Self and Cross Compatibility in Tetraploid Blackberry Cultivars

Julia L. Perry¹ and J.N. Moore²
Department of Horticulture and Forestry, University of Arkansas, Fayetteville, AR 72701

Abstract. No differences in percentage fruit set resulted from self or cross pollination in 8 tetraploid cultivars of erect blackberry (Rubus subgenus Eubatus), but 2 selections with diploid ancestry showed decreased fruit set from self-pollination. In some cultivars, self-pollination resulted in reduced fruit size and generally resulted in decreased seed number per fruit. Fluorescence microscopy showed no differences in rate or extent of pollen tube growth from self or cross pollen within blackberry styles. Caging experiments indicated that blackberries are not dependent on insects for pollination, but wind dispersal of pollen is important in securing uniform fruit set.

Self-incompatibility has been demonstrated in 11 of 23 Rubus species (4). A number of compatibility studies in the red raspberry, R. idaeus L., have been reported. Keep (4) found that wild clones of R. idaeus were largely self-incompatible, due to stylar inhibition of self-pollen tubes, but that nearly all British red raspberry cultivars were fully self-fertile. Zych (9) observed that several United States red raspberry cultivars also were self-compatible. Daubeney (2), however, reported a lower percentage of drupelet set when flowers of 7 red raspberry cultivars were self-pollinated in British Columbia.

In contrast to the several studies on red raspberry, very little information has been reported on the breeding behavior of the cultivated blackberry (Rubus (Tourn.) L. subgenus Eubatus). Detjen (3) reported that 11 cultivars of blackberry were self-fruitful, but 10 of 12 cultivars descended from dewberry were self-incompatible. Darrow (1) observed that wild blackberries of the eastern United States were entirely or nearly self-sterile, but that selections had been made which were productive when grown alone.

Interest in the commercial production of blackberries is increasing in the eastern United States (7). Many growers are using a monoculture system, although no reports are available on the self-compatibility of the new cultivars being planted. The objective of this study was to determine the breeding behavior of the blackberry cultivars currently being grown in the eastern United States.

Eight cultivars and 2 advanced selections were evaluated in 1979 and 1980 for cross- and self-compatibility. Potted plants were forced into bloom in a greenhouse in January of each year. Using the procedures of Ourceky (8), flowers were emasculated when buds reached full size, but before the petals separated. Pollen was applied by hand immediately after emasculation and again 2 days later. Each flower was labeled with date of pollination. 'Cheyenne' was used as the pollen donor in all cross-pollinations. 'Cherokee' was used to cross-pollinate 'Cheyenne'. Generally, 50 or more flowers on each cultivar were pollinated with each type (self or cross) of pollen.

In vivo pollen tube growth in styles was observed by fluorescence microscopy, using the procedures of Martin (6). Flowers for this study were emasculated, pollinated by hand, and covered with paper bags to prevent pollen contamination. After 48 hr, the bags were removed and the aggregate of pistils fixed in 1 formalin: 8 ethanol: 1 acetic acid (by volume) for later staining. Cross- and self-pollinated flowers from each of 10 cultivars were examined for rate and extent of pollen tube growth and for any indication of pollen tube inhibition within the style.

The method of natural pollination was determined by comparing fruit size and seed set resulting from 3 treatments: 1) plants grown in a greenhouse in the absence of wind and insects; 2) field grown plants enclosed in 18 mesh screen cages and sprayed with insecticides to allow only wind to be a factor.

Received for publication 1 Oct. 1984. Published with approval of the director, Arkansas Agr. Expt. Sta. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked advertisement solely to indicate this fact.

¹Present address: Fruit Crops Dept., Univ. of Florida, Gainesville, FL 32611.
²Professor of Horticulture.

Literature Cited

Fig. 1. Effect of cross- and self-pollination on the percentage of fruit set of blackberry cultivars.
in pollination; and 3) field grown plants exposed to both wind and insect pollination. Four replications of 'Cheyenne' were used for each treatment, and 40 fruits from each replication were weighed, and seed numbers were determined.

No significant differences in percentage fruit set from cross or self pollination occurred in the named cultivars (Fig. 1). Only the selections, A-577 and A-593, showed a decreased set in self-pollinated flowers. A-577, resulting from a cross of 'Whitford Thornless' × 'Early Harvest', was the only diploid clone in the test. Although A-593 is tetraploid, it originated from the cross 'Brazos' (4x) × 'Hillquist' (2x) and apparently resulted from an unreduced gamete of 'Hillquist'. Thus, the only clones in the study that exhibited self-incompatibility were from diploid ancestry. Most of the cultivars responded similarly in percentage fruit set following cross-pollination, although 'Wells Beauty' showed somewhat less fruit set than the other cultivars.

Although pollen source did not affect percentage fruit set in most cultivars, self-pollination reduced average fruit weight in several cultivars (Fig. 2), most notably A-577, 'Dallas', 'Humble', and 'Wells Beauty'. Little or no reduction occurred in other cultivars. 'Cheyenne' produced significantly smaller fruit when pollinated by 'Cherokee' than when self-pollinated, but this effect was not apparent in fruit set. Lawrence (5) noted that pollen source in blackberry combinations appears to be important in drupelet set.

Self-pollination resulted in reduced seed number in fruits of most cultivars (Fig. 3). Notable exceptions were 'Cheyenne' and 'Womack', in which seed number in self-pollinated fruits was as great or greater than in cross-pollinated fruits.

Microscopic observation of pollen tube growth through the styles of blackberry flowers using fluorescence techniques showed no difference in rate or extent of growth between cross or self-pollens. Pollen tubes from both pollen sources grew the full length of the styles and into the ovary region during the 48 hr incubation period.

A comparison of fruit size and seed number from open pollinations in a greenhouse, open field, and insect-excluded field cages showed that blackberry flowers are not dependent on insects for pollination (Table 1). Caged plants produced larger fruits with more seeds than uncaged plants, but this may have been due to lower temperatures from shading whereas the uncaged field plots were exposed to unseasonably high temperatures in 1980. The small fruits with few seeds produced by greenhouse grown plants likely resulted from inadequate pollen dispersal within the flower. Fruits produced on these plants were malformed, indicating a lack of pollination of all pistils in the aggregate flower.

**Table 1.** Effect of method of pollination on fruit size and seed number in 'Cheyenne' blackberry.

<table>
<thead>
<tr>
<th>Location of plants</th>
<th>Fruit size (g)</th>
<th>Seeds per fruit (no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-caged</td>
<td>4.73 a</td>
<td>59.2 b</td>
</tr>
<tr>
<td>Field-open</td>
<td>3.86 b</td>
<td>45.9 b</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>2.95 c</td>
<td>27.7 c</td>
</tr>
</tbody>
</table>

'Mean separation in columns by Duncan’s multiple range test, 5% level.

**Fig. 2.** Effect of cross- and self-pollination on mean fruit weight of blackberry cultivars.

**Fig. 3.** Effect of cross- and self-pollination on seed number in fruits of blackberry cultivars.


### Inoculation Methods for Evaluating Verticillium Wilt Resistance in Strawberry Germplasm

**J.L. Maas, A.D. Draper, and G.J. Galletta**

*Fruit Laboratory, Horticultural Science Institute, Beltsville Agricultural Research Center, ARS, USDA, Beltsville, MD 20705*

**Additional index words.** inoculum potential, varietal reaction, *Fragaria × ananassa*

**Abstract.** Four methods of inoculation with *Verticillium* were tested for effectiveness in infecting strawberry plants grown in a greenhouse bench. The most severe and early symptoms were produced with a macerated mycelium root dip inoculum. Effect of inoculum aggressiveness on the extrapolation of plant resistance information is discussed.

The USDA strawberry (*Fragaria × ananassa Duch.*) breeding program has emphasized for many years *Verticillium* wilt resistance as a criterion for cultivar development. In the past, we used field screening tests to determine levels of *Verticillium* wilt resistance in advanced selections. However, in the past 5 years we have developed a satisfactory method to screen plants in a greenhouse bench test in which plant and pathogen interactions can be controlled better than in field plots (2). Concerns with the greenhouse bench test have included the suitability of the type of inoculum used, its method of application to the plants to be tested, and the var...