Relationship of Seed Number to Fruit Set in Apple — An Alternate Hypothesis

S. A. Weinbaum and R. K. Simons[1]

Despite positive correlations between the set potential of apple fruit and the number of viable seeds per ovary (7), the nature of this relationship remains obscure. Popular hypotheses include direct effects of hormones emanating from seeds or their influence on the directed movement of metabolites. Current interpretations suggest that fertilization initiates metabolic gradients (3, 4), and subsequently seeds are not essential for ovary development (12).

Post-bloom abscission of apple flowers and immature fruit does not indicate definitely that factors predisposing these organs to premature abscission did not exist prior to anthesis.

Our objective was to determine whether the reduced seed number in fruit disposed to premature abscission could be a result of differential blossom quality which preceded anthesis.

Twelve mature 'Golden Delicious' trees on 'Clark Dwarf' interstocks and 'Virginia Crab' rootstocks were chosen on the bases of profuse blooming and uniform size. Four hundred and eighty flower clusters (40 per tree) were partially deflorated (i.e., 4 of 5 flowers per cluster removed) 15 days prior to anthesis to eliminate fruit competition within the inflorescence; the remaining flower on these clusters occurred laterally on the peduncle and was subtended by a leaf (14). An equal number of clusters was undeflorated to maximize competition within the inflorescence; however, subsequent sampling of these clusters was restricted to apical fruit and lateral fruit in leaf axils.

Diploid pollen ('Jonathan' and 'Delicious') was collected, pretested for germinability (13) and transferred to receptive stigmas with a camel hair brush when blossoms were in the balloon stage (2). Twenty-one days after hand pollination (i.e., prior to June drop) the selected fruit on half the clusters were harvested and the viable seed counted. Abscission patterns of comparable fruit on the remaining clusters were monitored 59 days after pollination.

Results and Discussion

The set of apical fruit was greater than that of selected laterals in clusters whether partially deflorated or not (Table 1). The viable seed content of apical fruit likewise exceeded that of the laterals in both categories.

Since pollen was nonlimiting and pollen transfer was accomplished at the physiologically optimum stage of flower development, the reduced seed complement of lateral fruit would appear to indicate that fertilization was impossible in a percentage of ovules under existing field conditions. These results imply that a differential potential of flowers to set and mature precede anthesis and seed number is an expression of this differential. This view is supported by the fact that post-bloom abscission of apples is not random but is characteristically associated with fruit occupying particular phyllotactic positions within the inflorescence (8). An hypothesis based on the concept of the effective pollination period (15) may be generated to explain the proposed relationship; i.e., in apical flowers a larger percentage of the ovules remain viable until gametic fusion has occurred. The four to five days typically required for the pollen tube to traverse the length of the style (16) represent the

[1]University of California, Davis and University of Illinois, Urbana-Champaign, respectively.

Table 1. Comparative fruit set (%) and viable seeds in apical and selected lateral fruit harvested from undeflorated and partially-deflorated 'Golden Delicious' inflorescences.

	Inflorescence			
	Partially Deflorated		Undeflorated	
	Fruit Position on Inflorescence			
	Terminal	Lateral	Terminal	Lateral
Percent Fruit Set[1]	Removed	90.00	100.00	10.00
Viable Seed Content[2]	—	6.25 ± 0.33	8.73 ± 0.26	5.42 ± 0.41

[1]Determined 59 days after pollination.
[2]Determined 21 days after pollination.

minimum period ovules must remain viable for seed formation.

Correlative inhibition of laterally positioned flowers by the terminal prior to anthesis may be manifest as premature ovule degeneration. In the present instance the set potential and viable seed content of laterals, although increased following defloration, was less than apical fruit in undeflorated inflorescences. Suppression or degeneration of ovules prior to maturation of the embryo sac and flowering has been associated with weaker trees (5, 9). Conversely, the rate and duration of flower primordial development prior to the onset of dormancy on trees supplied with nitrogen during late summer was increased and enhanced fertility (ovule longevity) of these blossoms was apparent at anthesis (15). Positive correlations (in 5 apple cultivars) were found between the size of the dormant bud, the number of flowers per bud, percent fruit set and yield (1). Dormant bud size has also been correlated with sensitivity to the chemical thinning agent NAA applied subsequent to anthesis (11). Conditions during almond flower bud development significantly influence their inherent fruit setting ability (10). The occurrence of flower differntiation in the year prior to bloom has long been appreciated (6), but the definition of pre-bloom quality of these primordia and its relation to subsequent cropping awaits further analyses.

On the basis of our data and the literature cited, we believe that factors restricting seed formation (thus determining seed number) and presumably cropping, precede anthesis. These factors are sufficiently limiting as to be independent of pollen availability and transfer under field conditions. This does not imply the lack of subsequent influence by environmental and physiological elements.

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Strawberry Cultivar Testing in Canada's Maritime Provinces[4]

D. L. CRAIG[1], W. B. COLLINS[2], J. A. CUTCLIFFE[3]

Co-operative testing of strawberry cultivars at the Agriculture Canada Research Stations at Kentville, Nova Scotia, Fredericton, New Brunswick and Charlottetown, Prince Edward Island, was first undertaken in 1967 and reported in Fruit Varieties and Horticultural Digest, V. 25, No. 4, 1971. A new group of cultivars became available for testing in 1970. These cultivars and their place of origin were: 'Bounty' and 'S68-108' (Tioga x Guardsman S[1]), Kentville, N. S.; 'Veestar' and 'Vibrant', 'Vineland', Ontario; 'Redcoat', Ottawa; 'Raritan', New Jersey; 'Guardian' and 'Redchief', Maryland. Plants of the cultivar 'Guardian' were not available for planting at Kentville in 1970. 'S68-108' was placed in the Kentville and the Charlottetown test plots in 1972 and 1973 because it had performed well in observational type test plots at Kentville.

Plants for all test plots were grown in propagation beds at Kentville. The cultivars were planted at the 3 locations in 4 randomized complete blocks of 10 plants per plot each spaced 2 feet apart in rows 4½ feet apart. The plants formed matted rows which were maintained at a 2-foot width. All plots were plowed under after producing one crop of fruit. Standard fertility and pesticide programs were used at all locations. Fruit was considered unmarketable when it was malformed, damaged by rot or mechanically damaged.

Fruit size was calculated by randomely selecting and weighing 25 fruits from each replicate on each picking date. Fruit size was indicated in this report by the percentage of the marketable crop composed of fruit weighing more than 7 g. The 7 g level was chosen because the minimum fruit size to meet the Canada No. 1 Grade is 1.9 cm in diameter (1). A strawberry fruit of this diameter weighs approximately 7 g.

[1]Research Scientist, CDA, Research Station, Kentville, N. S.
[2]Research Scientist, CDA, Research Station, Fredericton, N. B.
[3]Research Scientist, CDA, Research Station, Charlottetown, P. E. I.
[4]Contribution No. 1579 of the Research Station, Kentville, N. S.