

Pedicle Characteristics of Four Apple Cultivars

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Abstract

Pedicle growth patterns of 'McIntosh,' 'Spartan,' 'Idared' and 'Delicious' apples were studied for 3 years in 2 locations. Growth occurred very early in the season; final pedicle lengths were reached by full bloom and pedicle diameters by 3-4 weeks after full bloom. Pedicles of lateral flowers were longer than those of king flowers for all cultivars. 'McIntosh' and 'Spartan' had the shortest pedicles while those of 'Idared' and 'Delicious' were longer. There were no differences among cultivars in pedicle diameter.

Introduction

The pedicle is the stem-like structure which extends from the extremely short peduncle some distance into the fleshy portion of the fruit. It is a very important plant organ as it links the vegetative parts of the tree to the fruit. Pedicle morphology, anatomy and physiology are crucial to proper flower and fruit development. Yet pedicles have received little attention. Many decades ago, Kraus and Ralston (2) described the vascular systems of apple pedicles. Since then most studies have concentrated on the abscission zone (3, 7). There have been no reports comparing pedicle development among cultivars.

The objective of this study was to compare king-flower and lateral-flower pedicle development in 4 apple cultivars over 3 years in 2 locations.

Materials and Methods

Pedicle growth was studied in 15-year old 'McIntosh,' 'Idared,' and 'Delicious' trees on M.26 rootstock from 1985-1987 and on 'Spartan' trees on M.26 in 1987 only at the Cambridge Research Station (CRS), University of Guelph, Ontario. Similar studies were carried out at the Horticultural Research Institute of Ontario, Horticul-

tural Experiment Station (HES) in Simcoe, Ontario on 15-year-old 'McIntosh' trees on seedling rootstock (1986-1987) and 'Spartan' trees on M.26 rootstock (1985-1987).

At the CRS, apple pedicle lengths and diameters were measured from June 13 to Oct. 3, 1985, April 27 to Sept. 25, 1986 and April 24 to June 8, 1987. All samples were randomly chosen from 20 to 30 trees per cultivar. In 1985, samples were taken monthly without separating king blooms (KB) from lateral blooms (LB). In 1986, pedicles from KB were measured separately from LB on a weekly basis from Apr. 22 until June 10 and monthly thereafter until crop harvest. In 1987, KB pedicle lengths and diameters were monitored twice a week from Apr. 21 until May 18, and weekly thereafter until June 8.

At the HES in 1986, KB and LB pedicles from 'McIntosh' and 'Spartan' trees were collected weekly from April 22 to June 1, bi-weekly until July 7 and monthly thereafter until Sept. 3. In 1987, KB pedicles were harvested and measured twice weekly from April 21 to May 20 and weekly until June 9, with a last sample on June 30.

Pedicle length and diameter were measured using electronic micrometer calipers. Length was measured from the peduncle/pedicle abscission zone to the point of entry into the fruit. Diameter was measured just below the swollen area of the peduncle/pedicle abscission zone except for pedicles from HES in 1986, which were measured on the swollen area.

A completely randomized design was used at the CRS for the four

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cultivars. At the HES, a randomized complete block design was used for the 2 cultivars. Means by date, cultivar and location were plotted to compare pedicel growth patterns. Student's *t*-tests were performed to compare KB results to LB results. To compare cultivar differences in KB and LB lengths and diameters an analysis of variance was performed over the 2 years and 2 locations for the 4 cultivars. These means were then separated using a protected LSD multiple comparison procedure.

Results

Pedicel length. In 1986, KB pedicel length growth was completed within 1 week AFB for 3 cultivars at the CRS (Fig. 1, Table 1). Pedicel lengths for other years, cultivars, locations and for LB closely resemble this pattern. In 1985, pedicel length was already complete by the first sample on June 13, about 4 weeks after full bloom (AFB). In 1986 and 1987 pedicels elongated

Table 1. Full bloom dates in May for 3 seasons at 2 locations.

Location	1985	1986	1987
CRS			
McIntosh	12	12	10
Spartan	13	14	12
Idared	13	12	11
Delicious	14	15	13
HES			
McIntosh	9	8	8
Spartan	10	11	10

until about 7-10 days AFB with 'McIntosh' LB length completed by FB. Both KB and LB pedicels from 'McIntosh' and 'Spartan' trees at HES in 1986 and 1987 had finished elongation at or prior to FB.

The rate of pedicel elongation prior to FB was greater for LB flowers than for KB flowers, resulting in a greater final length at harvest (Table 2). At the CRS in 1987, insufficient samples were available to assess differences between KB and LB pedicel develop-

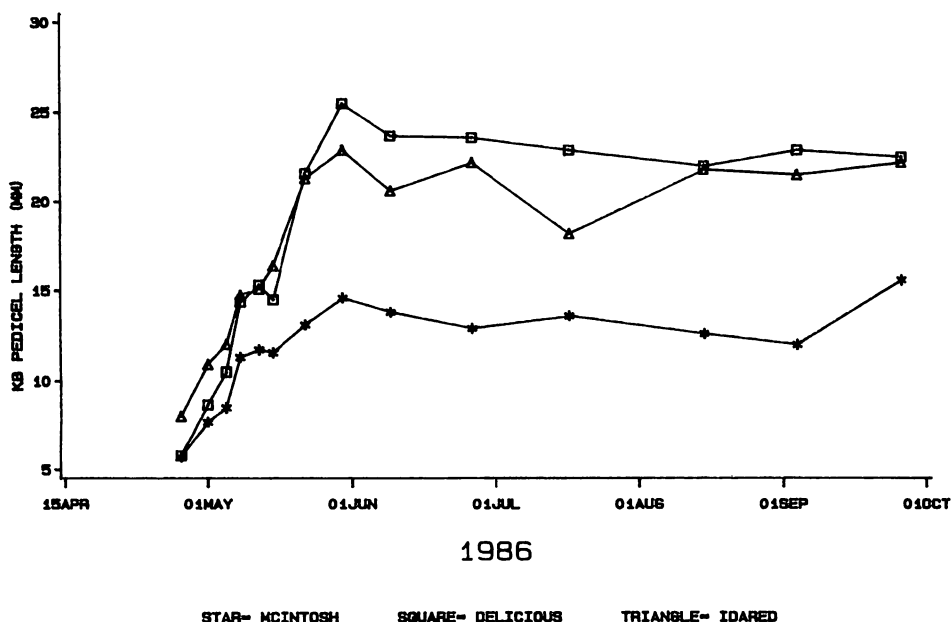


Figure 1. Elongation of king bloom pedicels of 3 apple cultivars in 1986 at the Cambridge Research Station, University of Guelph. Full bloom for 'McIntosh' was May 12, for 'Delicious' May 15, and for 'Idared' May 12.

Table 2. Mean king-bloom (KBL) and lateral-bloom (LBL) final pedicel lengths for 4 apple cultivars in 2 seasons. Measurements in mm.

Location	McIntosh		Spartan		Idared		Delicious	
	1986	1987	1986	1987	1986	1987	1986	1987
HES ¹								
KBL	12.3	16.3	15.0	18.4	—	—	—	—
KBL	15.9	19.7	17.3	19.8	—	—	—	—
	***	***	***	NS				
CRS ²								
KBL	14.0	15.2	—	17.4	20.6	18.7	23.2	18.4
LBL	17.9	17.4	—	18.6	27.3	22.4	28.3	26.1
	***	NS		NS	***	NS	***	*

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*, ***Significant at P = 0.05, P 0.001 respectively, Student's t-test.

ment except for ‘Delicious.’ Pedicel lengths varied among cultivars, with ‘McIntosh’ and ‘Spartan’ having shorter pedicels than ‘Idared’ or ‘Delicious’ (Table 3).

Pedicel diameter. Pedicel diameters did not differ among cultivars or between LB and KB (Table 3). These results remained consistent even when the pedicels from the HES (1986) were measured on the swollen area of the abscission zone. Growth in diameter was slower than growth in length but continued for a longer period. In 1985, ‘McIntosh’ pedicel diameters increased until Aug. 7 (12 weeks AFB), those of ‘Delicious’ until July 3 (7 weeks AFB) and those of ‘Idared’ showed no change from June 13 (4 weeks AFB). The more detailed studies of 1986 and 1987 indicated that expansion growth was virtually finished by 3-4 weeks AFB at the CRS and less than 3 weeks AFB at the HES.

Table 3. Mean pedicel lengths and diameters for king and lateral blooms over 3 seasons. Measurements in mm.

Cultivar	KBL	LBL	KBD	LBD
McIntosh	14.5a	17.7a	2.7a	2.7a
Spartan	16.9ab	18.6a	2.8a	2.8a
Idared	19.7 b	24.9 b	2.4a	2.1a
Delicious	20.8 b	27.2 b	2.5a	2.3a

²Mean separation within columns by protected LSD, 0.05 level.

Discussion

All exchanges of material (water, carbohydrates, calcium, hormones, etc. . . .) from the vegetative part of the tree to the fruit must take place via the pedicel. This makes this “pipeline” or “conduit” extremely important physiologically and commercially. Nii (5) found a strong correlation between fruit enlargement and the development of vascular tissue in the pedicel and flesh of Japanese pear fruit as well as in the other fleshy fruits (4, 6). Habdas et al. (1), reporting on the anatomical structure of apple pedicels during June drop, found an increased amount of xylem in the pedicels of large as compared to smaller fruitlets.

Our study showed no significant difference in pedicel diameters at either location from 1985-87, suggesting that pedicel expansion was constant for the cultivars studied. In general, pedicel diameters expanded until about 3-4 weeks AFB whereas pedicel lengths were essentially complete by FB. Anatomical studies (author, unpublished), have revealed that pedicels exhibit secondary growth. The rate at which secondary growth occurred in ‘McIntosh’ trees at the CRS (1985) may have been delayed, resulting in a slow but continual increase in diameter until 12 weeks AFB. Nevertheless, mean diameter at harvest was not significantly different among cultivars.

Pedicel length growth took place rapidly early in the season in all cultivars. The preceding season's climate as well as late winter-early spring conditions influence this growth process. These conditions probably help account for observed differences in mean pedicel length in different years. Since lengths are established so early in the growing season, it can become a valuable tool for an array of research. For example, in growth retardant studies, early examination of the applied material on pedicel length might indicate its potential activity on other plant organs.

In a blossom cluster, KB flowers appear to be longer than those of LB but this study found LB pedicels to be longer than those of KB pedicels. Probably KB flowers look longer than those of LB because they are sitting higher on the peduncle.

Further studies are needed to elucidate the function of the pedicel. These should include the development of vascular tissue in relation to water and assimilate movement and how they are influenced by horticultural

practices such as application of growth retardants.

Literature Cited

1. Haddas, H., L. S. Jankiewicz and B. Borkowska. 1982. Changes in anatomical structure of apple fruitlet pedicels preceding June drop. *Acta Agrobotanica* 35:11-23.
2. Kraus, E. J. and G. S. Ralston. 1916. The pollination of the pomaceous fruits. III. Gross vascular anatomy of the apple. *Oregon Agr. Coll. Exp. Sta. Bull.* 138:1-12.
3. MacDaniels, L. H. 1937. Some anatomical aspects of apple flower and fruit abscission. *Proc. Amer. Soc. Hort. Sci.* 34:122-129.
4. Nii, N. 1979. Fruit development in relation to the vascular anatomy of the fruit stalk in peach. *Studies of the Institute of Horticulture, Kyoto University*, 9:13-18. (Japanese).
5. Nii, N. 1980a. Seasonal changes in growth and enlargement of the Japanese pear fruit, *Pyrus serotina* cv. Chinsheiki, in relation to vascular bundle development in the pedicel and flesh. *J. Hort. Sci.* 55:385-396.
6. Nii, N. 1980b. The growth of citrus fruits, satsuma mandarin and hassaku, in relation to the development of tissue systems in the leaf and fruit stalk. *J. Jap. Soc. Hort. Sci.* 49:23-25. (Japanese).
7. Simons, R. K. and M. C. Chu. 1975. Spur/pedicel abscission in plum (*Prunus domestica* L. cv. Stanley) morphology and anatomy of persisting and drop fruits. *J. Amer. Soc. Hort. Sci.* 100:656-666.

Obituary:

DR. DONALD W. McKENZIE

Dr. Donald W. McKenzie (age 63) of Havelock North, New Zealand, was killed in an auto accident July 2, 1988. Don was widely known to the international apple industry for establishing a comprehensive collection of over 1000 apple varieties, his development and promotion of the central leader system of tree management and initiation of the New Zealand apple breeding program. He was responsible for the importation and evaluation of close to 2000 new apple types and from these evaluations such commercial cultivars as 'Gala,' 'Royal Gala,' 'Splendour' and 'Fuji' were introduced to the industry and continue to gain importance. Don McKenzie was known internationally and made many visits not only to the U.S. but also developed close research ties with Japan. He was a man of much patience and persistence always looking for ways of helping the apple industry and he will be remembered fondly by all those who knew him.