

CORRELATION BETWEEN CROSS-POLLINATION BY ZUTANO AND HASS FRUIT YIELD

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Higher than normal fruit set has been observed on Hass trees planted near trees of other varieties. These high fruit counts occurred despite a generally poor fruit set among Hass trees in the neighboring areas. Could pollination by the trees of the other variety have an effect on Hass trees resulting in high fruit counts?

To examine the relationship between high fruit counts and outcrossing, this study concentrated on a grove where Zutano pollen may have an influence on Hass fruit set. Because the embryo of the Hass fruit is the result of a pollination event, we developed an assay with Hass embryo DNA and a molecular marker uniquely identifying Zutano to detect if Zutano pollen fertilized the Hass flower to produce Hass fruit. A caveat of the assay is that absence of the Zutano marker does not imply that the embryo arose by self-pollination. The limitation of the assay is its inability to determine the degree of self-pollination; only the presence of pollen from the specific variety of interest can be detected.

The predictions for the relationship between outcrossing and fruit yield are: 1) If a correlation existed between outcrossing and fruit yield, Hass trees located near Zutano would show a high degree of outcrossing and a high fruit count. 2) In the absence of Zutano trees, we would expect a low degree of outcrossing and low fruit count.

The grove where we collected the Hass avocados had 18-year-old Hass trees with top worked Zutano trees. Five sites consisting of two to five trees were chosen within the grove. Ten Hass fruits were collected from each site and fruit counts were taken from two trees in the site. An exception was site 1, where fruit counts were performed on one tree. Table 1 gives a general description of the sites. Sites 3 and 4 had Hass trees with topworked Zutano trees. The sites having only Hass trees, sites 2 and 5, had the best fruit production for the grove when compared to other isolated Hass trees. Seventy beehives were situated next to Hass trees in Site 1.

Table 1. Description of collection sites.

Site	1	Hass next to beehives
	2	18-year-old Hass with no Zutano trees within six-tree distance. Fruit and number counts taken from best 2 of 4 trees
	3	18-year-old Hass trees next to 3-year-old topworked Zutano trees graft
	4	18-year-old Hass trees next to 3-year-old topworked Zutano graft. These were two best production Hass trees which were not by Zutano trees
	5	18-year-old Hass Trees with no Zutano trees within six rows. Best 2 trees of 4

The data for percent outcrossing and fruit yield are shown in Table 2. Percent outcrossing was calculated by the following formula:

$$\frac{\text{number of Hass fruit showing a Zutano marker} \times 100}{\text{number of fruit assayed}}$$

Average Number of Fruit was calculated for each site by adding the total number of fruit for a site and dividing by the number of trees where fruit numbers were taken.

Table 2. Data for Outcrossing by Zutano and Hass Fruit Yield.

Column 1 shows the collection site number. Column 2 is the number of assayed Hass embryos pollinated by Zutano. Column 3 shows the total number of Hass embryos assayed. Percent outcrossing was calculated by the formula:

$$\frac{\text{number of Hass embryos showing the Zutano marker} \times 100}{\text{the number of Hass embryos assayed}}$$

Average number of fruit per tree is the averaged fruit count for the two Hass trees at each collection site.

Site	Presence of Zutano Marker	Number of Fruit Analyzed	% Outcrossing	Average Number of Fruit per Tree
1	2	8	25%	62
2	1	5	20%	48.5
3	5	6	83%	204
4	4	5	80%	175
5	0	3	0%	17.5

Figure 1 shows the graph of the data. The graph for percent outcrossing and the graph for average number of Hass fruit have been combined to make one graph. The left vertical line represents the outcrossing graph with the scale reflecting the values for percent outcrossing. The outcrossing value for each site is shown as a bar. The right vertical line is the second graph showing the data for fruit yield. The circles represent the data for fruit yield for each site and the line connecting the circles aids in visualization of the values. The bottom horizontal line is shared by both graphs and shows the collection site number.

A correlation between percent outcrossing and fruit yield is clearly seen on the graph. As predicted, sites with Zutano trees (#3 and #4) that had higher percent outcrossing (56% and 85%, respectively) had a higher fruit count (204 and 175, respectively). This is compared to the sites with no Zutano trees (#1, #2, #5) had low value for percent outcrossing (25%, 25%, and 17.5%, respectively) and a low number of fruit (average = 62, 48.5, and 17.5, respectively). The site with beehives and absence of Zutano trees had a slightly higher value for outcrossing and fruit yield as compared to sites with only Hass.

Outcrossing by Zutano and Hass Fruit Yield

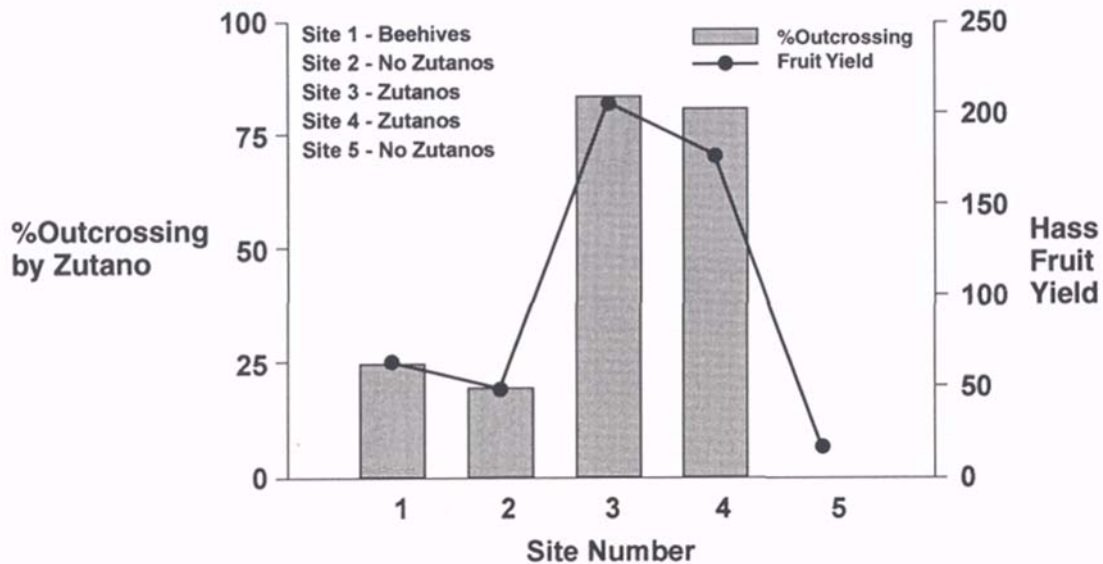


Figure 1. The graph shows the relationship between percent outcrossing and average number of fruit for the five collection sites. The left vertical line is percent outcrossing. The right vertical line is average fruit yield. The bottom horizontal line is the collection site number.

The statistical test, Kendall coefficient of rank correlation, was used to test for the significance of association between the two values, percent outcrossing, and average number of fruit. The results of the test showed a positive correlation with a significance of 0.05 indicating a statistical correlation between outcrossing by Zutano and fruit yield.

The two caveats of this data set are:

1) This is a small study with only ten fruit analyzed from each collection site. Any conclusions drawn from these data should be done with caution. 2) The study was performed in the inland region of Temecula. A similar study performed in a coastal region may not show the same results; weather may have an effect on fruit set in the coastal regions.

The conclusion drawn from this study is a positive statistical correlation exists between outcrossing by Zutano and Hass fruit numbers. When Zutano trees were present, Hass fruit showed a high degree of outcrossing by Zutano and the trees have a high fruit set. If Zutano trees are absent, outcrossing and fruit set are low. The presence of beehives slightly increases the amount of outcrossing in the coastal regions⁷.

Reference

¹Kobayashi, M., D. Henderson, J. Davis, and M.T. Clegg. 1996. Outcrossing in avocado: is there a relationship to fruit yield? California Avocado Society Yearbook 1996. 80: (this volume)