel and have a smooth, attractive shell that yields easy halves. The very plump kernels average 8.3 g with mostly good color but it has also had some bad years. Trees in selection blocks are still young. Watch for blanks and degree of lateral bearing

94-020-35 (Vina x PI159568) (selected 2001): This early in-shell selection harvests within a week of Payne with moderate blight and good yield. Shells are very solid and have excellent strength for in-shell use but are pointed and have a rough inner surface, which along with excellent fill, may impede halves. Kernels average 8.1 g but kernel color has not been consistently light. Nuts are long and oval like Sunland and the thick shell accounts for nuts averaging only 49% kernel. Tree appears to have a spreading weepy or willowy growth habit. (Trials: Stolp, Moore, Conant, Sierra Gold)

95-007-13 (77-012 x Serr) (selected 2001): This Serr seedling harvests close to Payne, has

good yield and a solid, attractive shell but has not had good color the last several years. The amount of shrivel and strength of seals need to be watched further. Nuts yield 53% kernel and kernels average 8.3 g. New foliage has been noted to have a wilting appearance in late summer at some locations and it showed considerable mold at one location this year. Continue to evaluate it in selection blocks and grower trials. (Trials: Stuke, Conant, Scheuring)

***95-011-14** (67-013 x Chico) (selected 2001): This protogynous selection harvests with, or before, Payne and is characterized by great yield, excellent shell color and appearance, and mostly Chandler-like extra light kernels averaging 7.7 g. It may have sufficient shell strength for in-shell use but strength and seals should be watched and nut size is not large. Nuts yield 57% kernel with very easy removal of halves. Kernel quality and harvest date are excellent. This selection has shown some summer heat damage to the foliage and some summer nut drop. Watch for susceptibility to blight and summer heat stressed black nuts. (Trials: Sierra Gold, Scheuring, Conant, Moore, Bonturi, Spanfelner)

95-011-15 (67-013 x Chico) (selected 2001): Another selection with very good yield and kernel color, this tree has a solid shell and seal suitable for in-shell use but doesn't have the shell appearance of its above sibling. The harvest date is about a week before Chandler and nuts average 52% kernel. Nuts are sometimes not well-filled and can have a thick leathery packing tissue. Kernels are not plump and average 7.4 g. but color has been mostly light to extra light. Blight is a serious concern when unsprayed. (Trial: Sierra Gold)

95-011-16 (67-013 x Chico) (selected 2003): This protandrous early in-shell selection harvests about a week after Payne and has large, light colored kernels that average 8.2 g. Nuts have very solid, attractive, oval shells that give 55% kernel. It has a tendency to tip shrivel. Yield is mostly good but watch the variation. (Trials: Scheuring)

95-011-22 (67-013 x Chico) (selected 2001): A high yielding selection with mostly light to extra light kernels and a mid-season harvest date. Nuts have 54% kernel with shell and seal strength suitable for in-shell use. Nut size is a concern. Kernels average 7.1 g but have declined noticeably as trees have aged. (Trials: Conant)

95-013-6 (Vina x Howard) (selected 2003): This tree was selected for its harvest date near Payne time, excellent kernel color, easy halves, and very solid shell suitable for in-shell use. It is a large vigorous tree. Kernels average 7.8 g in selection blocks but nuts average only 49% kernel. Hulls are thick so the nuts look bigger on the tree than they really are. Probable discard 2004.

95-013-12 (Vina x Howard) (selected 2003): Selected as an early in-shell possibility, this tree produces good yield close to Payne harvest time. The large, attractive nuts have a rounded Vina or Hartley shape and a very solid shell and yield halves easily but average only 47% kernel. Large, light kernels average 8.4 g. Consider as a lateral bearing, earlier harvesting Hartley replacement.

95-018-23 (Tulare x Chandler) (selected 2003): Excellent yield of mostly extra light kernels

and harvests about a week after Payne. This is a short season selection that leafs after Chandler and has low blight. Shells are thin and have inadequate strength for in-shell use. Nuts yield 52% kernel and easy halves but fill is poor and kernels average only 7.0 g. (Trials: Scheuring, Carriere)

95-026-16 (Lara x Chico) (selected 2003): This protogynous selection harvests with Payne or earlier and has very good kernel color and little blight. Nuts yield 51% kernel and have solid shells and seals. Nuts have averaged only 7.2 g. Nut size and consistency of yield are concerns with this selection. Continue to watch in the selection blocks where nuts on young, less crowded trees are averaging 8.3g.

95-026-22 (Lara x Chico) (selected 2001): This protandrous tree harvests mid-season with a very strong shell and seal and good nut size. Kernels average 8.8 g and nuts yield 48% kernel. Kernels have generally been large, shiny, and light. Blight incidence has remained very low. The rough textured shells are very solid and can have inner roughness as well. If nuts are too well filled, kernels can be a bit difficult to remove in halves. This tree continues to have good nut size and yield. (Trials: Conant, Scheuring, Sierra Gold, Carriere, Taylor, Stuke)

96-013-13 (Howard x Chico) (selected 2003): This protogynous tree was selected for its excellent yield, light kernel color, good shell appearance, and mid-season harvest. It had better yield than Tulare trees around it as a seedling, an equivalent harvest date, and better color. The light colored, smooth, attractive shells have been solid and adequate for in-shell use most years. Nuts give 54% kernel but kernels average only 6.7 g and are not large on young trees in a selection block.

97-003-11 (Tulare x Mixed Chinese – Phase II) (selected 2004): Selected for its mid-season harvest, strong yield, Chandler leafing date, and large, plump, light colored kernels averaging 9.4 g. The large well-filled nuts yield 57% kernel. Shells are rough and seals should be watched.

97-003-23 (Tulare x Mixed Chinese – Phase II) (selected 2005): This is has a mid-season harvest. Nuts have a very attractive smooth and light colored shell and give 52% kernel. Kernels have excellent color and easy removal but have averaged only 7.2 g. Just beginning to bear in selection block.

97-003-40 (Tulare x Mixed Chinese – Phase II) (selected 2005): This is a protogynous mid-season selection with good yield. Nuts have a very solid strong shell and seal resulting in only 48% kernel. Color of the 7.4 g kernels has been good.

97-003-46 (Tulare x Mixed Chinese – Phase II) (selected 2005): This selection harvest very early, approximately with Payne and has large plump 8.6 g kernels with good color and easy removal. Shell strength and seal are probably not good enough or in-shell use. Nuts average 58% kernel.

97-003-65 (Tulare x Mixed Chinese – Phase II) (selected 2005): This selection has excellent color and large 8.3 g kernels with solid shells and 52% kernel but the harvest time may be too close to Chandler, yield needs to be watched further, and it is showing a tendency to produce blanks.

97-003-79 (Tulare x Mixed Chinese – Phase II) (selected 2005): This is a protandrous mid-season selection with exceptionally large 10.2 g kernels, smooth shells, and good yield. Removal of halves is very easy and the shells are solid, yielding 55% kernel. Kernel color may not be adequate. (Trial: Sierra Gold)

97-003-96 (Tulare x Mixed Chinese – Phase II) (selected 2005): This selection harvests about ten days after Payne. Nuts have a solid shell and seal with 51% kernel. The kernel color has been very good and kernels average 7.8 g. Pay attention to veins and watch this on rootstock. (Trial: Sierra Gold)