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

Year 3 of 3

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Benefits to the Industry

SSR technology is a powerful tool to determine the pollen parents of avocado progeny of known maternal genetic background. The four SSR markers we have selected for use to determine pollen parents are powerfully informative for the range of cross pollinizing cultivars available in the selected orchards and, therefore, highly capable of discerning the specific pollen parent of each sampled fruit. The cultivars included in the study are Bacon, Ettinger, Fuerte, Harvest, Hass, 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 makes this endeavor one of the most comprehensive ever preformed on avocado. As a result of this three-year suite of studies, avocado growers and advisors will, for the first time, unequivocally know the impact of interplanting complimentary cultivars, and how these ultimately influence the crop.

Objectives

The primary objective of this research is 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 had begun SSR analysis of the embryos in marble-sized 'Hass' fruits that were harvested at the Debusschere orchard located on the coastal plain near Camarillo in Ventura County on June 13,

2004. Approximately 25 marble-sized fruits were sampled evenly down six trees of interplanted rows and eight trees of 'Hass' rows consisting of ten trees in 48 rows across a block of trees interplanted every 6 rows with the cultivars listed above and nearby Lamb Hass (Fig. 1). The results of a portion of those samples in which analyses were completed were published in the *2004 California Avocado Research Symposium*. Details of the experimental and analytical protocols along with supporting literature were included therein. Pollen parent analysis of more than 4,000 fruit samples collected at marble sized stage on June, 13, 2004 (Tables 1a & 1b) and June 22, 2005 (partial results, Table 4a) and near-mature 'Hass' fruit collected on October 1, 2003 (See *2004 California Avocado Research Symposium*); November 1, 2004 (Tables 2a & 2b); and November 7, 2005 (Tables 5a & 5b) have been completed. About 35 fruit were harvested per row. The early-season fruit samples represent the first of two samplings each from the 2004 and 2005 flowering seasons. SSR analysis of 3/4 of the approximately 1,000 embryos from marble-sized fruit harvested in 2005 has now been completed, but only a portion of those have been graphically evaluated and tabulated for inclusion in this report (Table 4a). Marble sized fruit collected on June 24, 2006 and those to be collected in November 2006 remain to be analyzed. We will require a 1-yr, no-cost extension to complete those analyses and prepare a final report of all the work accomplished over the three-year study.

Results and Discussion

Results of genetic analyses of the embryos from marble sized fruit sampled on June 13, 2004 from test plots B2 and A2 at Debusschere orchard are presented in Tables 1a (western half of orchard plot) and 1b (eastern half). Similarly, results of the same population of fruits sampled at near maturity on November 1, 2004 are presented in Tables 2a & 2b. The tables report the results of individual fruits sampled from eight trees down each solid 'Hass' row and six trees down each row interplanted with pollinizer trees. These rows consisted of ten trees in the north plot and ten trees in the south plot designated N and S in the row columns of Tables 1 and 2.

Cross-pollination was greater than 50% only in "Hass' trees interplanted with 'Ettinger' and 'Fuerte' but substantially less than 50% cross pollination in trees interplanted with the other pollinizers. The extent of cross-pollination in adjacent rows was generally lower to non-existent compared to the pollinizer rows. On average, cross-pollination by any pollinizing cultivar was 6% or less. Over 60% of the marble sized fruit were self-pollinated whereas over 70% of the same population of nearly mature fruit were self-pollinated. This is far greater than the proportion of self-pollination (about 30%) observed in near-mature fruit harvested in the previous year, 2003 (Table 6).

The proportions of self-pollinated fruit were greater in the near-mature fruit harvested on November 1, 2004 (Table 2a – western half and Table 2b eastern half of orchard) than those sampled at the marble-sized stage of development. These high levels of self pollination displayed throughout the orchard give us the greatest opportunity to test the hypothesis that cross-pollinated fruit are retained to maturity in preference to self-pollinated fruit. The results thus far obtained, however, do not support the hypothesis.

Proportions of fruit pollinated by each cultivar within each row at marble size were compared to the proportions of self or cross-pollinations in fruit harvested from the same trees at near-maturity. The retention rate within each row observed in fruit pollinated by each cultivar was, thus, calculated between young fruit harvested at marble size (Y04) and near-mature fruit (M04) derived from flowers pollinated in spring of 2004 (Table 3).

The formula to calculate the retention rate = % of M04 - % of Y04. A positive number indicates increased retention of fruit derived from a particular pollinizer, and a negative number indicates a decrease in retention of

fruit pollinated by the indicated cultivar by the indicated amount. Zero indicates no relative change in retention of fruit pollinated by a particular parent cultivar during development. Overall, we have observed about an 8% increase in proportion of self-pollinated fruit and a concomitant decrease in retained fruit derived from cross-pollination (Table 3). There was, thus, greater loss of fruit derived from pollination by each pollinizing cultivar than by those that were self-pollinated. Even those fruit pollinated by 'Ettinger' appeared to be less retentive than the selfed fruit and no better than the other cultivars that are involved in the study.

A similar situation is now emerging in the results of fruit collected in 2005. Rows 27N to 34N include those most influenced by the cross pollinizing cultivar, Ettinger. The data now available for marble sized fruit collected on July 22, 2005 demonstrates similar pollination rates by Ettinger in these rows as has been shown in previous years. When one compares the rates of retention of young (Table 4a) vs. mature (Table 5a) 'Hass' fruit pollinated by 'Ettinger' in the interplanted and adjacent 'Ettinger' rows in 2005, however, it is again clear that there is a greater loss of 'Ettinger'-pollinated fruit over self-pollinated 'Hass' as fruit develop from marble size to near mature development. Overall, there was about 68% self pollination in near-mature fruit harvested in 2005 (Tables 5a & 5b). Tables 6a & 6b provides a comparison of the average rates of pollination for near mature fruits of each cultivar in each row and the overall averages for years 2003, 2004, and 2005.

Conclusion

The addition of one more year of data confirms previous observations regarding the relationships between cross- and self-pollination in this orchard. The proportion of self-pollination vs. cross-pollination may be influenced by cool temperature conditions to which the trees are exposed from year to year. Self pollination appears to be the dominant mode of pollination, and these preliminary results indicate that trees benefit from it, perhaps in preference over cross pollination.

Acknowledgements

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Figure 1. Layout of Debusschere orchard plots B2 (north half) and A2 (south half). Orchard is bordered by tall windbreak rows of Poplar to the west and Eucalyptus to the east. 'Hass' (X) trees are interplanted with 'Ettinger' (ET), 'Nobel' (BL-567) (67), 'Fuerte' (F), and 'Zutano' (Z) in the indicated rows of the north half of the orchard. 'Hass' (X) trees are interplanted with 'Marvel' (BL-516) (16), '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. 'Hass' fruit samples were collected evenly down rows among six trees in the interplanted rows and eight trees in 'Hass' rows.

												NORTH ROW													
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	TREE
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1
W			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
I			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xc	xc	x	x	x	x	x	x	3
N			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xo	xo	x	x	x	x	x	x	4
D			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5
B			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	6
R			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xc	xc	x	x	x	x	x	x	7
E			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xo	xo	x	x	x	x	x	x	8
A			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9
K			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	10
			ET						67						F						Z				TREE
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11
W			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12
I			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13
N			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14
D			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15
B			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16
R			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	17
E			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18
A			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	19
K			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	20
			16						HV						B						SP				
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	

B2

A2

Table 1a. Numbers and proportions of marble sized 'Hass' fruit harvested on June 13, 2004 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.

Pollinizer					Ettinger										Nobel							
Row	27N		28N		29N		30N		31N		32N		33N		34N		35N		36N		37N		38N	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	23	100	21	100	23	100	16	100	21	100	23	100	21	100	24	100	24	100	23	100	25	100	23	100
Zutano	1	4.3	0	0.0	1	4.3	2	12.5	0	0.0	2	8.7	2	9.5	3	12.5	0	0.0	1	4.3	2	8.0	0	0.0
Hass	18	78.3	10	47.6	1	4.3	10	62.5	18	85.7	18	78.3	13	61.9	17	70.8	17	70.8	9	39.1	17	68.0	15	65.2
Fuerte	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8	0	0.0	1	4.8	3	12.5	1	4.2	3	13.0	2	8.0	2	8.7
Ettinger	1	4.3	10	47.6	20	87.0	3	18.8	1	4.8	1	4.3	0	0.0	1	4.2	2	8.3	0	0.0	0	0.0	0	0.0
Bacon	1	4.3	0	0.0	0	0.0	0	0.0	1	4.8	0	0.0	1	4.8	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	1	4.3	0	0.0	0	0.0	1	4.2	2	8.7	1	4.0	3	13.0
Marvel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8	0	0.0	0	0.0	1	4.3	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
Nobel	0	0.0	0	0.0	1	4.3	1	6.3	0	0.0	1	4.3	0	0.0	0	0.0	1	4.2	5	21.7	2	8.0	1	4.3
Lamb Hass	2	8.7	1	4.8	0	0.0	0	0.0	0	0.0	0	0.0	3	14.3	0	0.0	2	8.3	2	8.7	1	4.0	2	8.7

Pollinizer					Marvel										Harvest							
Row	27S		28S		29S		30S		31S		32S		33S		34S		35S		36S		37S		38S	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	18	100	23	100	19	100	16	100	20	100	22	100	24	100	23	100	18	100	17	100	22	100	22	100
Zutano	0	0.0	0	0.0	0	0.0	5	31.3	1	5.0	1	4.5	1	4.2	1	4.3	0	0.0	3	17.6	0	0.0	0	0.0
Hass	9	50.0	11	47.8	8	42.1	4	25.0	14	70.0	20	90.9	20	83.3	17	73.9	10	55.6	11	64.7	20	90.9	22	100.0
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	0	0.0	0	0.0	0	0.0	0	0.0
Ettinger	1	5.6	3	13.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.2	2	8.7	0	0.0	0	0.0	0	0.0	0	0.0
Bacon	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
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	5.6	0	0.0	0	0.0	0	0.0
Marvel	6	33.3	5	21.7	7	36.8	4	25.0	4	20.0	1	4.5	0	0.0	2	8.7	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	6	33.3	2	11.8	0	0.0	0	0.0
Nobel	2	11.1	2	8.7	4	21.1	0	0.0	1	5.0	0	0.0	2	8.3	1	4.3	1	5.6	1	5.9	0	0.0	0	0.0
Lamb Hass	0	0.0	2	8.7	0	0.0	3	18.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	9.1	0	0.0

Table 1b. Numbers and proportions of marble sized 'Hass' fruit harvested on June 13, 2004 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.

				Fuerte												Zutano								Pollinizer
39N		40N		41N		42N		43N		44N		45N		46N		47N		48N		49N		50N		Sum		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
23	100	25	100	21	100	24	100	22	100	23	100	23	100	21	100	14	100	16	100	15	100	9	100	503	100	Total
1	4.2	0	0.0	1	4.8	0	0.0	0	0.0	1	4.3	1	4.3	6	28.6	5	35.7	2	12.5	0	0.0	0	0.0	31	6.2	Zutano
18	78.3	9	36.0	4	19.0	19	79.2	17	77.3	15	65.2	20	87.0	13	61.9	6	42.9	10	62.5	13	86.7	4	44.4	311	61.8	Hass
3	13.0	11	44.0	14	66.7	2	8.3	2	9.1	5	21.7	1	4.3	0	0.0	0	0.0	0	0.0	1	6.7	0	0.0	52	10.3	Fuerte
0	0.0	1	4.0	0	0.0	1	4.2	2	9.1	0	0.0	1	4.3	1	4.8	1	7.1	3	18.8	0	0.0	0	0.0	49	9.7	Ettinger
0	0.0	2	8.0	0	0.0	1	4.2	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	1.2	Bacon
1	4.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8	0	0.0	0	0.0	0	0.0	0	0.0	10	2.0	SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.6	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	12	2.4	Nobel
0	0.0	2	8.0	2	9.5	1	4.2	1	4.5	1	4.3	0	0.0	0	0.0	2	14.3	1	6.3	1	6.7	5	55.6	29	5.8	Lamb Hass

				Bacon												SirPrize								Pollinizer
39S		40S		41S		42S		43S		44S		45S		46S		47S		48S		49S		50S		Sum		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
24	100	22	100	22	100	22	100	23	100	22	100	18	100	16	100	15	100	24	100	26	100	23	100	501	100	Total
1	4.2	2	9.1	4	18.2	1	4.5	0	0.0	1	4.5	1	5.6	1	6.3	3	20.0	0	0.0	0	0.0	1	4.3	27	5.4	Zutano
15	62.5	17	77.3	13	59.1	13	59.1	17	73.9	16	72.7	8	44.4	8	50.0	5	33.3	24	100.0	20	76.9	19	82.6	341	68.1	Hass
0	0.0	0	0.0	1	4.5	2	9.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.6	Fuerte
0	0.0	0	0.0	0	0.0	2	9.1	3	13.0	2	9.1	0	0.0	2	12.5	2	13.3	0	0.0	0	0.0	1	4.3	19	3.8	Ettinger
1	4.2	0	0.0	1	4.5	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	8.7	4	0.8	Bacon
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	11.1	1	6.3	5	33.3	0	0.0	4	15.4	0	0.0	13	2.6	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	29	5.8	Marvel
1	4.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	5.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	10	2.0	Harvest
1	4.2	2	9.1	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	17	3.4	Nobel
5	20.8	1	4.5	3	13.6	4	18.2	3	13.0	3	13.6	6	33.3	4	25.0	0	0.0	0	0.0	2	7.7	0	0.0	38	7.6	Lamb Hass

Table 2a. Numbers and proportions of near-mature 'Hass' fruit harvested on November 1, 2004 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					Ettinger												Nobel							
Row	27N		28N		29N		30N		31N		32N		33N		34N		35N		36N		37N		38N	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	15	100	11	100	18	100	22	100	29	100	27	100	26	100	25	100	28	100	28	100	22	100	21	100
Zutano	0	0.0	0	0.0	0	0.0	0	0.0	3	10.3	0	0.0	2	7.7	0	0.0	1	3.6	1	3.6	0	0.0	3	14.3
Hass	13	86.7	1	9.1	1	5.6	12	54.5	26	89.7	21	77.8	20	76.9	20	80.0	19	67.9	23	82.1	20	90.9	15	71.4
Fuerte	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	7.7	2	8.0	1	3.6	0	0.0	0	0.0	2	9.5
Ettinger	2	13.3	10	90.9	16	88.9	7	31.8	0	0.0	4	14.8	0	0.0	0	0.0	1	3.6	1	3.6	1	4.5	0	0.0
Bacon	0	0.0	0	0.0	0	0.0	1	4.5	0	0.0	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	1	4.0	2	7.1	1	3.6	1	4.5	1	4.8
Marvel	0	0.0	0	0.0	1	5.6	2	9.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.6	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	1	3.6	1	3.6	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	2	7.7	2	8.0	3	10.7	0	0.0	0	0.0	0	0.0
Lamb Hass	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	7.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Pollinizer					Marvel												Harvest							
Row	27S		28S		29S		30S		31S		32S		33S		34S		35S		36S		37S		38S	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	31	100	31	100	30	100	31	100	31	100	31	100	31	100	29	100	31	100	25	100	28	100	31	100
Zutano	2	6.5	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	1	3.2	1	3.4	0	0.0	0	0.0	1	3.6	0	0.0
Hass	21	67.7	15	48.4	16	53.3	23	74.2	30	96.8	27	87.1	26	83.9	25	86.2	19	61.3	24	96.0	25	89.3	28	90.3
Fuerte	0	0.0	2	6.5	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
Ettinger	0	0.0	1	3.2	0	0.0	1	3.2	0	0.0	0	0.0	1	3.2	1	3.4	0	0.0	0	0.0	0	0.0	1	3.2
Bacon	0	0.0	0	0.0	0	0.0	2	6.5	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	1	3.6	0	0.0
SirPrize	0	0.0	2	6.5	0	0.0	1	3.2	0	0.0	1	3.2	1	3.2	0	0.0	1	3.2	1	4.0	1	3.6	2	6.5
Marvel	8	25.8	9	29.0	11	36.7	4	12.9	0	0.0	1	3.2	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	1	3.3	0	0.0	0	0.0	0	0.0	0	0.0	1	3.4	10	32.3	0.0	0.0	0	0.0	0	0.0
Nobel	0	0.0	2	6.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.4	1	3.2	0	0.0	0	0.0	0	0.0
Lamb Hass	0		0	0.0	2	6.7	0	0.0	0	0.0	0	0.0	2	6.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 2b. Numbers and proportions of near-mature ‘Hass’ fruit harvested on November 1, 2004 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.

				Fuerte												Zutano								Pollinizer
39N		40N		41N		42N		43N		44N		45N		46N		47N		48N		49N		50N		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
16	100	27	100	29	100	29	100	27	100	20	100	33	100	29	100	29	100	31	100	30	100	27	100	599	100	Total
1	6.3	1	3.7	2	6.9	2	6.9	3	11.1	2	10.0	0	0.0	3	10.3	8	27.6	2	6.5	2	6.7	0	0.0	36	6.0	Zutano
11	68.8	14	51.9	10	34.5	23	79.3	23	85.2	16	80.0	27	81.8	19	65.5	20	69.0	29	93.5	23	76.7	27	100	433	72.3	Hass
3	18.8	11	40.7	15	51.7	3	10.3	0	0.0	2	10.0	2	6.1	1	3.4	0	0.0	0	0.0	0	0.0	0	0.0	44	7.3	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	1	3.4	0	0.0	1	3.3	0	0.0	44	7.3	Ettinger
0	0.0	0	0.0	1	3.4	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	0.3	Bacon
0	0.0	0	0.0	1	3.4	1	3.4	0	0.0	0	0.0	2	6.1	6	20.7	0	0.0	0	0.0	4	13.3	0	0.0	20	3.3	SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	1	3.7	0	0.0	1	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	1.0	Marvel
0	0.0	1	3.7	0	0.0	0	0.0	0	0.0	0	0.0	1	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.7	Harvest
1	6.3	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	8	1.3	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	2	0.3	Lamb Has

				Bacon												SirPrize								Polinizer
39S		40S		41S		42S		43S		44S		45S		46S		47S		48S		49S		50S		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
30	100	29	100	30	100	30	100	30	100	16	100	15	100	18	100	29	100	30	100	30	100	0	0	647	100	Total
1	3.3	2	6.9	0	0.0	0	0.0	3	10.0	0	0.0	0	0.0	0	0.0	1	3.4	2	6.7	2	6.7	0	0.0	17	2.6	Zutano
23	76.7	20	69.0	18	60.0	27	90.0	27	90.0	11	68.8	12	80.0	14	77.8	9	31.0	23	76.7	25	83.3	0	0.0	488	75.4	Hass
3	10.0	1	3.4	2	6.7	0	0.0	0	0.0	0	0.0	1	6.7	1	5.6	0	0.0	0	0.0	0	0.0	0	0.0	11	1.7	Fuerte
0	0.0	0	0.0	0	0.0	2	6.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	1.1	Ettinger
1	3.3	1	3.4	4	13.3	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	10	1.5	Bacon
0	0.0	2	6.9	2	6.7	1	3.3	0	0.0	0	0.0	0	0.0	3	16.7	19	65.5	5	16.7	3	10.0	0	0.0	45	7.0	SirPrize
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	25.0	2	13.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	39	6.0	Marvel
2	6.7	0	0.0	0	0.0	0	0.0	0	0.0	1	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	15	2.3	Harvest
0	0.0	2	6.9	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	6	0.9	Nobel
0	0.0	1	3.4	4	13.3	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	9	1.4	Lamb Has

Table 3a. Comparison of percentage pollination within each row by each cultivar between young fruit (Y04) harvested at marble size and near-mature fruit (M04) derived from flowers pollinated in spring of 2004. The formula to calculate the Retention rate = % of M04 - % of Y04. A positive number indicates increased retention, and a negative number indicates a decrease in retention of fruit pollinated by the indicated cultivar by the indicated amount. Zero indicates no change in fruit retention during development.

Pollinizer							Ettinger																	
Row	27N			28N			29N			30N			31N			32N			33N			34N		
Stage*	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%
Total	15	23	0.0	11	21	0.0	18	23	0.0	22	16	0.0	29	21	0.0	27	23	0.0	26	21	0.0	25	24	0.0
Zutano	0	1	-4.3	0	0	0.0	0	1	-4.3	0	2	-12.5	3	0	10.3	0	2	-8.7	2	2	-1.8	0	3	-12.5
Hass	13	18	8.4	1	10	-38.5	1	1	1.2	12	10	-8.0	26	18	3.9	21	18	-0.5	20	13	15.0	20	17	9.2
Fuerte	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	1	-4.8	0	0	0.0	2	1	2.9	2	3	-4.5
Ettinger	2	1	9.0	10	10	43.3	16	20	1.9	7	3	13.1	0	1	-4.8	4	1	10.5	0	0	0.0	0	1	-4.2
Bacon	0	1	-4.3	0	0	0.0	0	0	0.0	1	0	4.5	0	1	-4.8	0	0	0.0	0	1	-4.8	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	1	-4.3	0	0	0.0	1	0	4.0
Marvel	0	0	0.0	0	0	0.0	1	0	5.6	2	0	9.1	0	0	0.0	0	0	0.0	0	1	-4.8	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
Nobel	0	0	0.0	0	0	0.0	0	1	-4.3	0	1	-6.3	0	0	0.0	0	1	-4.3	2	0	7.7	2	0	8.0
Lamb Hass	0	2	-8.7	0	1	-4.8	0	0	0.0	0	0	0.0	0	0	0.0	2	0	7.4	0	3	-14.3	0	0	0.0

Pollinizer							Marvel																	
Row	27S			28S			29S			30S			31S			32S			33S			34S		
Stage*	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%
Total	31	18	0.0	31	23	0.0	30	19	0.0	31	16	0.0	31	20	0.0	31	22	0.0	31	24	0.0	29	23	0.0
Zutano	2	0	6.5	0	0	0.0	0	0	0.0	0	5	-31.3	0	1	-5.0	1	1	-1.3	1	1	-0.9	1	1	-0.9
Hass	21	9	17.7	15	11	0.6	16	8	11.2	23	4	49.2	30	14	26.8	27	20	-3.8	26	20	0.5	25	17	12.3
Fuerte	0	0	0.0	2	0	6.5	0	0	0.0	0	0	0.0	1	0	3.2	0	0	0.0	0	0	0.0	0	0	0.0
Ettinger	0	1	-5.6	1	3	-9.8	0	0	0.0	1	0	3.2	0	0	0.0	0	0	0.0	1	1	-0.9	1	2	-5.2
Bacon	0	0	0.0	0	0	0.0	0	0	0.0	2	0	6.5	0	0	0.0	1	0	3.2	0	0	0.0	0	0	0.0
SirPrize	0	0	0.0	2	0	6.5	0	0	0.0	1	0	3.2	0	0	0.0	1	0	3.2	1	0	3.2	0	0	0.0
Marvel	8	6	-7.5	9	5	7.3	11	7	-0.2	4	4	-12.1	0	4	-20.0	1	1	-1.3	0	0	0.0	0	2	-8.7
Harvest	0	0	0.0	0	0	0.0	1	0	3.3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.4
Nobel	0	2	-11.1	2	2	-2.2	0	4	-21.1	0	0	0.0	0	1	-5.0	0	0	0.0	0	2	-8.3	1	1	-0.9
Lamb Hass	0	0	0.0	0	2	-8.7	2	0	6.7	0	3	-18.8	0	0	0.0	0	0	0.0	2	0	6.5	0	0	0.0

Table 3b. Continued across rows.

Nobel																		Fuerte								
35N			36N			37N			38N			39N			40N			41N			42N			43N		
M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%
28	24	0.0	28	23	75.0	22	25	0.0	21	23	0.0	16	23	0.0	27	25	0.0	29	21	0.0	29	24	0.0	27	22	0.0
1	0	3.6	1	1	1.9	0	2	-8.0	3	0	14.3	1	1	1.9	1	0	3.7	2	1	2.1	2	0	6.9	3	0	11.1
19	17	-3.0	11	9	29.6	20	17	22.9	15	15	6.2	11	18	-9.5	14	9	15.9	10	4	15.4	23	19	0.1	23	17	7.9
1	1	-0.6	3	3	5.7	0	2	-8.0	2	2	0.8	3	3	5.7	11	11	-3.3	15	14	-14.9	3	2	2.0	0	2	-9.1
1	2	-4.8	0	0	0.0	1	0	4.5	0	0	0.0	0	0	0.0	0	1	-4.0	0	0	0.0	0	1	-4.2	0	2	-9.1
0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	2	-8.0	1	0	3.4	0	1	-4.2	0	0	0.0
2	1	3.0	0	2	-8.7	1	1	0.5	1	3	-8.3	0	1	-4.3	0	0	0.0	1	0	3.4	1	0	3.4	0	0	0.0
0	0	0.0	0	1	-4.3	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	3.7
1	0	3.6	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.7	0	0	0.0	0	0	0.0	0	0	0.0
3	1	6.5	1	5	-15.5	0	2	-8.0	0	1	-4.3	1	0	6.3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
0	2	-8.3	0	2	-8.7	0	1	-4.0	0	2	-8.7	0	0	0.0	0	2	-8.0	0	2	-9.5	0	1	-4.2	0	1	-4.5

Harvest																		Bacon								
35S			36S			37S			38S			39S			40S			41S			42S			43S		
M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%
31	18	0.0	25	17	0.0	28	22	0.0	31	22	0.0	30	24	0.0	29	22	0.0	30	22	0.0	30	22	0.0	30	23	0.0
0	0	0.0	0	3	-17.6	1	0	3.6	0	0	0.0	1	1	-0.8	2	2	-2.2	0	4	-18.2	0	1	-4.5	3	0	10.0
19	10	5.7	24	11	31.3	25	20	-1.6	28	22	-9.7	23	15	14.2	20	17	-8.3	18	13	0.9	27	13	30.9	27	17	16.1
0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	0	10.0	1	0	3.4	2	1	2.1	0	2	-9.1	0	1	-4.3
0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.2	0	0	0.0	0	0	0.0	0	0	0.0	2	2	-2.4	0	3	-13.0
0	0	0.0	0	0	0.0	1	0	3.6	0	0	0.0	1	1	-0.8	1	0	3.4	4	1	8.8	0	0	0.0	0	0	0.0
1	1	-2.3	1	0	4.0	1	0	3.6	2	0	6.5	0	0	0.0	2	0	6.9	2	0	6.7	1	0	3.3	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	0.0
10	6	-1.1	0.0	2	-11.8	0	0	0.0	0	0	0.0	2	1	2.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
1	1	-2.3	0	1	-5.9	0	0	0.0	0	0	0.0	0	1	-4.2	2	2	-2.2	0	0	0.0	0	0	0.0	0	0	0.0
0	0	0.0	0	0	0.0	0	2	-9.1	0	0	0.0	0	5	-20.8	1	1	-1.1	4	3	-0.3	0	4	-18.2	0	2	-8.7

Table 3c. Continued across rows.

									Zutano														Pollinizer
44N			45N			46N			47N			48N			49N			50N			Total			Row
M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	Stage*
20	23	0.0	33	23	0.0	29	21	0.0	29	14	0.0	31	16	0.0	30	15	0.0	27	9	0.0	599	503	0.0	Total
2	1	5.7	0	1	-4.3	3	6	-18.2	8	5	-8.1	2	2	-6.0	2	0	6.7	0	0	0.0	36	31	-0.2	Zutano
16	15	14.8	27	20	-5.1	19	13	3.6	20	6	26.1	29	10	31.0	23	13	-10.0	27	4	55.6	421	311	8.5	Hass
2	5	-11.7	2	1	1.7	1	0	3.4	0	0	0.0	0	0	0.0	0	1	-6.7	0	0	0.0	47	52	-2.5	Fuerte
0	0	0.0	0	1	-4.3	0	1	-4.8	1	1	-3.7	0	3	-18.8	1	0	3.3	0	0	0.0	43	49	-2.6	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	0.0	2	6	-0.9	Bacon
0	0	0.0	2	0	6.1	6	1	15.9	0	0	0.0	0	0	0.0	4	0	13.3	0	0	0.0	19	10	1.2	SirPrize
0	1	-4.3	1	0	3.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	5	3	0.2	Marvel
0	0	0.0	1	0	3.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	0	0.5	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	9	12	-0.9	Nobel
0	1	-4.3	0	0	0.0	0	0	0.0	0	2	-14.3	0	1	-6.3	0	1	-6.7	0	5	-55.6	2	29	-5.4	Lamb Hass

									SirPrize														Pollinizer
44S			45S			46S			47S			48S			49S			50S			Total			Row
M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	M04	Y04	%-%	Stage*
16	22	-42.9	15	18	-33.4	18	16	-6.7	29	15	31.8	30	24	-9.1	30	26	-18.2	0	23		647	478	0.0	Total
0	1	-4.5	0	1	-4.5	0	1	-4.2	1	3	-10.2	2	0	6.7	2	0	6.7	0	1		17	26	-2.8	Zutano
11	16	-33.4	12	8	2.3	14	8	13.3	9	5	8.3	23	24	-32.4	25	20	-7.6	0	19		488	322	8.1	Hass
0	0	0.0	1	0	3.2	1	0	3.3	0	0	0.0	0	0	0.0	0	0	0.0	0	0		11	4	0.9	Fuerte
0	2	-9.1	0	0	0.0	0	2	-8.3	0	2	-9.1	0	0	0.0	0	0	0.0	0	1		7	18	-2.7	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	2		10	2	1.1	Bacon
0	0	0.0	0	2	-9.1	3	1	5.8	19	5	42.8	5	0	16.7	3	4	-8.2	0	0		45	13	4.2	SirPrize
4	0	14.3	2	0	6.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0		39	29	0.0	Marvel
1	0	3.6	0	1	-4.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0		15	10	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		6	17	-2.6	Nobel
0	3	-13.6	0	6	-27.3	0	4	-16.7	0	0	0.0	0	0	0.0	0	2	-9.1	0	0		9	37	-6.3	Lamb Hass

Table 4a. 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 4b.

Pollinizer					Ettinger												Nobel							
Row	27N		28N		29N		30N		31N		32N		33N		34N		35N		36N		37N		38N	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	30	100	37	100	32	100	35	100	36	100	35	100	27	100	34	100	0	####	0	####	0	####	0	####
Zutano	10	31.3	8	25.8	0	0.0	5	15.6	3	9.4	4	12.5	5	15.6	2	6.3		0.0		0.0		0.0		0.0
Hass	2	6.3	1	3.2	0	0.0	9	28.1	14	43.8	16	50.0	15	46.9	23	71.9		0.0		0.0		0.0		0.0
Fuerte	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	0	0.0	1	3.1		0.0		0.0		0.0		0.0
Ettinger	17	53.1	28	90.3	30	93.8	19	59.4	18	56.3	11	34.4	7	21.9	7	21.9		0.0		0.0		0.0		0.0
Bacon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.3	0	0.0	1	3.1		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
Marvel	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	2	6.3	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
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
Lamb Hass	1	3.1	0	0.0	1	3.1	1	3.1	1	3.1	0	0.0	0	0.0	0	0.0		0.0		0.0		0.0		0.0

Pollinizer					Marvel												Harvest							
Row	27S		28S		29S		30S		31S		32S		33S		34S		35S		36S		37S		38S	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####
Zutano		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Hass		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
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
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
Bacon		0.0		0.0		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
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
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
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
Lamb Hass		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 4b. 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 4a.

				Fuerte										Zutano									Pollinizer
39N		40N		41N		42N		43N		44N		45N		46N		47N		48N		49N		50N		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	266	100	Total
	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	37	5.7	Zutano
	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	80	12.3	Hass
	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	0.3	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	137	21.0	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	3	0.5	Bacon
	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	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	3	0.5	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	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	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	4	0.6	Lamb Has

				Bacon										SirPrize									Pollinizer
39S		40S		41S		42S		43S		44S		45S		46S		47S		48S		49S		50S		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	0	####	Total
	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	Zutano
	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	Hass
	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	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	0	0.0	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	Bacon
	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	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	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	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	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	Lamb Has

Table 5a. Numbers and proportions of near-mature 'Hass' fruit harvested on November 7, 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 5b.

Pollinizer					Ettinger												Nobel							
Row	27N		28N		29N		30N		31N		32N		33N		34N		35N		36N		37N		38N	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	32	100	31	100	32	100	32	100	32	100	32	100	32	100	32	100	32	100	30	100	32	100	28	100
Zutano	8	25.0	3	9.7	1	3.1	3	9.4	4	12.5	2	6.3	3	9.4	2	6.3	4	12.5	0	0.0	1	3.1	2	7.1
Hass	3	9.4	3	9.7	2	6.3	7	21.9	17	53.1	18	56.3	18	56.3	21	65.6	19	59.4	28	93.3	23	71.9	23	82.1
Fuerte	0	0.0	0	0.0	0	0.0	1	3.1	1	3.1	2	6.3	0	0.0	0	0.0	2	6.3	0	0.0	0	0.0	1	3.6
Ettinger	16	50.0	23	74.2	29	90.6	17	53.1	6	18.8	6	18.8	10	31.3	7	21.9	3	9.4	1	3.3	6	18.8	1	3.6
Bacon	0	0.0	0	0.0	0	0.0	3	9.4	2	6.3	0	0.0	0	0.0	1	3.1	2	6.3	0	0.0	2	6.3	1	3.6
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	3.1	0	0.0	0	0.0	0	0.0
Marvel	5	15.6	1	3.2	0	0.0	1	3.1	1	3.1	1	3.1	0	0.0	1	3.1	1	3.1	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	1	3.1	1	3.1	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	1	3.3	0	0.0	0	0.0
Lamb Hass	0	0.0	1	9.1	0	0.0	0	0.0	1	3.1	2	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Pollinizer					Marvel												Harvest							
Row	27S		28S		29S		30S		31S		32S		33S		34S		35S		36S		37S		38S	
Fruits	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	29	100	32	100	31	100	32	100	32	100	32	100	32	100	32	100	30	100	29	100	26	100	30	100
Zutano	2	6.3	0	0.0	3	9.4	1	3.1	3	9.4	3	9.4	2	6.3	1	3.1	0	0.0	0	0.0	0	0.0	4	14.3
Hass	15	46.9	11	35.5	8	25.0	15	46.9	22	68.8	26	81.3	22	68.8	27	84.4	28	87.5	25	83.3	24	85.7	23	82.1
Fuerte	2	6.3	0	0.0	0	0.0	5	15.6	1	3.1	2	6.3	1	3.1	0	0.0	0	0.0	1	3.3	1	3.6	0	0.0
Ettinger	6	18.8	10	32.3	7	21.9	8	25.0	4	12.5	1	3.1	2	6.3	3	9.4	0	0.0	0	0.0	0	0.0	2	7.1
Bacon	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	0	0.0	1	3.1	1	3.1	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	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Marvel	4	12.5	11	35.5	12	37.5	3	9.4	1	3.1	0	0.0	1	3.1	0	0.0	0	0.0	2	6.7	1	3.6	1	3.6
Harvest	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Nobel	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	0	0.0	0	0.0	0	0.0
Lamb Hass	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	3.3	0	0.0	0	0.0

Table 5b. Numbers and proportions of near-mature 'Hass' fruit harvested on November 7, 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 5a.

				Fuerte										Zutano										Pollinizer
39N		40N		41N		42N		43N		44N		45N		46N		47N		48N		49N		50N		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
30	100	29	100	32	100	31	100	32	100	32	100	32	100	27	100	31	100	30	100	31	100	31	100	745	100	Total
1	3.3	0	0.0	1	3.1	2	6.5	2	6.3	4	12.5	11	34.4	13	48.1	25	80.6	12	37.5	15	55.6	8	25.8	127	19.4	Zutano
19	63.3	16	55.2	18	56.3	25	80.6	29	90.6	26	81.3	17	53.1	11	40.7	4	12.9	16	50.0	11	40.7	11	35.5	385	59.0	Hass
2	6.7	9	31.0	12	37.5	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2	1	3.1	3	11.1	4	12.9	40	6.1	Fuerte
5	16.7	1	3.4	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	2	7.4	1	3.2	1	3.1	0	0.0	7	22.6	143	21.9	Ettinger
2	6.7	2	6.9	0	0.0	2	6.5	1	3.1	1	3.1	4	12.5	1	3.7	0	0.0	0	0.0	2	7.4	0	0.0	26	4.0	Bacon
0	0.0	1	3.4	0	0.0	1	3.2	0	0.0	1	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.6	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	1	3.2	12	1.8	Marvel
1	3.3	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	0.5	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	0.2	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	4	0.6	Lamb Hass

				Bacon										SirPrize										Pollinizer
39S		40S		41S		42S		43S		44S		45S		46S		47S		48S		49S		50S		Total		Row
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Fruits
30	100	31	100	29	100	27	100	26	100	29	100	31	100	31	100	32	100	20	100	29	100	28	100	710	100	Total
0	0.0	0	0.0	2	6.3	2	6.5	0	0.0	0	0.0	2	6.3	2	7.4	3	9.7	1	3.1	4	14.8	3	9.7	38	5.8	Zutano
26	86.7	22	75.9	13	40.6	17	54.8	20	62.5	24	75.0	22	68.8	23	85.2	21	67.7	14	43.8	17	63.0	19	61.3	484	74.1	Hass
2	6.7	1	3.4	1	3.1	0	0.0	3	9.4	1	3.1	0	0.0	0	0.0	1	3.2	0	0.0	1	3.7	0	0.0	23	3.5	Fuerte
1	3.3	3	10.3	0	0.0	0	0.0	2	6.3	2	6.3	4	12.5	1	3.7	0	0.0	1	3.1	4	14.8	5	16.1	66	10.1	Ettinger
1	3.3	4	13.8	13	40.6	8	25.8	1	3.1	2	6.3	0	0.0	1	3.7	1	3.2	4	12.5	0	0.0	1	3.2	39	6.0	Bacon
0	0.0	1	3.4	0	0.0	0	0.0	0	0.0	0	0.0	3	9.4	4	14.8	5	16.1	0	0.0	0	0.0	0	0.0	14	2.1	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	1	3.2	0	0.0	2	7.4	0	0.0	39	6.0	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	1	3.7	0	0.0	3	0.5	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	0.2	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	3	0.5	Lamb Hass

Table 6a. Comparison of percentage pollination within each row by each cultivar among three years 2003, 2004, and 2005 for near-mature 'Hass' fruit.

Pollinizer							Ettinger																	Nobel								
Row	27N			28N			29N			30N			31N			32N			33N			34N			35N			36N			37N			38N		
Year	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05
Zutano	20	0	25	10	0	10	5	0	3	5	0	9	5	10	13	39	0	6	47	8	9	0	0	6	6	4	13	20	4	0	32	0	3	0	14	7
Hass	15	87	9	10	9	10	0	6	6	11	55	22	53	90	53	28	78	56	27	77	56	50	80	66	28	68	59	50	82	93	47	91	72	37	71	82
Fuerte	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	6	0	8	0	0	8	0	6	4	6	0	0	0	5	0	0	5	10	4
Ettinger	60	13	50	80	91	74	95	89	91	79	32	53	21	0	19	28	15	19	20	0	31	0	0	22	33	4	9	10	4	3	11	5	19	21	0	4
Bacon	5	0	0	0	0	0	0	0	0	0	5	9	11	0	6	0	0	0	7	0	0	50	0	3	22	0	6	0	0	0	0	0	6	21	0	4
SirPrize	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	4	0	0	7	3	5	4	0	5	5	0	11	5	0
Marvel	0	0	16	0	0	3	0	6	0	0	9	3	0	0	3	6	0	3	0	0	0	0	0	3	0	0	3	0	4	0	0	0	0	5	0	0
Harvest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	4	0	0	4	0	0	0	0	0	0	0
Nobel	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	8	0	0	8	0	6	11	0	5	0	3	0	0	0	0	0	0
Lamb Hass	0	0	0	0	0	9	0	0	0	5	0	0	0	0	3	0	7	6	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
Total Fruit	20	15	32	20	11	31	20	18	32	19	22	32	19	29	32	18	27	32	15	26	32	2	25	32	18	28	32	20	28	30	19	22	32	19	21	28

Pollinizer							Marvel																	Harvest								
Row	27S			28S			29S			30S			31S			32S			33S			34S			35S			36S			37S			38S		
Year	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05
Zutano	28	6	6	6	0	0	6	0	9	6	0	3	10	0	9	9	3	9	5	3	6	5	3	3	0	0	0	7	0	0	7	4	0	0	0	14
Hass	22	68	47	22	48	35	39	53	25	24	74	47	45	97	69	64	87	81	79	84	69	74	86	84	47	61	88	53	96	83	71	89	86	30	90	82
Fuerte	0	0	6	0	6	0	0	0	0	0	0	16	10	3	3	0	0	6	0	0	3	0	0	0	0	0	0	7	0	3	0	0	4	0	0	0
Ettinger	11	0	19	28	3	32	39	0	22	47	3	25	10	0	13	9	0	3	0	3	6	11	3	9	5	0	0	0	0	0	0	0	0	0	3	7
Bacon	22	0	0	11	0	0	0	0	0	6	6	0	5	0	3	0	3	0	0	0	3	0	0	3	16	0	0	13	0	0	0	4	0	30	0	0
SirPrize	0	0	0	6	6	0	0	0	0	6	3	0	0	0	0	9	3	0	5	3	3	5	0	0	26	3	0	0	4	0	0	4	0	30	6	0
Marvel	0	26	13	0	29	35	17	37	38	0	13	9	5	0	3	9	3	0	5	0	3	5	0	0	0	0	0	0	0	7	0	0	4	0	0	4
Harvest	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	6	0	3	0	0	32	0	7	0	0	0	0	0	10	0	0
Nobel	0	0	0	17	6	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0
Lamb Hass	17	0	0	11	0	0	0	7	0	12	0	0	15	0	0	0	0	0	5	6	0	0	0	0	5	0	6	13	0	3	21	0	0	0	0	0
Total Fruit	18	31	29	18	31	32	18	30	31	17	31	32	20	31	32	11	31	32	19	31	32	19	29	32	19	31	30	15	25	29	14	28	26	10	31	30

Table 6b. Comparison of percentage pollination within each row by each cultivar among three years 2003, 2004, and 2005 for near-mature 'Hass' fruit.

				Fuerte															Zutano													Pollinizer
39N		40N			41N			42N			43N			44N			45N			46N			47N			48N			49N			50N			Total			Row
04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	Fruits
6	3	16	4	0	30	7	3	0	7	6	29	11	6	56	10	13	80	0	34	53	10	48	88	28	81	84	6	38	57	7	56	64	0	26	34	6	19	Zutano
69	63	21	52	55	15	34	56	21	79	81	12	85	91	33	80	81	5	82	53	5	66	41	6	69	13	5	94	50	21	77	41	9	100	35	23	72	59	Hass
19	7	26	41	31	40	52	38	5	10	3	6	0	0	11	10	0	0	6	0	11	3	0	0	0	3	5	0	3	0	0	11	0	0	13	7	7	6	Fuerte
0	17	11	0	3	5	0	3	0	0	0	6	0	0	0	0	0	10	0	0	5	0	7	0	3	3	5	0	3	14	3	0	9	0	23	26	7	22	Ettinger
0	7	0	0	7	0	3	0	16	0	6	6	0	3	0	0	3	0	0	13	11	0	4	6	0	0	0	0	0	0	0	7	18	0	0	6	0	4	Bacon
0	0	0	0	3	0	3	0	11	3	3	24	0	0	0	0	3	0	6	0	0	21	0	0	0	0	0	0	0	7	13	0	0	0	0	4	3	1	SirPrize
0	0	0	0	0	0	0	0	11	0	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	2	Marvel
0	3	0	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	Harvest
6	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	Nobel
0	0	26	0	0	10	0	0	32	0	0	12	0	0	0	0	0	5	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1	Lamb Has
16	30	19	27	29	20	29	32	19	29	31	17	27	32	18	20	32	20	33	32	19	29	27	17	29	31	19	31	30	14	30	31	11	27	31	420	599	745	Total Fruit

				Bacon															SirPrize													Pollinizer
39S		40S			41S			42S			43S			44S			45S			46S			47S			48S			49S			50S			Total			Row
04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	Year
3	0	5	7	0	13	0	6	17	0	6	22	10	0	12	0	0	5	0	6	0	0	7	15	3	10	25	7	3	11	7	15	37	0	10	12	3	6	Zutano
77	87	5	69	76	7	60	41	50	90	55	50	90	63	41	69	75	53	80	69	35	78	85	60	31	68	25	77	44	32	83	63	21	0	61	40	75	74	Hass
10	7	5	3	3	7	7	3	0	0	0	0	0	9	0	0	3	0	7	0	5	6	0	0	0	3	0	0	0	0	0	4	0	0	0	1	2	4	Fuerte
0	3	0	0	10	13	0	0	6	7	0	0	0	6	24	0	6	21	0	13	20	0	4	5	0	0	25	0	3	16	0	15	5	0	16	13	1	10	Ettinger
3	3	65	3	14	47	13	41	22	0	26	6	0	3	6	0	6	11	0	0	5	0	4	0	0	3	5	0	13	5	0	0	21	0	3	14	2	6	Bacon
0	0	5	7	3	0	7	0	6	3	0	22	0	0	12	0	0	5	0	9	25	17	15	20	66	16	20	17	0	16	10	0	0	0	0	9	7	2	SirPrize
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	13	0	0	0	0	0	0	3	0	0	0	5	0	7	0	0	0	2	6	6	Marvel
7	0	10	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	2	0	Harvest
0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	0	0	1	1	0	Nobel
0	0	5	3	0	13	13	0	0	0	0	0	0	0	6	0	0	0	0	0	10	0	0	0	0	0	0	0	0	11	0	0	11	0	0	6	1	0	Lamb Has
30	30	20	29	31	15	30	29	18	30	27	18	30	26	17	16	29	19	15	31	20	18	31	20	29	32	20	30	20	19	30	29	19	0	28	420	647	710	Total Fruit