The Pollen Receptivity Period and Its Relation to Fruit Setting in the Stone Fruits

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There is little information in the literature pertaining to the length of time after anthesis that flowers of the stone fruits remain receptive to pollen. The available information indicates that receptivity decreases rapidly after anthesis. Bradbury (1), in Wisconsin, noted that the stigmas turned brown and began to wither 3 to 4 days after anthesis in *Prunus cerasus*. Eaton (23, working in Ohio and Ontario, found that the proportion of functional embryo sacs decreased rapidly after anthesis in Windsor sweet cherry *(Prunus avium)*. He obtained a much higher rate of fertilization from pollinations 1 day after anthesis than from pollinations 2 days after anthesis.

Pollination tests were conducted with apricot, peach and sweet cherry at Prosser, Washington, to determine how long fruit buds emasculated for making crosses in the breeding program could be successfully pollinated and to answer fruit growers' questions concerning the length of time flowers remain receptive to pollen after anthesis. Growers generally believe that a flower will not set fruit unless the weather is favorable for bee activity on the day it opens. Breeding crosses are usually pollinated within 1 or 2 days after the buds are emasculated. Pollination tests conducted at Prosser with Lambert sweet cherry in 1967 and Tilton apricot in 1969 were continued for only 5 days after day of anthesis. Contrary to expectation pollinations on the fifth day after anthesis resulted in as good fruit sets as pollinations on the first day.

Longer-running tests with sweet cherry in 1970 and 1971 were disrupted by spring frosts. Consequently, tests from 1972 to 1978 were conducted with trees enclosed in cloth-covered cages and protected by propane heaters.

The following cultivars were used for the pollination tests: J. H. Hale and Earlihale peaches; Goldrich, Rival and Prosser 63-265 apricots; Bing, Chinook and Lambert sweet cherries. J. H. Hale and Earlihale are pollen sterile. Goldrich, Rival, Bing, Chinook and Lambert are self-incompatible. The possibility of accidental self-fertilization was present only with Prosser 63-265 apricot.

The pollens used were compatible pollens of various other cultivars or numbered selections. The pollen was collected beforehand and kept in frozen storage until needed.

A cage consisting of a wooden framework covered with tobacco shade cloth was constructed around each tree that was to be hand-pollinated a few days before flowering began. The trees were disbudded when flowering had progressed in the point where large numbers of buds ready to open in the next 24 to 36 hours were present. All of the open flowers and immature buds were removed, and, except on a Bing tree in 1972, the buds that were retained were emasculated to aid in detecting buds that were overlooked during disbudding and to facilitate hand-pollination.

The next day was the day of anthesis for the emasculated buds. The first pollinations were made on the

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day after anthesis. One branch bearing 50 to 100 pistils was pollinated on each succeeding day. Apricot and peach pollinations were continued for up to 13 days. Sweet cherry styles begin to abscise approximately 7 days after anthesis; pollinations were discontinued when abscission became prevalent. One or 2 trees of each species were pollinated each spring in most years.

Fruit set was determined by counting the fruit remaining on each pollinated branch after the "June drop" had occurred and calculating % set. The end of the period of receptiveness of pistils to pollen was indicated by an abrupt decline in fruit set on most of the trees (Table 1). Means for years were not calculated because the resulting values obscure this sudden decrease in fruit set exhibited by individual trees. The day-to-day variations in fruit set during the period of pollen receptiveness are presumably due to natural variability in fruit set on different branches of a tree.

Apricot was pollinated in 1972, 1975, 1976 and 1978. The 1972 data were extremely variable (Table 1a). This probably was the result of injury to pistils caused by a frost that occurred during the flowering period. Nevertheless, the data show clearly that the

Table 1. Percentage fruit set on branches of individual trees from pollinations on successive days after anthesis; (a) in apricot, (b) in peach, (c) in sweet cherry.

Cultivar	Year of test	Days after anthesis +1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12	+13	Unpoll. check
a. Apricot															
Goldrich	1972	25	51	26	56	26	41	43	19						0
Goldrich	1972	12	63	38	53	49	35	44	32	0					0
Rival	1975	87	79	—	80	52	42	40							
P63-265	1976	86	83	89	85	75	65	74	34	6	5				6
Goldrich	1978	—	64	49	48	27	18	1	0	1	0				0
P63-265	1978	84	77	67	58	30	10	4	14	9	10				5
b. Peach															
J. H. Hale	1973	49	84	74	26	53	76	55	21	20	0				0
J. H. Hale	1973	67	71	61	67	56	51	65	26	32	28	10	2		2
Earlihale	1973	77	—	56	53	84	62	75	57	67	31	9	0		0
Earlihale	1973	87	—	80	74	67	72	58	81	43	7	2			0
J. H. Hale	1974	—	—	67	67	72	—	62	48	44	32	18	13	12	0
J. H. Hale	1974	—	—	59	70	76	—	66	47	35	43	21	21	10	0
Earlihale	1974	—	96	77	77	70	91	83	73	—	87	66	39		0
Earlihale	1974	—	81	89	51	86	87	91	85	—	73	48	68		0
J. H. Hale	1976	65	—	64	—	57	67	57	16	26	24	11	9	5	0
c. Sweet cherry															
Bing	1972	—	—	54	68	69	65	79	21	18	23	—	9		
Chinook	1973	79	16	—	71	58	53	13	1						
Bing	1973	—	81	75	69	61	23	0							0
Bing	1974	39	—	91	55	24	3	3	0						0
Bing	1974	—	—	62	48	31	0	0	0	2					0
Lambert	1975	57	52	57	57	58	54	25							1
Lambert	1978	28	12	33	31	20	37	2	1	1	1				1

pistils were receptive for 7 days after anthesis. The receptive period was 7 days in 1975 and 1976, also, but was only 4 days in 1978.

Peach was pollinated in 1973, 1974 and 1976. The receptive period of peach pistils ranged from 7 to 12 days (Table 1b). In both 1973 and 1974 Earlihale continued to have high fruit sets for 2 or 3 days longer than J. H. Hale. Also, the receptive periods of both Earlihale and J. H. Hale lasted approximately 2 days longer in 1974 than in 1973. The mean maximum temperatures during the pollination periods were 15.6°C in 1973 and 11.7°C in 1974. Pistil receptiveness may have been prolonged by the substantially cooler temperatures in 1974.

Sweet cherry was pollinated in 1972, 1973, 1974, 1975 and 1978. The pistils were receptive for 4 to 7 days (Table 1c). Pollination was discontinued when abscission of the styles became prevalent. The flowers pollinated in 1972 were not emasculated. Consequently, most of the fruits that set from pollinations on the eighth day and later may have developed from late-opening buds that escaped detection and removal.

In the 1978 tests fruit set was adversely affected by unidentified causes. Fruit set on the Lambert tree pollinated in 1978 was markedly lower than in previous years for the 6 days the pistils were receptive. A second tree pollinated in 1978 set almost no fruit (data omitted in Table 1). Reduced fruit set also occurred in 1978 cherry breeding crosses and in commercial cherry orchards. As stated above, the receptive period of apricot was exceptionally short in 1978. No climatic factor that could account for these effects was noted.

The prolonged periods of receptiveness of stone fruit pistils to pollen observed in this study may be due to the climate of this region during the flowering period of the stone fruits. They bloom from late March to mid-April at Prosser. Daytime temperatures are mild and the nights cold during this period. These conditions may be favorable for prolonging the viability of the embryo sacs.

Growers of stone fruits in eastern Washington and adjacent areas with similar climates experience poor set of fruit in some years. Sweet cherry growers are particularly vulnerable, because they need a high set in order to obtain a full crop. The long receptive period of individual blossoms and the extended flowering period of the trees provides ample opportunity for pollination to occur in most years, so it is unlikely that poor fruit set is due to inadequate pollination. Other factors that influence fruit set need to be examined for the cause of poor set of stone fruits in this region.

Literature Cited

1. Bradbury, Dorothy. 1929. A comparative study of the developing and aborting fruits of *Prunus cerasus*. *Amer. J. Bot.* 16:525-542.
2. Eaton, G. W. 1959. A study of the megagametophyte in *Prunus avium* and its relation to fruit setting. *Canad. J. Plant Sci.* 39:466-476.

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I certify that the statements made by me above are correct and complete. Loren D. Tukey, Business Manager, September 29, 1979.