Blackberry Pollen Sterility Associated with Merton Thornless Germplasm[1]

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Merton Thornless is the most important source of genetic thornlessness for tetraploid blackberry breeding programs. As a source of thornlessness, however, it has several drawbacks, including an ability to transmit sterility to a high percentage of its progeny (4). Although Merton Thornless is fully self-fertile, it was derived from a backcross of John Innes to a partially fertile thornless seedling of John Innes (4). Sterility associated with crosses involving Merton Thornless was one of the major problems encountered early in the USDA thornless blackberry breeding program (3, 4). Many backcross, F_1, and F_2 progeny of Merton Thornless failed to blossom, and a high incidence of partial sterility existed in those that did blossom (4). Selection of fully fertile thornless progeny was accomplished, however, and 5 cultivars have been originated by the USDA (1, 2, 3). Several of the USDA thornless cultivars and selections have been used as a source of thornlessness in the Arkansas blackberry breeding program.

In the USDA blackberry breeding program fertility was evaluated by rating open-pollinated fruit set (4). Such a rating examines only embryosac fertility under the conditions of cross-pollination which exist in the breeder's nursery. Although pollen sterility is not a problem in the USDA cultivars, it has been observed in the thornless blackberry breeding program at the University of Arkansas. This study was initiated to examine pollen production and fertility among breeding lines in the Arkansas blackberry breeding program.

Materials and Methods

Sixty-nine tetraploid blackberry selections and cultivars were examined for pollen production and self-fertility during the bloom period of 1983. The blackberries tested included: 23 thornless and 15 thorny Arkansas selections, 5 thornless USDA selections, 3 thornless USDA cultivars (all having Merton Thornless in their ancestry) and 19 thorny Arkansas selections and 4 thorny cultivars (which do not have Merton Thornless as an ancestor). Both groups of blackberries have similar genetic backgrounds aside from the Merton Thornless contribution.

Pollen production was evaluated by collecting 25 flowers of each clone just prior to anthesis. Anthers were removed from the flowers with a scalpel and air-dried on a sheet of white paper. The amount of pollen released from the anthers was evaluated visually with a 5X hand lens after 48 hours and given a subjective rating of good, fair, or poor.

Self-fertility of the blackberry clones was tested by securing a white paper bag over a single cluster of unopened flower buds on each clone. Each bag was shaken at least 2 different times during the bloom period to assist in pollen dispersal. Self-fertility was evaluated by examining fruit set of the bagged clusters approximately 2 weeks after bloom. Each clone was given a fruit-set rating of good, fair, or poor. Because conditions for good pollination and fruit set are not ideal within the paper bag, there were often different degrees of fruit set among the berries of a cluster. A fruit-set rating of good was given when at least

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Table 1. Pollen production and self-fertility of tetraploid blackberry selections and cultivars.

Merton Thornless Ancestry			Thorny Ancestry		
Clone	Pollen Production	Self Fertility	Clone	Pollen Production	Self Fertility
A-1270*	Fair	Good	A-1091	Good	Good
A-1264*	Fair	Good	A-1012	Good	Good
A-1261	Good	Good	A-955	Good	Poor
A-1236*	Good	Poor	A-923	Good	Good
A-1235*	Fair	Poor	A-916	Fair	Good
A-1231	Good	Good	A-897	Good	Good
A-1196*	Poor	Poor	A-878	Good	Poor
A-1194*	Good	Good	A-871	Good	Good
A-1193*	Good	Good	A-795	Fair	Good
A-1192*	Good	Good	A-724	Good	Good
A-1187	Poor	Poor	A-708	Good	Good
A-1173	Poor	Poor	A-687	Good	Good
A-1172*	Good	Fair	A-672	Good	Good
A-1166	Poor	Good	A-665	Good	Good
A-1159*	Fair	Good	A-618	Good	Good
A-1157	Fair	Good	A-606	Good	Good
A-1154*	Good	Good	A-593	Good	Good
A-1153*	Poor	Poor	A-548	Good	Good
A-1152*	Good	Fair	A-546	Good	Good
A-1151*	Good	Good	Cherokee	Good	Good
A-1150*	Poor	Poor	Comanche	Good	Good
A-1149*	Good	Good	Cheyenne	Good	Good
A-1144	Good	Good	Brazos	Good	Good
A-1141*	Good	Good			
A-1140	Good	Good			
A-1139	Good	Good			
A-1138	Good	Good			
A-1137	Good	Good			
A-1134	Good	Good			
A-1133	Good	Good			
A-1132*	Poor	Good			
A-1131	Good	Good			
A-1130*	Fair	Good			
A-1128*	Poor	Good			
A-1125*	Fair	Good			
A-1098*	Good	Good			
A-1011*	Fair	Poor			
A-998	Poor	Good			
SIUS 68-6-15*	Fair	Fair			
SIUS 68-6-16*	Good	Good			
SIUS 68-1-8*	Good	Good			
SIUS 68-1-7*	Good	Good			
SIUS 64-21-10*	Good	Good			
Thornfree*	Good	Good			
Smoothstem*	Good	Good			
Black Satin*	Good	Good			

*Thornless.

one fruit had set a full complement of drupelets. Clusters having no fully set berries but several with at least half the drupelets set were given a fair rating. Clusters were rated poor when all of the fruit had less than half of the drupelets set.

Results and Discussion

Pollen production was variable among clones having Merton Thornless as an ancestor (Table 1). Twenty-eight of these clones were rated good, 9 were rated fair, and another 9 rated poor. In contrast, 21 clones that do not have Merton Thornless in their ancestry had good pollen production, and only 2 were rated fair. Thus, it appears that pollen production could be a factor in the sterility associated with Merton Thornless germplasm.

The subjective rating of pollen production, however, does not by itself conclusively demonstrate male sterility. More direct evidence is given by comparing self-fertility to open-pollinated fruit set. Five of the 9 clones with poor pollen production were also rated poor for self-fertility. In addition, 2 of the thornless clones with fair pollen production (A-1011 and A-1235) and 1 with good pollen production (A-1236) had poor self-fertility. All clones except A-1173 had good fruit set when open-pollinated. This selection appears to be partially female sterile as well as pollen sterile. Only 2 selections of thorny ancestry (A-878 and A-955) were rated poor for self-fertility. Both of these selections produced abundant pollen and observations indicate that severe disease infections may have been the cause of poor fruit set in these selections.

Examination of pedigrees revealed that 3 pairs of full-sibs were among the 8 pollen-sterile selections with Merton Thornless ancestry. Also, 1 full-sib pair had a parent previously identified as partially sterile. Therefore, it is evident that pollen sterility is associated with germplasm derived from Merton Thornless and may actually be linked to the thornless character. Genetic analysis will be necessary for confirmation of linkage between thornlessness and pollen sterility.

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