Breeding and Genetics

Use of Simple Sequence Repeats (SSR) to Determine Incidence and Effectiveness of Self- and Cross-pollinated Avocado Fruit in Southern California

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SSR technology is a powerful tool to determine the pollen parents of avocado progeny of known maternal genetic background. The four SSR markers selected for use to determine pollen parents were powerfully informative for the range of cross pollinizing cultivars available in the selected orchards and were, therefore, highly capable of discerning the specific pollen parent of each sampled fruit including those that were the result of self pollination. The cultivars included in the study were Hass and its potential cross pollinizers: Bacon, Ettinger, Fuerte, Harvest, Lamb Hass, Marvel, Nobel, SirPrize, and Zutano. This, coupled with the opportunity to sample fruits in replicated experimental plots comparing cross- and self-pollinations in trees located various distances from pollinizing cultivars, and comparing retention of cross- vs. self-pollinated fruit over the development season made this endeavor one of the most comprehensive ever preformed on avocado. This report is the final installment of a four-year suite of studies. It provides California avocado growers and advisors answers to the long sought after impacts of interplanting complimentary cultivars, and how these ultimately influence the crop.

The primary objective of this research was to determine the pollen parent of each fruit sampled early in fruit development and in those sampled late in fruit development at or near maturity. Secondarily with this knowledge applied to the population of fruits sampled from trees in experimental plots described below, the objectives include:

- 1. Estimate the proportions of successful self-pollinations with 'Hass' and cross-pollinations with specific cultivars that occurred in the individual rows of varying proximity to cross-pollinizing cultivars.
- 2. Determine if the proportion of outcrossed fruit increases during maturity due to preferential abscission of self-pollinated fruit as has been found for certain pollen parents of 'Hass'.
- **3.** Determine if there is preferential retention of cross-pollinated fruit pollinated by a specific cultivar during maturation.

Summary

In September of 2004, we began SSR analysis of near mature 'Hass' fruit embryos that were harvested on October 1, 2003 at the Debusschere orchard located on the coastal plain near Camarillo in Ventura County. The results of those samples were published in the 2004 California Avocado Research Symposium. Details of the experimental and analytical protocols used throughout the fouryear study, along with supporting literature, were included therein. Twenty-four fruits in the first two samplings (2003 near-mature fruit and 2004 marble sized fruit) and 36 fruits thereafter were sampled evenly down four 'Hass' trees of interplanted rows and six trees of purely 'Hass' rows. Each row consisted of north and south plots each having ten 'Hass' trees in 48 rows across a block of trees interplanted every 6 rows with the complimentary cultivars listed above and nearby Lamb Hass (Fig. 1). The results of subsequent samplings and pollen parent analysis of marble sized fruit collected on June, 13, 2004 and near-mature fruit collected on November 1, 2004 and November 7, 2005 were reported in the 2006 California Avocado Research Symposium. This, the final installment, reports the completed parental analysis of the more than 4,500 fruit sampled at marble size on June 22, 2005 and June 24, 2006 and at near-mature stage on November 6, 2006. It is supplemented with further analyses summarizing the three years of pollen parent analysis results of marble sized fruits harvested in June of 2004 to 2006 and the four years of results in near-mature fruit sampled in October/November of 2003 to 2006.

Current Results and Overall Project Discussion

Results of genetic analyses of the embryos from marble sized fruit sampled on June 22, 2005 from test plots B2 and A2 at Debusschere orchard are presented in Tables 1a (western half of orchard plot) and 1b (eastern half). Similarly, the pollen parent analyses of fruit sampled from the same plots on June 24, 2006 are displayed in Tables 2a and 2b, and the same population of fruits sampled at near maturity on November 6, 2006 is presented in Tables 3a & 3b. The average number and proportion of pollinations by each pollen parent including 'Hass' (self pollinated) across the northern and southern portions of the orchard at each stage each year are listed at the end of Tables 1b, 2b, and 3b.

As has occurred each year for the last four years, self-pollination within Stage 2 (male stage) flowers was the dominant mode of reproduction. Cross-pollination was greatest in "Hass' trees interplanted in the same or adjacent rows with 'Ettinger', 'Fuerte', or 'Zutano'. The extent of cross-pollination in adjacent rows was low to very low compared to the pollinizer rows. On average, across the orchard, cross-pollination by any pollinizing cultivar was 31% or less depending upon sample year and stage of fruit development. The proportions of self-pollination ranged from 37% to 66% depending on sampling location (N or S portion of orchard), fruit stage of development, and year sampled.

The predominance of self-pollination in Stage 2 flowers was consistent for the four years of flowering as evidenced by the percent proportions of self-pollinated near-mature fruit sampled in 2003, 2004, 2005, and 2006. Self-pollination was not a result of close pollination. We have observed that floral openings in cool temperature conditions, which promote delayed and (at rare times) overlapping of floral openings in the same cultivar, are rarely sufficiently overlapped to allow pollen to be transferred from flower to flower. Moreover, temperature conditions that cause overlap are always too cold to allow sufficient pollen tube growth to reach the ovary in time to fertilize the egg. The overall average number (Table 4) and percent proportion (Table 5) of harvested fruit analyzed to be self-pollinated over the four years of study was significantly greater than those of any cross pollinizing cultivar. The overall average percent proportion of self-pollinations found in near-mature fruit was 55.5% (Table 5).

The four-year accumulated distribution of the number of near-mature fruit pollinated by the various cultivars from row to row in the North plot and South plots of the Debusschere orchard is displayed in Figures 2a and 2b, respectively. The total overall number of near-mature fruit analyzed for paternity in each row over the four seasons was around 100. The accumulated numbers and, hence, proportions

of fruit determined to be pollinated by each pollinizing cultivar in each row are displayed within each histobar. Results in the companion study examining caged and open pollinated trees, funded by BARD, over the same four-year period have consistently indicated that pollen is wind blown and that virtually no pollen is transferred by bees despite their heavy presence in the orchard. Figures 2a and 2b display the extent of pollen drift from the pollinizer rows to other rows within the North and South plots.

The extent of pollen drift for each complimentary cultivar as expressed by the outreach index over the past four years, is displayed in Table 6. The outreach index was calculated by adding the products of the proportion of fruit pollinated by a particular cultivar times the number of rows from the row in which that cultivar was planted [Σ (proportion pollen parent X row # from parent)] among all the rows in the orchard for each year. Zutano was deemed the farthest reaching pollinizer with an average outreach index over the four years of 20.4, followed by Ettinger at 13.5, and the remaining potential pollinizing cultivars at 5.2 or less. The lowest outreach index in Nobel could be attributed to the small tree size of that cultivar throughout the study. They never grew more than about 4 ft high bearing few flowering stems.

The purpose for harvesting fruit for paternity analysis at the marble-sized stage and the near-mature stage was to determine if the population of cross- and self-pollinated fruit shifted in favor of any fruit pollinated by a particular superior setting cultivar. For example, it has been reported that more self-pollinated fruit abscise during development in favor of those pollinated especially by Ettinger. Analysis of differences in percent proportions of fruit pollinated by each cultivar, including self-pollinations by 'Hass', as the fruit developed to the near-mature stage revealed consistently greater retention of self-pollinated fruit over any of those pollinated by complimentary cultivars during the three observation years (Table7). The proportion of self-pollinated fruit had losses or little change in proportion as they developed.

Based on the average results of paternity analysis of near-mature fruit sampled in different rows at the Debusschere orchard over the past four years, we estimated the potential out crossing proportions of each complimentary cultivar at different interplanted ratios with 'Hass' if trees were growing in similar conditions as that of the Debusschere orchard (Table 8). A ratio of 1:1 represents every row interplanted with the indicated cultivar, thus having equal numbers of 'Hass' trees and trees of the pollinizing cultivar. A ratio of 1:3 would be a planting of two solid 'Hass' rows between each interplanted row and so on for the increasing proportions of 'Hass' rows in an orchard. Clearly, as one "dilutes" the orchard with more complimentary cultivars, one obtains a greater proportion of cross-pollination by that cultivar, but does it result in increased yield?.

We estimated the number of near-mature fruit on each of eight trees in each row in 2006 (Table 9). Fruit counts were made on individual trees by visually counting the fruit while holding push button counting devises to record the number of fruit observed within each tree canopy. The range in yield from tree to tree within each row without any apparent pattern was great (Table 9). Moreover the average yield from row to row displayed no discernable pattern with regard to proximity to interplanted rows (Figures 3a and 3b). Yields in the western and easternmost rows were highly influenced by shading from the poplar and eucalyptus wind break trees, but there was no indication of increased yields in the orchard rows near the interplanted rows. Yield among rows was random. Moreover, comparison of Figures 3a and 3b with Tables 3a and 3b reveal no pattern with regard to percent pollination by a particular cultivar and yield.

Finally, we measured the ratio of seed length and width and fresh seed weight before subjecting the embryos to SSR analysis (Table 10). There was a significantly greater length to width ratio in 'Fuerte'-

pollinated seeds over all the others. On average, 'SirPrize- and Harvest-pollinated seeds were significantly largest at about 21 grams compared to the smallest (12.5 g) in fruits pollinated by 'Bacon'

Conclusions

Self-pollination within Stage 2 flowers appears to be the dominant mode of avocado reproduction unless a high proportion of complimentary cultivars with high outreach indexes are interplanted in the orchard. The results reported here are consistent with the conclusions derived from caged experiments, that avocado flowers are wind pollinated. We observed liberation of pollen from Stage 2 flowers of complimentary cultivars and 'Hass' flowers each year. Each flowering tree acts as a filter to catch drifting pollen in 2 to 4% of the flowers open in Stage 1, and dispersal of 'Hass' pollen in Stage 2 makes it readily available to receptive stigmas within the same flowers.

Yield in 2006 was not related to pollen parent. Microclimates within the orchard and possible internal alternate bearing effects from the previous year's production most likely determine yield. We observed fruit set occurring only on days in which the temperatures warmed to above the high 60's at night and low 80's during the day. No cross pollinizing cultivar matched the fruit retention capabilities of self-pollinated fruit; hence the observation of superior fruit set and retention by Ettinger pollinated fruit reported in Israel is not true for conditions present in the Debusschere orchard.

How does one resolve the conflicting observations by some growers that solid 'Hass' plantings produce good yields, whereas cross-pollinizing cultivars seem to be necessary on other farms. For example, the eight cross-pollinizing cultivars with a 1:6 interplanted ratio contributed to an average of about 45% of the yield in the Debusschere orchard over the past four years. Perhaps the answer to this enigma lies in the timing of pollen arrival and the interactions of cool temperatures with flowers resulting in slowed pollen tube growth.

We observed that pollen tube growth in 'Hass 'flowers was severely inhibited when temperatures were within the lower range of those mentioned above regardless of cultivar or stage of application to the stigmas. There were no delays or overlap of floral openings; however, pollen tubes grew only to the base of the styles by three days after pollen deposition. Research in Florida has demonstrated that individual flowers begin producing large amounts of ethylene beginning on the day of Stage 2 opening, and dramatically higher proportions of flowers begin producing ethylene over the first and second days after Stage 2 opening. Once each flower begins producing ethylene it separates from the tree two days later. It is, thus, a race against time for pollen to arrive at the egg to fertilize it before the abscission event begins. Successful fertilizations prevent the onset of ethylene production in some flowers resulting in the observed initial fruit set.

Later abscission can still occur, but in California, temperature seems to dominate the success or failure of the pollination event. When temperatures are too low to allow successful fertilizations, no fruit set occurs, and flowers abscise. It is possible that, because of the one day earlier arrival of pollen from complimentary cultivars in Stage 1, this pollen has 32 more hours to grow to the egg than does the pollen arriving from within flowers in Stage 2 before the onset of the abscission event. Thus, conditions may favor successful cross-pollination during marginally cool temperature conditions, hence favoring more fruit set. Interplanting of cross-pollinizing cultivars would be advantageous in chronically cool conditions, such as Debusschere, to provide additional potential for fruit set. If temperatures are sufficiently warm during flowering, then self-pollinated flowers would have the same potential to successfully fertilize the egg and produce fruit. The need for cross pollinizing cultivars for good yields would thus be reduced as demonstrated in large, solid block plantings in warm areas.

Figure 1. Debusschere orchard plots B2 (north half) and A2 (south half) are bordered by tall windbreak rows of Poplar to the west and Eucalyptus to the east. 'Hass' (X) trees are interplanted with 'Ettinger' (ET), 'Nobel' (N), 'Fuerte' (F), and 'Zutano' (Z) in the indicated rows of the north half of the orchard and with 'Marvel' (M), 'Harvest' (HV), 'Bacon' (B), and 'SirPrize' (SP) in the indicated rows of the south half of the orchard. 'Lamb Hass' is interplanted with 'Hass' in rows 29, 35, 41, and 47 in the adjacent section immediately south of the displayed plotted section.

											-	NORTH														
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в	x	х	X ET	х	х	х	х	х	X N	х	х	х	х	х	× F	х	х	х	х	х	x Z	х	х	х	5	02
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Pollinizer					Etti	nger											No	bel						
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Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	30	100	37	100	32	100	35	100	36	100	35	100	27	100	34	100	30	100	26	100	33	100	31	100
Zutano	10	33.3	8	21.6	0	0.0	5	14.3	3	8.3	4	11.4	5	18.5	2	5.9	5	16.7	6	23.1	3	9.1	7	22.6
Hass	2	6.7	1	2.7	0	0.0	9	25.7	14	38.9	16	45.7	15	55.6	23	67.6	16	53.3	11	42.3	19	57.6	13	41.9
Fuerte	0	0.0	0	0.0	0	0.0	1	2.9	0	0.0	0	0.0	0	0.0	1	2.9	1	3.3	0	0.0	0	0.0	3	9.7
Ettinger	17	56.7	28	75.7	30	93.8	19	54.3	18	50.0	11	31.4	7	25.9	7	20.6	6	20.0	3	11.5	9	27.3	3	9.7
Bacon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	5.7	0	0.0	1	2.9	2	6.7	5	19.2	1	3.0	0	0.0
SirPrize	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Marvel	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	2	5.7	0	0.0	0	0.0	0	0.0	1	3.8	1	3.0	3	9.7
Harvest	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Nobel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.5
LambHass	1	3.3	0	0.0	1	3.1	1	2.9	1	2.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
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Pollinizer	0	70		~~~		arvel		00		10		00				40		vest	0	~~	07	20		<u> </u>
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Zutano	91					2 4 1	A	10 1	0	0.0	4		-				2	0.4	4	6.0	E	15.0		
	-		-	18.2	1	3.1	4	12.1	0	0.0	1	2.9	0	0.0	0	0.0	3	9.1	1	6.3	5	15.6	3	11.5
Hass	11	28.9	5	15.2	1 6 0	18.8	12	36.4	24	70.6	1 27	2.9 77.1	-	0.0 8.7	0 27	0.0 79.4	27	81.8	1 13	81.3	24	75.0	17	65.4
Fuerte	11 1	28.9 2.6	5 1	15.2 3.0	0	18.8 0.0	12 3	36.4 9.1	24 0	70.6 0.0	0	2.9 77.1 0.0	0	0.0 8.7 0.3	0 27 0	0.0 79.4 0.0	-	81.8 0.0	0	81.3 0.0	-	75.0 0.0	17 2	65.4 7.7
Fuerte Ettinger	11 1 4	28.9 2.6 10.5	5 1 13	15.2 3.0 39.4	0 9	18.8 0.0 28.1	12 3 9	36.4 9.1 27.3	24	70.6 0.0 23.5		2.9 77.1 0.0 11.4	0 27 1 1	0.0 8.7 0.3 0.3	0 27 0 5	0.0 79.4 0.0 14.7	27	81.8 0.0 3.0	0 0	81.3 0.0 0.0	24 0 1	75.0 0.0 3.1	17 2 2	65.4 7.7 7.7
Fuerte Ettinger Bacon	11 1 4 0	28.9 2.6 10.5 0.0	5 1 13 0	15.2 3.0 39.4 0.0	0 9 0	18.8 0.0 28.1 0.0	12 3 9 0	36.4 9.1 27.3 0.0	24 0 8 1	70.6 0.0 23.5 2.9	0	2.9 77.1 0.0 11.4 2.9	0 27 1 1 0	0.0 8.7 0.3 0.3 0.0	0 27 0 5 0	0.0 79.4 0.0 14.7 0.0	27 0 1	81.8 0.0 3.0 3.0	0 0 2	81.3 0.0 0.0 12.5	24 0 1 2	75.0 0.0 3.1 6.3	17 2 2 2	65.4 7.7 7.7 7.7
Fuerte Ettinger Bacon SirPrize	11 1 4 0 0	28.9 2.6 10.5 0.0 0.0	5 1 13	15.2 3.0 39.4 0.0 0.0	0 9 0 0	18.8 0.0 28.1 0.0 0.0	12 3 9 0	36.4 9.1 27.3 0.0 0.0	24 0 8 1 0	70.6 0.0 23.5 2.9 0.0	0	2.9 77.1 0.0 11.4 2.9 2.9	0 27 1 1	0.0 8.7 0.3 0.3 0.0 0.0	0 27 0 5	0.0 79.4 0.0 14.7 0.0 0.0	27 0 1 1 0	81.8 0.0 3.0 3.0 0.0	0 0 2 0	81.3 0.0 0.0 12.5 0.0	24 0 1 2 0	75.0 0.0 3.1 6.3 0.0	17 2 2 2 0	65.4 7.7 7.7 7.7 0.0
Fuerte Ettinger Bacon SirPrize Marvel	11 1 4 0 0 3	28.9 2.6 10.5 0.0 0.0 7.9	5 1 13 0	15.2 3.0 39.4 0.0 0.0 21.2	0 9 0 0 16	18.8 0.0 28.1 0.0 0.0 50.0	12 3 9 0 0 5	36.4 9.1 27.3 0.0 0.0 15.2	24 0 8 1 0 1	70.6 0.0 23.5 2.9 0.0 2.9	0 4 1 1 1	2.9 77.1 0.0 11.4 2.9 2.9 2.9	0 27 1 1 0	0.0 8.7 0.3 0.3 0.0 0.0 0.0	0 27 0 5 0	0.0 79.4 0.0 14.7 0.0 0.0 2.9	27 0 1	81.8 0.0 3.0 3.0 0.0 0.0	0 0 2 0 0	81.3 0.0 0.0 12.5 0.0 0.0	24 0 1 2 0 0	75.0 0.0 3.1 6.3 0.0 0.0	17 2 2 2 0 0	65.4 7.7 7.7 7.7 0.0 0.0
Fuerte Ettinger Bacon SirPrize	11 1 4 0 0	28.9 2.6 10.5 0.0 0.0	5 1 13 0	15.2 3.0 39.4 0.0 0.0	0 9 0 0	18.8 0.0 28.1 0.0 0.0	12 3 9 0	36.4 9.1 27.3 0.0 0.0	24 0 8 1 0	70.6 0.0 23.5 2.9 0.0	0	2.9 77.1 0.0 11.4 2.9 2.9	0 27 1 1 0	0.0 8.7 0.3 0.3 0.0 0.0	0 27 0 5 0	0.0 79.4 0.0 14.7 0.0 0.0	27 0 1 1 0	81.8 0.0 3.0 3.0 0.0	0 0 2 0	81.3 0.0 0.0 12.5 0.0	24 0 1 2 0	75.0 0.0 3.1 6.3 0.0	17 2 2 2 0	65.4 7.7 7.7 7.7 0.0

Table 1a. Numbers and proportions of marble sized 'Hass' fruit harvested on June 22, 2005 that were pollinated by all potential pollen donors in the western half of the Debusschere orchard plot. Table representing the eastern half of the plot is shown in Table 1b.

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#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
36	100	33	100	36	100	33	100	33	100	33			100	32	100	36	100		100	33	100	27	100	779	100	
1	2.8	10	30.3	6	16.7	5	15.2	8	24.2	8			44.8	18	56.3	28	77.8		53.1	14	42.4	13	48.1	199		Zutano
24	66.7	12	36.4	9	25.0	20	60.6	20	60.6	19			34.5	10	31.3	4	11.1	8	25.0	6	18.2	5		286		Hass
4	11.1	6	18.2	16	44.4	6	18.2	3	9.1	3		2	6.9	0	0.0	1	2.8	0	0.0	1	3.0	3	11.1 3.7	51		Fuerte
3	8.3	0	0.0	5	13.9	2	6.1	2	6.1	0		4	13.8	0	0.0	3		4	12.5	9	27.3	1	-	191		Ettinger
0	0.0	1	3.0	0	0.0	0	0.0	0	0.0	0			0.0	2	6.3	0			6.3	1	3.0	3		20		Bacon
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0 3		0 0	0.0	1 0	3.1	0			3.1	1	3.0	0	0.0	3		SirPrize
· ·	2.8	2	6.1	0	0.0 0.0	0	0.0	0	0.0			-	0.0	0	0.0 3.1	0			0.0	1	3.0	0	0.0	15		Marvel
0	0.0 2.8	2 0	6.1 0.0	0	0.0	0 0	0.0	0 0	0.0 0.0	0 0		0 0	0.0	0	<u> </u>	0 0	•••		0.0	0 0	0.0	2 0	7.4 0.0	5 3		Harvest Nobel
2	2.0 5.6	0	0.0	0	0.0	0	0.0	0	0.0	0		-	0.0	0	0.0	0			0.0	0	0.0	0	0.0	6		L.Hass
	5.0	0	0.0	0	0.0	U	0.0	0	0.0	0	0.0	0	0.0	U	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.9	L.1 1055
				Ba	icon											Sir	Prize									
3	9S	4	0S		icon 1S	4	28	4	35	4	14S	4	5S	4	6S		Prize	4	.8S	4	95	5	0S	То	tal	
	9S %		0S %	4	1S		2S %		3S %		14S %		5S %		6S %	4	7S		.8S %		9S %		0S %	To #		Fruits
3' # 31	9S % 100	4 # 31	%			4 # 36	2S % 100	4 # 35	%	#	%	#	%	#	%		7S %	4 # 31	%	4 # 17	9S % 100	5 # 34	%	#	tal % 100	Fruits Total
#	%	#		4 #	1S %	#	%	#			% 100	# 34				4 #	7S	# 31		#	%	#	% 100	-	% 100	
#	% 100	# 31	% 100	4 # 32	1S % 100	#	% 100	# 35	% 100	# 27	% 100 18.5	# 34	% 100	# 30	% 100	4 # 29	7S % 100 31.0	# 31 10	% 100	# 17	% 100	# 34	% 100	# 734	% 100 21.7	Total
# 31 7	% 100 22.6	# 31 12	% 100 38.7	4 # 32 18	1S % 100 56.3	# 36 7	% 100 19.4	# 35 10	% 100 28.6	# 27 5	% 100 18.5	# 34 12	% 100 35.3	# 30 4	% 100 13.3	4 # 29 9	7S % 100 31.0	# 31 10 9	% 100 32.3	# 17 5	% 100 29.4	# 34 10 12	% 100 29.4	# 734 142	% 100 21.7 60.2	Total Zutano
# 31 7 19	% 100 22.6 61.3	# 31 12 11	% 100 38.7 35.5	4 # 32 18	1S % 100 56.3 25.0	# 36 7 18	% 100 19.4 50.0	# 35 10 17	% 100 28.6 48.6	# 27 5	% 100 18.5 70.4 3.7	# 34 12	% 100 35.3 55.9	# 30 4 23	% 100 13.3 76.7	4 # 29 9 13	7S % 100 31.0 44.8	# 31 10 9	% 100 32.3 29.0	# 17 5 5	% 100 29.4 29.4	# 34 10 12	% 100 29.4 35.3	# 734 142 393	% 100 21.7 60.2 4.1	Total Zutano Hass
# 31 7 19 0	% 100 22.6 61.3 0.0	# 31 12 11 0	% 100 38.7 35.5 0.0	4 # 32 18 8 2	1S % 100 56.3 25.0 6.3	# 36 7 18 6	% 100 19.4 50.0 16.7	# 35 10 17 3	% 100 28.6 48.6 8.6	# 27 5 19	% 100 18.5 70.4 3.7 7.4	# 34 12 19 1	% 100 35.3 55.9 2.9	# 30 4 23 0	% 100 13.3 76.7 0.0	4 # 29 9 13 0	7S % 100 31.0 44.8 0.0 6.9	# 31 10 9 2 4	% 100 32.3 29.0 6.5	# 17 5 5 2	% 100 29.4 29.4 11.8	# 34 10 12 2	% 100 29.4 35.3 5.9 11.8	# 734 142 393 27	% 100 21.7 60.2 4.1 13.2	Total Zutano Hass Fuerte
# 31 7 19 0 3	% 100 22.6 61.3 0.0 9.7	# 31 12 11 0	% 100 38.7 35.5 0.0 3.2	4 # 32 18 8 2	1S % 100 56.3 25.0 6.3 0.0	# 36 7 18 6 2	% 100 19.4 50.0 16.7 5.6	# 35 10 17 3	% 100 28.6 48.6 8.6 11.4	# 27 5 19 1 2	% 100 18.5 70.4 3.7 7.4 0.0	# 34 12 19 1 2	% 100 35.3 55.9 2.9 5.9	# 30 4 23 0	% 100 13.3 76.7 0.0 3.3	4 # 29 9 13 0 2	7S % 100 31.0 44.8 0.0 6.9 0.0	# 31 10 9 2 4	% 100 32.3 29.0 6.5 12.9	# 17 5 5 2	% 100 29.4 29.4 11.8 23.5	# 34 10 12 2 4	% 100 29.4 35.3 5.9 11.8	# 734 142 393 27 86	% 100 21.7 60.2 4.1 13.2 5.2	Total Zutano Hass Fuerte Ettinger
# 31 7 19 0 3 1	% 100 22.6 61.3 0.0 9.7 3.2	# 31 12 11 0 1 7	% 100 38.7 35.5 0.0 3.2 22.6	4 # 32 18 8 2 0 4	1S % 100 56.3 25.0 6.3 0.0 12.5	# 36 7 18 6 2 2	% 100 19.4 50.0 16.7 5.6 5.6	# 35 10 17 3 4 1	% 100 28.6 48.6 8.6 11.4 2.9	# 27 5 19 1 2 0	% 100 18.5 70.4 3.7 7.4 0.0 0.0	# 34 12 19 1 2 0	% 100 35.3 55.9 2.9 5.9 0.0	# 30 4 23 0 1 1	% 100 13.3 76.7 0.0 3.3 3.3	4 29 9 13 0 2 0	7S % 100 31.0 44.8 0.0 6.9 0.0 17.2	# 31 10 9 2 4 4 4 0	% 100 32.3 29.0 6.5 12.9 12.9	# 17 5 5 2 4 1	% 100 29.4 29.4 11.8 23.5 5.9	# 34 10 12 2 4 4	% 100 29.4 35.3 5.9 11.8 11.8	# 734 142 393 27 86 34	% 100 21.7 60.2 4.1 13.2 5.2 1.1	Total Zutano Hass Fuerte Ettinger Bacon
# 31 7 19 0 3 1 0	% 100 22.6 61.3 0.0 9.7 3.2 0.0	# 31 12 11 0 1 7 0	% 100 38.7 35.5 0.0 3.2 22.6 0.0	4 # 32 18 8 2 0 4 0 4	1S % 100 56.3 25.0 6.3 0.0 12.5 0.0	# 36 7 18 6 2 2 2 0	% 100 19.4 50.0 16.7 5.6 5.6 0.0	# 35 10 17 3 4 1 0	% 100 28.6 48.6 8.6 11.4 2.9 0.0	# 27 5 19 1 2 0 0	% 100 18.5 70.4 3.7 7.4 0.0 0.0 0.0	# 34 12 19 1 2 0 0	% 100 35.3 55.9 2.9 5.9 0.0 0.0	# 30 4 23 0 1 1 1	% 100 13.3 76.7 0.0 3.3 3.3 3.3 3.3	4 29 9 13 0 2 0 5	7S % 100 31.0 44.8 0.0 6.9 0.0 17.2 0.0	# 31 10 9 2 4 4 4 0	% 100 32.3 29.0 6.5 12.9 12.9 0.0	# 17 5 5 2 4 1 0	% 100 29.4 29.4 11.8 23.5 5.9 0.0	# 34 10 12 2 4 4 4 0	% 100 29.4 35.3 5.9 11.8 11.8 0.0	# 734 142 393 27 86 34 7	% 100 21.7 60.2 4.1 13.2 5.2 1.1 5.7	Total Zutano Hass Fuerte Ettinger Bacon SirPrize
# 31 7 19 0 3 1 0 0	% 100 22.6 61.3 0.0 9.7 3.2 0.0 0.0	# 31 12 11 0 1 7 0 0	% 100 38.7 35.5 0.0 3.2 22.6 0.0 0.0	4 # 32 18 8 2 0 4 0 4 0 0	1S % 100 56.3 25.0 6.3 0.0 12.5 0.0 0.0	# 36 7 18 6 2 2 2 0 0 0	% 100 19.4 50.0 16.7 5.6 5.6 5.6 0.0 0.0	# 35 10 17 3 4 1 0 0	% 100 28.6 48.6 8.6 11.4 2.9 0.0 0.0	# 27 5 19 1 2 0 0 0	% 100 18.5 70.4 3.7 7.4 0.0 0.0 0.0 0.0	# 34 12 19 1 2 0 0 0 0	% 100 35.3 55.9 2.9 5.9 0.0 0.0 0.0	# 30 4 23 0 1 1 1 1 0	% 100 13.3 76.7 0.0 3.3 3.3 3.3 3.3 0.0	4 29 9 13 0 2 0 5 0	7S % 100 31.0 44.8 0.0 6.9 0.0 17.2 0.0 0.0	# 31 10 9 2 4 4 4 0 0 0 0	% 100 32.3 29.0 6.5 12.9 12.9 12.9 0.0	# 17 5 2 4 1 0 0	% 100 29.4 29.4 11.8 23.5 5.9 0.0 0.0	# 34 10 12 2 4 4 4 0 2	% 100 29.4 35.3 5.9 11.8 11.8 11.8 0.0 5.9	# 734 142 393 27 86 34 7 37	% 100 21.7 60.2 4.1 13.2 5.2 1.1 5.7 0.8 0.5	Total Zutano Hass Fuerte Ettinger Bacon SirPrize Marvel

Table 1b. Numbers and proportions of marble sized 'Hass' fruit harvested on June 22, 2005 that were pollinated by all potential pollen donors in the eastern half of the Debusschere orchard plot. Table representing the western half of the plot is shown in Table 1a.

Pollinizer					Etti	inger											No	obel						
Row	2	7N	2	8N	2	9N	3	0N	3	1N	3	32N	3	3N	3	4N	3	5N	30	6N	37	7N	3	8N
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	32	100	32	100	31	100	32	100	32	100	30	100	31	100	32	100	30	100	32	100	31	100	29	100
Zutano	1	3.1	0	0.0	1	3.2	0	0.0	1	3.1	0	0.0	3	9.7	3	9.4	4	13.3	1	3.1	1	3.2	5	17.2
Hass	11	34.4	5	15.6	4	12.9	10	31.3	12	37.5	22	73.3	17	54.8	23	71.9	15	50.0	21	65.6	25	80.6	12	41.4
Fuerte	0	0.0	0	0.0	1	3.2	0	0.0	4	12.5	1	3.3	0	0.0	1	3.1	6	20.0	5	15.6	2	6.5	8	27.6
Ettinger	20	62.5	27	84.4	25	80.6	22	68.8	14	43.8	6	20.0	10	32.3	3	9.4	4	13.3	4	12.5	2	6.5	2	6.9
Bacon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.3	1	3.2	1	3.1	1	3.3	0	0.0	0	0.0	0	0.0
SirPrize	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Marvel	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	1	3.2	2	6.9
Harvest	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Nobel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0
LambHass	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 2a. Numbers and proportions of marble sized 'Hass' fruit harvested on June 24, 2006 that were pollinated by all potential pollen donors in the western half of the Debusschere orchard plot. Table representing the eastern half of the plot is shown in Table 2b.

Pollinizer					Ма	arvel											Har	vest						
Row	2	7S	2	8S	2	9S	3	0S	3	1S	3	2S	3	3S	3	4S	3	5S	3	6S	37	'S	3	8S
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	18	100	28	100	29	100	31	100	32	100	32	100	28	100	32	100	29	100	31	100	32	100	32	100
Zutano	3	16.7	7	25.0	0	0.0	2	6.5	0	0.0	1	3.1	0	0.0	5	15.6	2	6.9	7	22.6	7	21.9	10	31.3
Hass	12	66.7	16	57.1	13	44.8	18	58.1	29	90.6	25	78.1	27	96.4	26	81.3	25	86.2	20	64.5	17	53.1	19	59.4
Fuerte	1	5.6	0	0.0	0	0.0	2	6.5	0	0.0	1	3.1	0	0.0	0	0.0	2	6.9	4	12.9	6	18.8	0	0.0
Ettinger	0	0.0	5	17.9	5	17.2	3	9.7	2	6.3	2	6.3	1	3.6	1	3.1	0	0.0	0	0.0	1	3.1	1	3.1
Bacon	2	11.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.3
SirPrize	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Marvel	0	0.0	0	0.0	11	37.9	6	19.4	1	3.1	2	6.3	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0
Harvest	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Nobel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
LambHass	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 2b. Numbers and proportions of marble sized 'Hass' fruit harvested on June 24, 2006 that were pollinated by all potential pollen donors in the eastern half of the Debusschere orchard plot. Table representing the western half of the plot is shown in Table 2a. Fruit samples harvested from Rows 48S, 49S and 50S were not analyzed due to damage during transit to Florida.

				Fu	erte											Zu	itano									
3	9N	4	ON	4	1N	4	2N	4	3N	4	4N	4	5N	4	6N	4	7N	4	8N	4	9N	5	0N	Tot	tal	
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
31	100	32	100	30	100	32	100	32	100	31	100	32	100	32	100	28	100	32	100	32	100	30	100	748	100	Total
6	19.4	0	0.0	2	6.7	7	21.9	9	28.1	17	54.8	25	78.1	31	96.9	27	96.4	17	53.1	25	78.1	3	10.0	189	25.3	Zutano
9	29.0	1	3.1	2	6.7	15	46.9	18	56.3	8	25.8	7	21.9	0	0.0	1	3.6	8	25.0	5	15.6	22	73.3	273	36.5	Hass
16	51.6	31	96.9	23	76.7	10	31.3	4	12.5	4	12.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	13.3	120	16.0	Fuerte
0	0.0	0	0.0	2	6.7	0	0.0	1	3.1	2	6.5	0	0.0	1	3.1	0	0.0	4	12.5	1	3.1	1	3.3	151	20.2	Ettinger
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.3	1	3.1	0	0.0	7	0.9	Bacon
0	0.0	0	0.0	1	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	2	0.3	SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	0.7	Marvel
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	Harvest
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	Nobel
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	L.Hass

				Ba	icon											Sir	Prize									
3	9S	4	-0S	4	1S	4	-2S	4	3S	4	4S	4	-5S	4	6S	4	7S	4	8S	4	I9S	5	50S	Tot	al	
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
31	100	32	100	32	100	31	100	32	100	32	100	31	100	31	100	31	100	0	####	0	####	0	####	637	100	Total
16	51.6	23	71.9	19	59.4	13	41.9	5	15.6	14	43.8	4	12.9	17	54.8	15	48.4							170	26.7	Zutano
12	38.7	3	9.4	8	25.0	11	35.5	26	81.3	17	53.1	27	87.1	11	35.5	8	25.8							370	58.1	Hass
2	6.5	0	0.0	1	3.1	3	9.7	0	0.0	1	3.1	0	0.0	1	3.2	1	3.2							25	3.9	Fuerte
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.5							23	3.6	Ettinger
1	3.2	6	18.8	4	12.5	4	12.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0							19	3.0	Bacon
0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	2	6.5	4	12.9							7	1.1	SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0							21	3.3	Marvel
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0							0	0.0	Harvest
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0							0	0.0	Nobel
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2							2	0.3	L.Hass

Table 3a. Numbers and proportions of near-mature 'Hass' fruit harvested on November 6, 2006 that were pollinated by all potential pollen donors in the western half of the Debusschere orchard plot. Table representing the eastern half of the plot is shown in Table 3b.

Pollinizer					Etti	nger											No	bel						
Row	2	7N	2	8N	2	9N	3	ON	3	1N	3	2N	3	3N	3	4N	3	5N	30	6N	37	'N	3	8N
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	30	100	32	100	30	100	28	100	32	100	31	100	31	100	31	100	26	100	27	100	28	100	24	100
Zutano	0	0.0	0	0.0	1	3.3	0	0.0	0	0.0	1	3.2	1	3.2	2	6.5	0	0.0	2	7.4	1	3.6	4	16.7
Hass	9	30.0	15	46.9	1	3.3	11	39.3	19	59.4	23	74.2	27	87.1	24	77.4	21	80.8	19	70.4	19	67.9	13	54.2
Fuerte	1	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	2	6.5	1	3.8	4	14.8	4	14.3	5	20.8
Ettinger	19	63.3	17	53.1	28	93.3	16	57.1	11	34.4	4	12.9	2	6.5	3	9.7	4	15.4	1	3.7	3	10.7	2	8.3
Bacon	1	3.3	0	0.0	0	0.0	1	3.6	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
SirPrize	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Marvel	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	1	3.6	0	0.0
Harvest	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	1	3.7	0	0.0	0	0.0
Nobel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
LambHass	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pollinizer						arvel												rvest						
Row		7S		8S		9S		0S		1S	-	2S		3S	-	4S		5S	-	6S	37		-	8S
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Fruits Total		% 100	# 32	% 100	# 32	% 100	# 23	% 100	# 26	% 100	# 30	% 100	# 32	% 100	# 29	% 100	# 27	% 100	-	% 100	# 31	% 100	-	% 100
Fruits Total Zutano	# 31 5	% 100 16.1	# 32 0	% 100 0.0	# 32 0	% 100 0.0	# 23 0	% 100 0.0	# 26 0	% 100 0.0	# 30 0	% 100 0.0	# 32 0	% 100 0.0	# 29 5	% 100 17.2	# 27 2	% 100 7.4	# 32 1	% 100 3.1	# 31 3	% 100 9.7	# 30 4	% 100 13.3
Fruits Total Zutano Hass	# 31	% 100 16.1 64.5	# 32 0 26	% 100 0.0 81.3	# 32 0 19	% 100 0.0 59.4	# 23	% 100 0.0 73.9	# 26 0 21	% 100 0.0 80.8	# 30 0 25	% 100 0.0 83.3	# 32 0 29	% 100 0.0 90.6	# 29	% 100 17.2 69.0	# 27	% 100 7.4 63.0	# 32 1 27	% 100 3.1 84.4	# 31 3 28	% 100 9.7 90.3	# 30	% 100 13.3 83.3
Fruits Total Zutano Hass Fuerte	# 31 5 20 1	% 100 16.1 64.5 3.2	# 32 0 26 0	% 100 0.0 81.3 0.0	# 32 0 19 3	% 100 0.0 59.4 9.4	# 23 0 17 1	% 100 0.0 73.9 4.3	# 26 0 21 3	% 100 0.0 80.8 11.5	# 30 0 25 0	% 100 0.0 83.3 0.0	# 32 0 29 0	% 100 0.0 90.6 0.0	# 29 5	% 100 17.2 69.0 3.4	# 27 2 17 1	% 100 7.4 63.0 3.7	# 32 1 27 0	% 100 3.1 84.4 0.0	# 31 3 28 0	% 100 9.7 90.3 0.0	# 30 4 25 1	% 100 13.3 83.3 3.3
Fruits Total Zutano Hass Fuerte Ettinger	# 31 5	% 100 16.1 64.5 3.2 9.7	# 32 0 26 0 4	% 100 0.0 81.3 0.0 12.5	# 32 0 19 3 3	% 100 0.0 59.4 9.4 9.4	# 23 0 17 1 3	% 100 0.0 73.9 4.3 13.0	# 26 0 21 3 1	% 100 0.0 80.8 11.5 3.8	# 30 0 25 0 5	% 100 0.0 83.3 0.0 16.7	# 32 0 29 0 0	% 100 0.0 90.6 0.0 0.0	# 29 5 20 1 1	% 100 17.2 69.0 3.4 3.4	# 27 2	% 100 7.4 63.0 3.7 3.7	# 32 1 27 0 0	% 100 3.1 84.4 0.0 0.0	# 31 3 28 0 0	% 100 9.7 90.3 0.0 0.0	# 30 4 25 1 0	% 100 13.3 83.3 3.3 0.0
Fruits Total Zutano Hass Fuerte Ettinger Bacon	# 31 5 20 1 3 0	% 100 16.1 64.5 3.2 9.7 0.0	# 32 0 26 0 4 0	% 100 0.0 81.3 0.0 12.5 0.0	# 32 0 19 3 3 0	% 100 0.0 59.4 9.4 9.4 0.0	# 23 0 17 1 3 0	% 100 0.0 73.9 4.3 13.0 0.0	# 26 0 21 3 1 0	% 100 0.0 80.8 11.5 3.8 0.0	# 30 0 25 0 5 0	% 100 0.0 83.3 0.0 16.7 0.0	# 32 0 29 0 0 3	% 100 0.0 90.6 0.0 0.0 9.4	# 29 5 20 1 1 0	% 100 17.2 69.0 3.4 3.4 0.0	# 27 2 17 1 1 1 1	% 100 7.4 63.0 3.7 3.7 3.7	# 32 1 27 0 0 0 2	% 100 3.1 84.4 0.0 0.0 6.3	# 31 3 28 0 0 0	% 100 9.7 90.3 0.0 0.0 0.0	# 30 4 25 1 0 0	% 100 13.3 83.3 3.3 0.0 0.0
Fruits Total Zutano Hass Fuerte Ettinger Bacon SirPrize	# 31 5 20 1 3	% 100 16.1 64.5 3.2 9.7 0.0 0.0	# 32 0 26 0 4 0 0	% 100 0.0 81.3 0.0 12.5 0.0 0.0	# 32 0 19 3 3	% 100 59.4 9.4 9.4 0.0 0.0	# 23 0 17 1 3 0 0 0	% 100 0.0 73.9 4.3 13.0 0.0 0.0	# 26 0 21 3 1	% 100 80.8 11.5 3.8 0.0 0.0	# 30 25 0 5 0 0 0	% 100 0.0 83.3 0.0 16.7 0.0 0.0	# 32 0 29 0 0	% 100 0.0 90.6 0.0 0.0 9.4 0.0	# 29 5 20 1 1 0 0	% 100 17.2 69.0 3.4 3.4 0.0 0.0	# 27 2 17 1 1 1 1 0	% 100 7.4 63.0 3.7 3.7 3.7 0.0	# 32 1 27 0 0 0 2 0	% 100 3.1 84.4 0.0 0.0 6.3 0.0	# 31 3 28 0 0 0 0 0	% 100 9.7 90.3 0.0 0.0 0.0 0.0	# 30 4 25 1 0 0 0	% 100 13.3 83.3 3.3 0.0 0.0 0.0
Fruits Total Zutano Hass Fuerte Ettinger Bacon SirPrize Marvel	# 31 5 20 1 3 0 0 0 2	% 100 16.1 64.5 3.2 9.7 0.0 0.0 6.5	# 32 0 26 0 4 0 0 0 2	% 100 0.0 81.3 0.0 12.5 0.0 0.0 6.3	# 32 0 19 3 3 3 0 0 0 7	% 100 59.4 9.4 9.4 0.0 0.0 21.9	# 23 0 17 1 3 0 0 0 2	% 100 0.0 73.9 4.3 13.0 0.0 0.0 8.7	# 26 0 21 3 1 0 0 0	% 100 80.8 11.5 3.8 0.0 0.0 3.8	# 30 25 0 5 0 0 0 0	% 100 0.0 83.3 0.0 16.7 0.0 0.0 0.0	# 32 0 29 0 0 3 0 3 0 0	% 100 90.6 0.0 9.4 0.0 0.0	# 29 5 20 1 1 0 0 0	% 100 17.2 69.0 3.4 3.4 0.0 0.0 0.0	# 27 2 17 1 1 1 1 0 0	% 100 7.4 63.0 3.7 3.7 3.7 0.0 0.0	# 32 1 27 0 0 2 0 0 0	% 100 3.1 84.4 0.0 0.0 6.3 0.0 0.0	# 31 3 28 0 0 0 0 0 0 0	% 100 9.7 90.3 0.0 0.0 0.0 0.0 0.0	# 30 4 25 1 0 0 0 0	% 100 13.3 83.3 3.3 0.0 0.0 0.0 0.0
Fruits Total Zutano Hass Fuerte Ettinger Bacon SirPrize Marvel Harvest	# 31 5 20 1 3 0	% 100 16.1 64.5 3.2 9.7 0.0 0.0 6.5 0.0	# 32 0 26 0 4 0 0	% 100 0.0 81.3 0.0 12.5 0.0 0.0 6.3 0.0	# 32 0 19 3 3 0	% 100 59.4 9.4 9.4 0.0 0.0 21.9 0.0	# 23 0 17 1 3 0 0 0	% 100 0.0 73.9 4.3 13.0 0.0 0.0 8.7 0.0	# 26 0 21 3 1 0 0 0 1	% 100 0.0 80.8 11.5 3.8 0.0 0.0 3.8 0.0	# 30 25 0 5 0 0 0	% 100 0.0 83.3 0.0 16.7 0.0 0.0 0.0 0.0	# 32 0 29 0 0 0 3 0	% 100 90.6 0.0 9.0 9.4 0.0 0.0 0.0	# 29 5 20 1 1 0 0	% 100 17.2 69.0 3.4 3.4 0.0 0.0 0.0 0.0 6.9	# 27 2 17 1 1 1 1 0	% 100 7.4 63.0 3.7 3.7 3.7 0.0 0.0 18.5	# 32 1 27 0 0 0 2 0	% 100 3.1 84.4 0.0 0.0 6.3 0.0 0.0 6.3	# 31 3 28 0 0 0 0 0	% 100 9.7 90.3 0.0 0.0 0.0 0.0 0.0 0.0	# 30 4 25 1 0 0 0 0 0 0	% 100 13.3 83.3 3.3 0.0 0.0 0.0 0.0 0.0 0.0
Fruits Total Zutano Hass Fuerte Ettinger Bacon SirPrize Marvel	# 31 5 20 1 3 0 0 0 2	% 100 16.1 64.5 3.2 9.7 0.0 0.0 6.5	# 32 0 26 0 4 0 0 0 2	% 100 0.0 81.3 0.0 12.5 0.0 0.0 6.3	# 32 0 19 3 3 3 0 0 0 7	% 100 59.4 9.4 9.4 0.0 0.0 21.9	# 23 0 17 1 3 0 0 0 2	% 100 0.0 73.9 4.3 13.0 0.0 0.0 8.7	# 26 0 21 3 1 0 0 0	% 100 80.8 11.5 3.8 0.0 0.0 3.8	# 30 25 0 5 0 0 0 0	% 100 0.0 83.3 0.0 16.7 0.0 0.0 0.0	# 32 0 29 0 0 3 0 3 0 0	% 100 90.6 0.0 9.4 0.0 0.0	# 29 5 20 1 1 0 0 0	% 100 17.2 69.0 3.4 3.4 0.0 0.0 0.0	# 27 2 17 1 1 1 1 0 0	% 100 7.4 63.0 3.7 3.7 3.7 0.0 0.0	# 32 1 27 0 0 2 0 0 0	% 100 3.1 84.4 0.0 0.0 6.3 0.0 0.0	# 31 3 28 0 0 0 0 0 0 0	% 100 9.7 90.3 0.0 0.0 0.0 0.0 0.0	# 30 4 25 1 0 0 0 0	% 100 13.3 83.3 3.3 0.0 0.0 0.0 0.0

1				Fu	erte										[Zu	tano									
3	89N	4	0N	4	1N	4	2N	4	3N	4	4N	4	5N	4	6N	4	7N	4	8N	4	9N	5	0N	To	tal	
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
28	100	32	100	25	100	14	100	31	100	25	100	28	100	30	100	24	100	26	100	29	100	27	100	669	100	Total
0	0.0	7	21.9	2	8.0	1	7.1	4	12.9	6	24.0	10	35.7	26	86.7	21	87.5	15	57.7	16	55.2	6	22.2	126	18.8	Zutano
20	71.4	4	12.5	3	12.0	10	71.4	22	71.0	18	72.0	15	53.6	3	10.0	2	8.3	7	26.9	12	41.4	19	70.4	336	50.1	Hass
5	17.9	21	65.6	20	80.0	1	7.1	4	12.9	0	0.0	1	3.6	1	3.3	0	0.0	1	3.8	1	3.4	2	7.4	75		Fuerte
1	3.6	0	0.0	0	0.0	2	14.3	0	0.0	1	4.0	0	0.0	0	0.0	0	0.0	1	3.8	0	0.0	0	0.0	115		Ettinger
0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4		Bacon
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	7.1	0	0.0	0	0.0	2	7.7	0	0.0	0	0.0	4		SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.2	0	0.0	0	0.0	0	0.0	4		Marvel
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2		Harvest
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0		Nobel
2	7.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.4	L.Hass
																	<u></u>									
· •	00	4	00		icon		<u> </u>	4	<u></u>		40	4			~~		Prize		<u> </u>	4	<u></u>		00	Та	4-1	
	39S		0S	4	1S		2S		3S		4S		5S		6S	4	7S		8S		9S		0S	To		F ucito
#	%	#	%	4 #	1S %	#	%	#	%	#	%	#	%	#	%	4 #	7S %	#	%	#	%	#	%	#	%	Fruits
# 30	% 100	# 28	% 100	4 # 15	1S % 100	# 27	% 100	# 30	% 100	# 26	% 100	# 28	% 100	# 29	% 100	4 # 26	7S % 100	# 30	% 100	# 32	% 100	# 27	% 100	# 683	% 100	Total
# 30 13	% 100 43.3	# 28 8	% 100 28.6	4 # 15 9	1S % 100 60.0	# 27 4	% 100 14.8	# 30 10	% 100 33.3	# 26 4	% 100 15.4	# 28 11	% 100 39.3	# 29 5	% 100 17.2	4 # 26 5	7S % 100 19.2	# 30 8	% 100 26.7	# 32 9	% 100 28.1	# 27 9	% 100 33.3	# 683 115	% 100 16.8	Total Zutano
# 30 13 14	% 100 43.3 46.7	# 28 8 9	% 100 28.6 32.1	4 # 15 9 3	1S % 100 60.0 20.0	# 27 4 17	% 100 14.8 63.0	# 30 10 13	% 100 33.3 43.3	# 26 4 20	% 100 15.4 76.9	# 28 11 17	% 100 39.3 60.7	# 29 5 21	% 100 17.2 72.4	4 # 26 5 14	7S % 100 19.2 53.8	# 30	% 100 26.7 60.0	# 32 9 18	% 100 28.1 56.3	# 27 9 11	% 100 33.3 40.7	# 683 115 449	% 100 16.8 65.7	Total Zutano Hass
# 30 13 14 1	% 100 43.3 46.7 3.3	# 28 8 9 0	% 100 28.6 32.1 0.0	4 # 15 9 3 0	1S % 100 60.0 20.0 0.0	# 27 4 17 3	% 100 14.8 63.0 11.1	# 30 10 13 4	% 100 33.3 43.3 13.3	# 26 4	% 100 15.4 76.9 0.0	# 28 11 17 0	% 100 39.3 60.7 0.0	# 29 5 21 2	% 100 17.2 72.4 6.9	4 # 26 5 14 3	7S % 100 19.2 53.8 11.5	# 30 8 18 1	% 100 26.7 60.0 3.3	# 32 9	% 100 28.1 56.3 6.3	# 27 9 11 0	% 100 33.3 40.7 0.0	# 683 115 449 27	% 100 16.8 65.7 4.0	Total Zutano Hass Fuerte
# 30 13 14 1 1	% 100 43.3 46.7 3.3 3.3	# 28 8 9 0 1	% 100 28.6 32.1 0.0 3.6	4 # 15 9 3 0 0	1S % 100 60.0 20.0 0.0 0.0	# 27 4 17 3 0	% 100 14.8 63.0 11.1 0.0	# 30 10 13 4 0	% 100 33.3 43.3 13.3 0.0	# 26 4 20 0	% 100 15.4 76.9 0.0 3.8	# 28 11 17 0 0	% 100 39.3 60.7 0.0 0.0	# 29 5 21 2 1	% 100 17.2 72.4 6.9 3.4	4 # 26 5 14 3 3	7S % 100 19.2 53.8 11.5 11.5	# 30 8 18 1 3	% 100 26.7 60.0 3.3 10.0	# 32 9 18 2 1	% 100 28.1 56.3 6.3 3.1	# 27 9 11 0 3	% 100 33.3 40.7 0.0 11.1	# 683 115 449 27 35	% 100 16.8 65.7 4.0 5.1	Total Zutano Hass Fuerte Ettinger
# 30 13 14 1 1 1	% 100 43.3 46.7 3.3 3.3 3.3	# 28 8 9 0 1 10	% 100 28.6 32.1 0.0 3.6 35.7	4 # 15 9 3 0 0 0 3	1S % 100 60.0 20.0 0.0 0.0 20.0	# 27 4 17 3 0 3	% 100 14.8 63.0 11.1 0.0 11.1	# 30 10 13 4 0 3	% 100 33.3 43.3 13.3 0.0 10.0	# 26 4 20 0 1 1	% 100 15.4 76.9 0.0 3.8 3.8	# 28 11 17 0 0 0	% 100 39.3 60.7 0.0 0.0 0.0	# 29 5 21 2 1 0	% 100 17.2 72.4 6.9 3.4 0.0	4 # 26 5 14 3 3 0	7S % 100 19.2 53.8 11.5 11.5 0.0	# 30 8 18 1	% 100 26.7 60.0 3.3 10.0 0.0	# 32 9 18 2 1 0	% 100 28.1 56.3 6.3 3.1 0.0	# 27 9 11 0 3 1	% 100 33.3 40.7 0.0 11.1 3.7	# 683 115 449 27 35 28	% 100 16.8 65.7 4.0 5.1 4.1	Total Zutano Hass Fuerte Ettinger Bacon
# 30 13 14 1 1 1 0	% 100 43.3 46.7 3.3 3.3 3.3 0.0	# 28 8 9 0 1 10 0	% 100 28.6 32.1 0.0 3.6 35.7 0.0	4 # 15 9 3 0 0 0 3 0 0	1S % 100 60.0 20.0 0.0 0.0 20.0 0.0	# 27 4 17 3 0 3 0 3	% 100 14.8 63.0 11.1 0.0 11.1	# 30 10 13 4 0 3 0	% 100 33.3 43.3 13.3 0.0 10.0 0.0	# 26 4 20 0 1 1 0	% 100 15.4 76.9 0.0 3.8 3.8 0.0	# 28 11 17 0 0 0 0 0	% 100 39.3 60.7 0.0 0.0 0.0 0.0	# 29 5 21 2 1 0 0	% 100 17.2 72.4 6.9 3.4 0.0 0.0	4 # 26 5 14 3 3 0 0	7S % 100 19.2 53.8 11.5 11.5 0.0 0.0	# 30 8 18 1 3 0 0 0	% 100 26.7 60.0 3.3 10.0 0.0 0.0	# 32 9 18 2 1 1 0 2	% 100 28.1 56.3 6.3 3.1 0.0 6.3	# 27 9 11 0 3 1 3	% 100 33.3 40.7 0.0 11.1 3.7 11.1	# 683 115 449 27 35 28 28 5	% 100 16.8 65.7 4.0 5.1 4.1 0.7	Total Zutano Hass Fuerte Ettinger Bacon SirPrize
# 30 13 14 1 1 1 0 0	% 100 43.3 46.7 3.3 3.3 3.3 3.3 0.0 0.0	# 28 8 9 0 1 10 0 0	% 100 28.6 32.1 0.0 3.6 35.7 0.0 0.0	4 # 15 9 3 0 0 3 0 0 0 0	1S % 100 60.0 20.0 0.0 20.0 20.0 0.0 0.0	# 27 4 17 3 0 3 0 3 0 0 0 0	% 100 14.8 63.0 11.1 0.0 11.1 0.0 0.0	# 30 10 13 4 0 3 3 0 0 0	% 100 33.3 43.3 13.3 0.0 10.0 0.0 0.0	# 26 4 20 0 1 1 1 0 0	% 100 15.4 76.9 0.0 3.8 3.8 3.8 0.0 0.0	# 28 11 17 0 0 0 0 0 0	% 100 39.3 60.7 0.0 0.0 0.0 0.0 0.0	# 29 5 21 2 1 0 0 0	% 100 17.2 72.4 6.9 3.4 0.0 0.0 0.0	4 # 26 5 14 3 3 0	7S % 100 19.2 53.8 11.5 11.5 0.0 0.0 0.0	# 30 8 18 1 3 0 0 0 0	% 100 26.7 60.0 3.3 10.0 0.0 0.0 0.0	# 32 9 18 2 1 0 2 0	% 100 28.1 56.3 6.3 3.1 0.0 6.3 0.0	# 27 9 11 0 3 1 3 0	% 100 33.3 40.7 0.0 11.1 3.7 11.1 0.0	# 683 115 449 27 35 28 5 14	% 100 16.8 65.7 4.0 5.1 4.1 0.7 2.0	Total Zutano Hass Fuerte Ettinger Bacon SirPrize Marvel
# 30 13 14 1 1 1 0	% 100 43.3 46.7 3.3 3.3 3.3 0.0	# 28 8 9 0 1 10 0	% 100 28.6 32.1 0.0 3.6 35.7 0.0	4 # 15 9 3 0 0 0 3 0 0	1S % 100 60.0 20.0 0.0 0.0 20.0 0.0	# 27 4 17 3 0 3 0 3	% 100 14.8 63.0 11.1 0.0 11.1	# 30 10 13 4 0 3 0	% 100 33.3 43.3 13.3 0.0 10.0 0.0	# 26 4 20 0 1 1 0	% 100 15.4 76.9 0.0 3.8 3.8 0.0	# 28 11 17 0 0 0 0 0	% 100 39.3 60.7 0.0 0.0 0.0 0.0	# 29 5 21 2 1 0 0	% 100 17.2 72.4 6.9 3.4 0.0 0.0	4 # 26 5 14 3 3 0 0	7S % 100 19.2 53.8 11.5 11.5 0.0 0.0	# 30 8 18 1 3 0 0 0	% 100 26.7 60.0 3.3 10.0 0.0 0.0	# 32 9 18 2 1 1 0 2	% 100 28.1 56.3 6.3 3.1 0.0 6.3	# 27 9 11 0 3 1 3	% 100 33.3 40.7 0.0 11.1 3.7 11.1	# 683 115 449 27 35 28 28 5	% 100 16.8 65.7 4.0 5.1 4.1 0.7 2.0 1.5	Total Zutano Hass Fuerte Ettinger Bacon SirPrize

Table 3b. Numbers and proportions of near-mature 'Hass' fruit harvested on November 6, 2006 that were pollinated by all potential pollen donors in the eastern half of the Debusschere orchard plot. Table representing the western half of the plot is shown in Table 3a.

Table 4. Yearly and overall average number of near-mature fruits pollinated by the indicated cultivars from 2003 to 2006. Individual row results can be found in previous reports published in the 2004, 2005, and 2006 California Avocado Research Symposium Proceedings.

Fruits	2003	2004	2005	2006	Ave.	P=0.05	P=0.01
Zutano	182	53	165	241	160.3	b	b
Hass	256	921	869	785	707.8	а	а
Fuerte	34	55	63	102	63.5	bc	b
Ettinger	154	51	209	150	141.0	bc	b
Bacon	82	12	65	32	47.8	bc	b
SirPrize	52	65	18	9	36.0	bc	b
Marvel	13	45	51	18	31.8	bc	b
Harvest	5	19	6	12	10.5	bc	b
Nobel	11	14	2	0	6.8	С	b
L.Hass	51	11	7	3	18.0	bc	b

Averages followed by different letters are significantly different at 95% and 99% confidence levels (P=0.05 column and P=0.01 columns, respectively) based on Duncan's Multiple Range Test.

Table 5. Yearly and overall average percent proportion of near-mature fruits pollinated by the indicated cultivars from 2003 to 2006. Individual row results can be found in previous reports published in the 2004, 2005, and 2006 California Avocado Research Symposium Proceedings.

Fruits	2003	2004	2005	2006	% Ave.	P=0.05	P=0.01
Zutano	21.7	4.3	11.3	17.8	13.8	b	b
Hass	30.5	73.9	59.7	58.1	55.5	а	а
Fuerte	4.0	4.4	4.3	7.5	5.1	bc	b
Ettinger	18.3	4.1	14.4	11.1	12.0	bc	b
Bacon	9.8	1.0	4.5	2.4	4.4	bc	b
SirPrize	6.2	5.2	1.2	0.7	3.3	bc	b
Marvel	1.5	3.6	3.5	1.3	2.5	bc	b
Harvest	0.6	1.5	0.4	0.9	0.9	с	b
Nobel	1.3	1.1	0.1	0.0	0.6	с	b
L.Hass	6.1	0.9	0.5	0.2	1.9	bc	b

Averages followed by different letters are significantly different at 95% and 99% confidence levels (P=0.05 column and P=0.01 columns, respectively) based on Duncan's Multiple Range Test.

Figure 2a. Accumulated distribution of the number of near-mature fruit pollinated by the indicated cultivars during the 2003, 2004, 2005 and 2006 flowering seasons by row within the North plot of the Debusschere orchard.

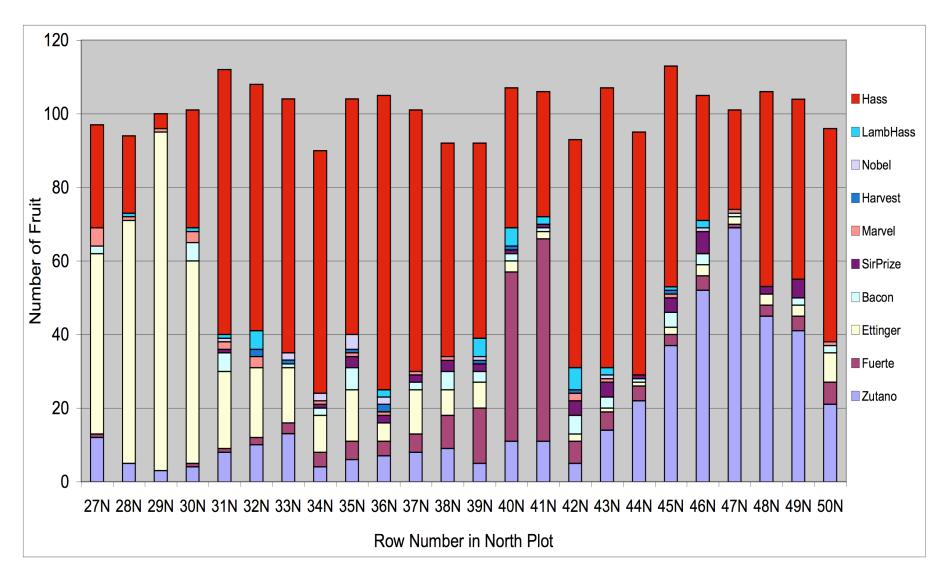


Figure 2b. Accumulated distribution of the number of near-mature fruit pollinated by the indicated cultivars during the 2003, 2004, 2005 and 2006 flowering seasons by row within the South plot of the Debusschere orchard.

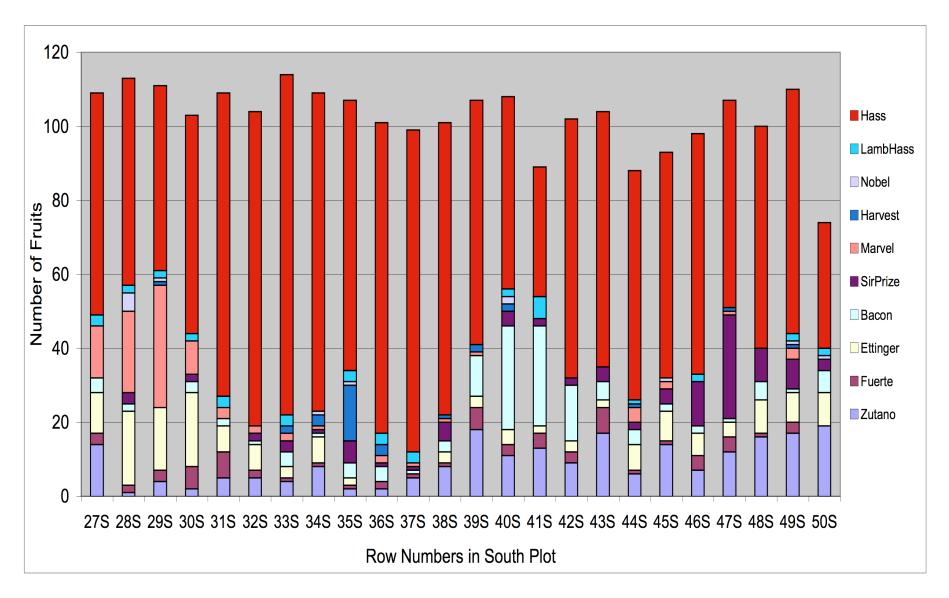


Table 6. Outreach Index calculated for each complimentary cultivar as determined from paternity results of near-mature fruit from 2003 to 2006. Outreach index was calculated by adding the products of the proportion of fruit pollinated by a particular cultivar times the number of rows from the row in which that cultivar was planted [Σ (proportion pollen parent X row # from parent)] among all the rows in the orchard for each year.

Cultivar	2003	2004	2005	2006	Average	P=0.05	P=0.01
Zutano	40.0	7.4	21.5	12.7	20.4	а	а
Ettinger	21.7	4.1	17.8	10.5	13.5	b	ab
SirPrize	13.4	6.1	1.0	0.5	5.2	С	bc
Bacon	13.7	1.2	3.0	2.5	5.1	с	bc
Fuerte	2.9	3.3	4.6	6.2	4.3	с	bc
Marvel	2.5	6.9	4.0	0.4	3.4	С	с
Harvest	0.9	1.1	0.6	0.6	0.8	С	с
Nobel	1.3	0.5	0.0	0.0	0.5	С	с

Averages followed by different letters are significantly different at 95% and 99% confidence levels (P=0.05 column and P=0.01 columns, respectively) based on Duncan's Multiple Range Test.

Table 7. Average retention rate of "Hass" avocado fruit pollinated by various cultivars through all rows of the Debusschere orchard during 2004, 2005, and 2006. Fruit retention was calculated by subtracting the percent pollination proportion by each cultivar in marble–sized fruit (YO#%) from that of the same population sampled at the near-mature fruit stage (MO#%) within each row.

Year		2004 (Off-Year)		2005 (Me	edium-Year)	2006 (Medium-Year)					
Pollinizer	M04%	Y04%	(M04%-Y04%) ± SE	M05%	Y05%	(M05%-Y05%) ± SE	M06%	Y06%	(M06%-Y06%) ± SE			
Zutano	4.3	5.8	-1.5 ± 1.3	11.3	22.5	-11.2 ± 1.9	17.8	25.9	-8.1 ± 2.2			
Hass	73.7	64.5	9.1 ± 2.6	59.7	44.9	14.8 ± 2.0	58.1	46.4	11.6 ± 2.7			
Fuerte	4.7	5.7	-1.0 ± 0.7	4.3	5.2	-0.8 ± 0.8	7.5	10.5	-2.9 ± 1.4			
Ettinger	4.1	6.8	-2.8 ± 1.3	14.4	18.3	-3.9 ± 1.2	11.1	12.6	-1.5 ± 1.2			
Bacon	1.0	0.8	0.2 ± 0.4	4.5	3.6	0.9 ± 1.1	2.4	1.9	0.5 ± 0.6			
SirPrize	5.2	2.3	2.8 ± 1.0	1.2	0.7	0.6 ± 0.4	0.7	0.6	0.0 ± 0.4			
Marvel	3.6	3.3	0.3 ± 0.9	3.5	3.4	0.1 ± 0.7	1.3	1.9	-0.5 ± 0.5			
Harvest	1.5	1.0	0.4 ± 0.4	0.4	0.7	-0.2 ± 0.3	0.9	0.0	0.9 ± 0.5			
Nobel	1.2	3.0	-1.7 ± 0.8	0.1	0.4	-0.3 ± 0.2	0.0	0.1	-0.1 ± 0.1			
LambHass	0.9	6.7	-5.8 ± 1.6	0.5	0.4	0.1 ± 0.3	0.2	0.1	0.1 ± 0.2			
# Fruits Tested	1246	1004		1455	1513		1352	1385				

Table 8. The estimated effect of pollinizer density in an orchard based on overall averaged pollination results of samples harvested in 2003, 2004, 2005, and 2006. It is presumed that each pollinizing cultivar would be interplanted within the row of 'Hass' trees in the pollinizing row (HP). All other rows would have only 'Hass' (H) trees.

				- 11:							
Percentage of Paternity (Ratio of Pollinizer to Hass)											
Pollinizer	% (1:1)	% (1:3)	% (1:5)	% (1:7)	% (1:9)						
Ettinger	92.0 a	73.9 a	57.4 a	46.3 a	39.2 a						
Zutano	71.0 ab	55.6 a	49.6 a	42.9 a	36.7 a						
Fuerte	52.3 bc	33.2 b	24.4 b	19.6 b	16.1 b						
Bacon	30.2 cd	24.8 bc	18.7 bc	15.0 bc	12.0 bc						
Marvel	28.2 cd	17.9 bc	13.6 bc	10.6 bc	8.7 bc						
SirPrize	25.4 cd	16.2 bc	12.1 bc	9.4 bc	8.6 bc						
Harvest	12.7 d	6.2 c	4.0 c	3.2 bc	2.7 bc						
Nobel	4.1 d	2.7 c	2.0 c	1.4 c	1.4 c						
Hass (Self)	8.0 - 95.9	26.1 - 97.3	42.6 - 98.0	53.7 - 98.6	60.8 - 98.6						
Duncen's multi	la ranga taat n=0	0E									

Duncan's multiple range test, p=0.05

Ratio of							Rov	v Numb	ber						
Hass (H) to	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pollinizer (P)															
1:1	HP	HP	HP	HP	HP	HP	HP	HP	HP						
1:3	Н	HP	Н	Н	HP	Н	Η	HP	Н	Η	HP	Н	Н	HP	Н
1:5	Н	Н	HP	Н	Н	Н	Η	HP	Н	Η	Н	Н	HP	Н	Н
1:7	Н	Н	Н	HP	Н	Н	Н	Н	Н	Н	HP	Н	Н	Н	Н
1:9	Н	Н	Н	Н	HP	Н	Н	Н	Н	Н	Н	Н	Н	HP	Н

HP=Pollinizer cultivar interplanted with 'Hass'

H='Hass' only

Table 9. Numbers of near-mature 'Hass' fruit visually counted on November 6, 2006 from each of 8 trees of every row in the North and South plots of the Debusschere orchard. Trees at the ends of each 10-tree row were not included in the counts due to potential outside influences on yield from light, wind, and/or neighboring pollinizing cultivars in the rows.

Pollinizer			Ettinger						Nobel						Fuerte						Zutano				
Row	27N	28N	29N	30N	31N	32N	33N	34N	35N	36N	37N	38N	39N	40N	41N	42N	43N	44N	45N	46N	47N	48N	49N	50N	Total
Fruits	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Total	531	1932	1169	2447	2178	2567	2719	2709	3457	2923	2394	2908	3341	3986	3185	3723	3689	3224	2533	3506	3273	1964	981	358	61697
Tree # 2	109	367	239	297	279	406	464	47	416	395	572	172	284	439	294	212	222	403	417	100	142	206	219	114	6815
Tree # 3	28	394	13	361	469	244	462	332	617	436	148	447	398	642	590	607	345	159	480	596	328	251	134	25	8506
Tree # 4	141	218	337	346	425	282	304	562	260	697	428	336	609	780	638	546	434	792	277	492	407	194	5	23	9533
Tree # 5	44	151	242	351	269	282	368	235	472	285	242	530	291	613	342	569	729	274	495	542	276	222	59	18	7901
Tree # 6	4	238	0	160	25	346	45	247	237	312	293	451	412	501	521	440	491	418	172	186	621	184	108	11	6423
Tree # 7	42	173	3	320	232	605	342	331	530	242	376	203	631	543	136	717	175	152	178	473	339	406	157	2	7308
Tree # 8	143	196	233	365	244	191	324	485	544	307	21	586	231	149	415	391	557	752	146	469	697	288	158	87	7979
Tree # 9	20	195	102	247	235	211	410	470	381	249	314	183	485	319	249	241	736	274	368	648	463	213	141	78	7232
Ave. fruits/tree	66	242	146	306	272	321	340	339	432	365	299	364	418	498	398	465	461	403	317	438	409	246	123	45	7712
Std. Dev.	56	90	133	71	135	134	133	166	135	150	169	164	149	197	175	178	211	248	142	194	182	73	66	42	994
Std. Err.	20	32	47	25	48	48	47	59	48	53	60	58	53	70	62	63	74	88	50	68	64	26	23	15	351
															_										
Pollinizer	070	000	Marvel		040			0.40	Harvest		070			400	Bacon	40.0 *	100	110	450	(00)	SirPrize	40.0*	400	500	T ()
Row	27S	28S	29S	30S	31S	32S	33S	34S	35S	36S	37S	38S	39S	40S	41S	42S*	43S	44S	45S	46S	47S	48S*	49S	50S	Total
Row Fruits	#	#	29S #	#	#	#	#	#	35S #	#	#	#	#	#	41S #	#	#	#	#	#	47S #	#	#	#	#
Row Fruits Total	# 584	# 1464	29S # 2078	# 1954	# 2038	# 1790	# 2478	# 2545	35S # 1683	# 1806	# 1979	# 2478	# 2446	# 2655	41S # 2140	# 2685	# 3139	# 1983	# 1884	# 2234	47S # 1631	# 1222	# 308	# 728	# 45932
Row Fruits Total Tree # 2	# 584 18	# 1464 53	29S # 2078 594	# 1954 158	# 2038 377	# 1790 69	# 2478 219	# 2545 241	35S # 1683 170	# 1806 312	# 1979 315	# 2478 323	# 2446 398	# 2655 161	41S # 2140 320	# 2685 364	# 3139 515	# 1983 222	# 1884 318	# 2234 252	47S # 1631 230	# 1222 271	# 308 13	# 728 130	# 45932 6043
Row Fruits Total Tree # 2 Tree # 3	# 584 18 151	# 1464 53 97	29S # 2078 594 301	# 1954 158 626	# 2038 377 229	# 1790 69 167	# 2478 219 518	# 2545 241 464	35S # 1683 170 219	# 1806 312 128	# 1979 315 343	# 2478 323 244	# 2446 398 361	# 2655 161 457	41S # 2140 320 301	# 2685 364 175	# 3139 515 431	# 1983 222 283	# 1884 318 358	# 2234 252 363	47S # 1631 230 178	# 1222 271 200	# 308 13 168	# 728 130 96	# 45932 6043 6858
Row Fruits Total Tree # 2 Tree # 3 Tree # 4	# 584 18 151 45	# 1464 53 97 122	29S # 2078 594 301 241	# 1954 158 626 320	# 2038 377 229 419	# 1790 69 167 422	# 2478 219 518 336	# 2545 241 464 334	35S # 1683 170 219 76	# 1806 312 128 348	# 1979 315 343 368	# 2478 323 244 341	# 2446 398 361 320	# 2655 161 457 406	41S # 2140 320 301 339	# 2685 364 175 469	# 3139 515 431 431	# 1983 222 283 266	# 1884 318 358 284	# 2234 252 363 337	47S # 1631 230 178 262	# 1222 271 200 201	# 308 13 168 22	# 728 130 96 162	# 45932 6043 6858 6871
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5	# 584 18 151 45 14	# 1464 53 97 122 157	29S # 2078 594 301 241 303	# 1954 158 626 320 68	# 2038 377 229 419 252	# 1790 69 167 422 202	# 2478 219 518 336 417	# 2545 241 464 334 244	35S # 1683 170 219 76 144	# 1806 312 128 348 118	# 1979 315 343 368 264	# 2478 323 244 341 309	# 2446 398 361 320 204	# 2655 161 457 406 470	41S # 2140 320 301	# 2685 364 175 469 305	# 3139 515 431 431 256	# 1983 222 283 266 188	# 1884 318 358 284 244	# 2234 252 363 337 201	47S # 1631 230 178 262 250	# 1222 271 200 201 38	# 308 13 168	# 728 130 96 162 19	# 45932 6043 6858 6871 5156
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5 Tree # 6	# 584 18 151 45 14 39	# 1464 53 97 122 157 196	29S # 2078 594 301 241 303 185	# 1954 158 626 320 68 243	# 2038 377 229 419 252 197	# 1790 69 167 422 202 297	# 2478 219 518 336 417 111	# 2545 241 464 334 244 329	35S # 1683 170 219 76 144 334	# 1806 312 128 348 118 207	# 1979 315 343 368 264 97	# 2478 323 244 341 309 205	# 2446 398 361 320 204 266	# 2655 161 457 406 470 111	41S # 2140 320 301 339 486 1	# 2685 364 175 469 305 336	# 3139 515 431 431 256 223	# 1983 222 283 266 188 194	# 1884 318 358 284 244 147	# 2234 252 363 337 201 294	47S # 1631 230 178 262 250 242	# 1222 271 200 201 38 82	# 308 13 168 22 3 1	# 728 130 96 162 19 96	# 45932 6043 6858 6871 5156 4433
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5 Tree # 6 Tree # 7	# 584 18 151 45 14 39 97	# 1464 53 97 122 157 196 90	29S # 2078 594 301 241 303 185 221	# 1954 158 626 320 68 243 212	# 2038 377 229 419 252 197 254	# 1790 69 167 422 202 297 152	# 2478 219 518 336 417 111 372	# 2545 241 464 334 244 329 246	35S # 1683 170 219 76 144 334 324	# 1806 312 128 348 118 207 443	# 1979 315 343 368 264 97 285	# 2478 323 244 341 309 205 475	# 2446 398 361 320 204 266 254	# 2655 161 457 406 470 111 340	41S # 2140 320 301 339 486 1 445	# 2685 364 175 469 305 336 336	# 3139 515 431 431 256 223 435	# 1983 222 283 266 188 194 173	# 1884 318 358 284 244 147 145	# 2234 252 363 337 201 294 428	47S # 1631 230 178 262 250 242 191	# 1222 271 200 201 38 82 153	# 308 13 168 22 3 1 35	# 728 130 96 162 19 96 76	# 45932 6043 6858 6871 5156 4433 6022
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5 Tree # 6 Tree # 7 Tree # 8	# 584 18 151 45 14 39 97 151	# 1464 53 97 122 157 196 90 367	29S # 2078 594 301 241 303 185 221 144	# 1954 158 626 320 68 243 212 269	# 2038 377 229 419 252 197 254 42	# 1790 69 167 422 202 297 152 361	# 2478 219 518 336 417 111 372 247	# 2545 241 464 334 244 329 246 248	35S # 1683 170 219 76 144 334 324 233	# 1806 312 128 348 118 207 443 71	# 1979 315 343 368 264 97 285 113	# 2478 323 244 341 309 205 475 307	# 2446 398 361 320 204 266 254 284	# 2655 161 457 406 470 111 340 324	41S # 2140 320 301 339 486 1 445 207	# 2685 364 175 469 305 336 336 336 246	# 3139 515 431 431 256 223 435 428	# 1983 222 283 266 188 194 173 232	# 1884 318 358 284 244 147 145 239	# 2234 252 363 337 201 294 428 104	47S # 1631 230 178 262 250 242 250 242 191 75	# 1222 271 200 201 38 82 153 83	# 308 13 168 22 3 1 35 51	# 728 130 96 162 19 96 76 109	# 45932 6043 6858 6871 5156 4433 6022 5254
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5 Tree # 6 Tree # 7 Tree # 8 Tree # 9	# 584 18 151 45 14 39 97 151 69	# 1464 53 97 122 157 196 90 367 382	29S # 2078 594 301 241 303 185 221 144 89	# 1954 158 626 320 68 243 212 269 58	# 2038 377 229 419 252 197 254 42 268	# 1790 69 167 422 202 297 152 361 120	# 2478 219 518 336 417 111 372 247 258	# 2545 241 464 334 244 329 246 248 439	35S # 1683 170 219 76 144 334 324 233 183	# 1806 312 128 348 118 207 443 71 179	# 1979 315 343 368 264 97 285 113 194	# 2478 323 244 341 309 205 475 307 274	# 2446 398 361 320 204 266 254 284 359	# 2655 161 457 406 470 111 340 324 386	41S # 2140 320 301 339 486 1 445 207 41	# 2685 364 175 469 305 336 336 246 454	# 3139 515 431 256 223 435 428 420	# 1983 222 283 266 188 194 173 232 425	# 1884 318 358 284 244 147 145 239 149	# 2234 252 363 337 201 294 428 104 255	47S # 1631 230 178 262 250 242 191 75 203	# 1222 271 200 201 38 82 153 83 83 194	# 308 13 168 22 3 3 1 35 51 15	# 728 130 96 162 19 96 76 109 40	# 45932 6043 6858 6871 5156 4433 6022 5254 5294
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 4 Tree # 5 Tree # 6 Tree # 7 Tree # 8 Tree # 9 Ave. fruits/tree	# 584 18 151 45 14 39 97 151 69 73	# 1464 53 97 122 157 196 90 367 382 183	29S # 2078 594 301 241 303 185 221 144 89 260	# 1954 158 626 320 68 243 212 269 58 244	# 2038 377 229 419 252 197 254 42 268 255	# 1790 69 167 422 202 297 152 361 120 224	# 2478 219 518 336 417 111 372 247 258 310	# 2545 241 464 334 244 329 246 248 439 318	35S # 1683 170 219 76 144 334 324 233 183 210	# 1806 312 128 348 118 207 443 71 179 226	# 1979 315 343 368 264 97 285 113 194 247	# 2478 323 244 341 309 205 475 307 274 310	# 2446 398 361 320 204 266 254 284 359 306	# 2655 161 457 406 470 111 340 324 386 332	41S # 2140 320 301 339 486 1 445 207 41 268	# 2685 364 175 469 305 336 336 246 454 336	# 3139 515 431 256 223 435 428 420 392	# 1983 222 283 266 188 194 173 232 425 248	# 1884 318 358 284 244 147 145 239 149 236	# 2234 252 363 337 201 294 428 104 255 279	47S # 1631 230 178 262 250 242 191 75 203 204	# 1222 271 200 201 38 82 153 83 194 153	# 308 13 168 22 3 1 35 51 15 39	# 728 130 96 162 19 96 76 109 40 91	# 45932 6043 6858 6871 5156 4433 6022 5254 5294 5294 5741
Row Fruits Total Tree # 2 Tree # 3 Tree # 4 Tree # 5 Tree # 6 Tree # 7 Tree # 8 Tree # 9	# 584 18 151 45 14 39 97 151 69	# 1464 53 97 122 157 196 90 367 382	29S # 2078 594 301 241 303 185 221 144 89	# 1954 158 626 320 68 243 212 269 58	# 2038 377 229 419 252 197 254 42 268	# 1790 69 167 422 202 297 152 361 120	# 2478 219 518 336 417 111 372 247 258	# 2545 241 464 334 244 329 246 248 439	35S # 1683 170 219 76 144 334 324 233 183	# 1806 312 128 348 118 207 443 71 179	# 1979 315 343 368 264 97 285 113 194	# 2478 323 244 341 309 205 475 307 274	# 2446 398 361 320 204 266 254 284 359	# 2655 161 457 406 470 111 340 324 386	41S # 2140 320 301 339 486 1 445 207 41	# 2685 364 175 469 305 336 336 246 454	# 3139 515 431 256 223 435 428 420	# 1983 222 283 266 188 194 173 232 425	# 1884 318 358 284 244 147 145 239 149	# 2234 252 363 337 201 294 428 104 255	47S # 1631 230 178 262 250 242 191 75 203	# 1222 271 200 201 38 82 153 83 83 194	# 308 13 168 22 3 3 1 35 51 15	# 728 130 96 162 19 96 76 109 40	# 45932 6043 6858 6871 5156 4433 6022 5254 5294

Figure 3a. Average yield of near-mature 'Hass' fruit visually counted on November 6, 2006 from each row in the North plot of the Debusschere orchard. Compare these average row-to-row yields with the percent proportions of pollinations in 2006 by each cultivar in Table 3a & b.

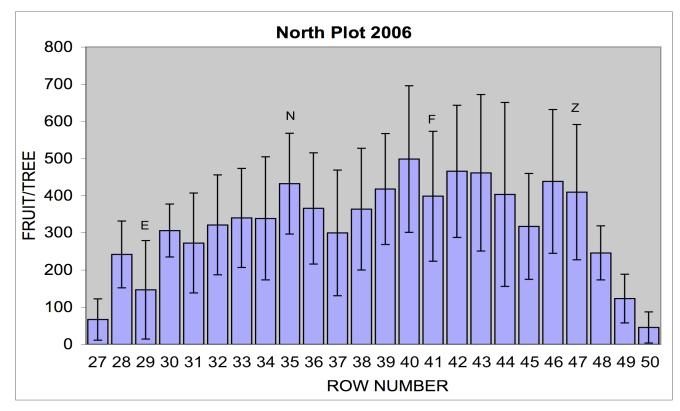


Figure 3b. Average numbers of near-mature 'Hass' fruit visually counted on November 6, 2006 from each row in the South plot of the Debusschere orchard. Compare these average row-to-row yields with the percent proportions of pollinations in 2006 by each cultivar in Table 3a & b.

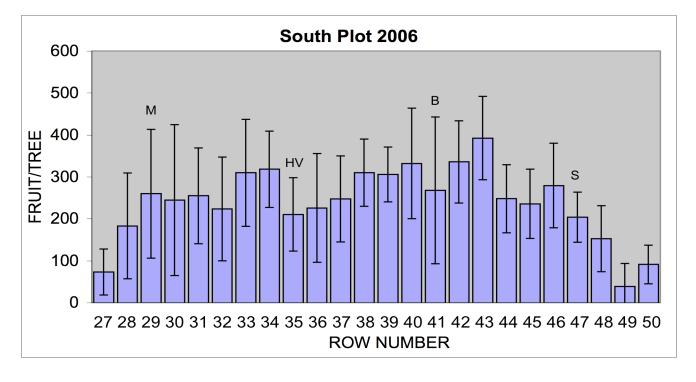


Table 10. Influence of pollen parent on near-mature 'Hass' avocado seed shape and size.

	Seed S	hape	Seed	Size
	# of fruit tested	Lenth:width	# of fruit tested	Weight (g)
Zutano	175	1.20a	242	17.7c
Hass	567	1.24a	831	15.2b
Fuerte	84	1.38b	101	15.6b
Ettinger	140	1.25a	152	17.8c
Bacon	28	1.24a	33	12.5a
SirPrize	7	1.26a	9	21.3d
Marvel	15	1.27a	18	21.5d
Harvest	11	1.20a	11	14.6b
Nobel	0		0	
L.Hass	10	1.29ab	12	13.8ab

Duncan's test, P=0.01

Seeds were collected on 11/6/2006

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