Longevity of *Rubus* Seeds after Long-term Cold Storage

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Abstract. Seeds of 25 blackberry (*Rubus* spp.), five red raspberry (*R. idaeus* L.), and two black raspberry (*R. occidentalis* L.) populations that had been stored for 22 to 26 years were planted in the greenhouse to evaluate their germination. Germination ranged from 0% to 84% among all populations. Thorny and thorny x thornless blackberry populations had the highest average germination; most populations had >40% germination. Thornless blackberry populations ranged from 1% to 16% germination. The seeds of two of the five red raspberry populations did not germinate and none of the black raspberry seeds germinated.

A seed longevity classification proposed by Ewart (1908) included the following groupings: microbotic (<3 years), mesobiotic (3 to 1.5 years), and macrobotic (15 to 100 years). More recently, Hartman and Kester (1975) divided seed longevity into short-lived (storable for a few days to almost 1 year), medium-lived (storable for 2 to 1.5 years), or long-lived (storable 1.5 to 20 years or more). Galletta (1975) classified the seeds of temperate fruit as usually long-lived, especially if stored in dry, cold conditions and sealed to maintain low relative humidity and freedom from pests. Strawberry achenes have germinated as well after 23 years as after 1 year of storage at 4.5C (Scott and Draper, 1970). Blueberry seeds also have been stored successfully for at least 20 years (Galletta, 1975). Priestly (1986) cited a 1834 report in which raspberry seeds were found in a "hardened mass of fecal matter" in an excavated tomb, probably dating to pre-Roman times. A few wild raspberry plants were produced from these seeds. Heit (1967) found that blackberry seeds germinated for several years without prior treatment. Blackberries were much more difficult to germinate than raspberries.

Research on *Rubus* seed (pyrene) handling mainly has focused on scarification because germination is inhibited by the hard endocarp of *Rubus* spp. (Ourecky, 1975). Seed scarification usually is done using sulfuric acid for 15 to 20 min for raspberry (*R. idaeus* L., *R. occidentalis* L.) (Jennings and Tullock, 1965;

Scott and Ink, 1957) and up to 3 h for blackberry (*Rubus* spp.) (Moore et al., 1974). Scarified seeds also must be stratified for 3 to 4 months at 2 to 5C to complete after-ripening (Ourecky, 1975). Our study was undertaken to evaluate the longevity of blackberry and raspberry seeds stored long term.

Seeds used in this study had been stored dry 22 to 26 years at 4 to 5C in sealed containers. Seeds had been collected from open-pollinated (OP) or controlled-pollination fruit representing populations of two black raspberry, five red raspberry, and twenty-five blackberry populations (Table 1). The seeds were removed from storage in Aug. 1991 and scarified with technical-grade sulfuric acid: blackberries were scarified for 3 h and raspberries for 30 min (Moore et al., 1974). After scarification, the seeds were rinsed for 5 min under running water, dipped for 5 min in a solution containing an excessive concentration of sodium bicarbonate, and rinsed again. The seeds were packed in sealed containers with moist potting soil (Promix BX, Premier Brands, New Rochelle, N.Y.) and stored for 4 months at 4C. Four replications of 50 seeds/population were sown in Dec. 1991 on the surface of moist potting soil (same brand as for storage) and covered lightly to allow exposure of the seeds to light (Scott and Draper, 1967). Greenhouse conditions during germination were natural daylength and a minimum/maximum of 18/24C. Seedlings were counted and removed from the medium weekly until 13 May 1992 (≈5 months). Data were tested by analysis of variance and means were separated by Duncan's multiple range test.

Germination ranged from 0% to 84% among the populations tested (Table 1). Most of the thorny (76%) and thornless x thorny

Table 1. Germination of *Rubus* seeds after long-term storage.

<i>Rubus</i> type	Seed parent	Storage duration (yrs)	Germination (%)
Thorny blackberry	Wells Beauty OP ^a	22	84 a ^y
	Wells Beauty OP	23	78 ab
	Dallas OP	23	78 ab
	Brazos OP	23	70 bc
	Dallas OP	22	67 cd
	Humble OP	23	63 cd
	Ranger OP	23	59 d
	Ebony King OP	23	59 d
	Bailey OP	23	58 d
	Midnight OP	23	48 e
	Hedrick OP	23	46 ef
	Darrow x Brazos	25	44 ef
	Darrow x Ranger	25	42 ef
	Ebony King OP	22	40 ef
	Lawton OP	23	38 f
	Lawton OP	22	29 g
	Ranger OP	22	14 h
Thorny x thornless blackberry	Thornfree x Ranger	25	61 cd
	Thornfree x Darrow	25	49 e
	US 1452 x Ranger	25	4 j
Thornless blackberry	SIUS 62-8-1 OP	26	16 hi
	SIUS 62-31-3 OP	26	9 ij
	SIUS 62-15-1 OP	26	8 ij
	SIUS 62-31-2 OP	26	5 j
	SIUS 62-27-1 OP	26	1 j
Red raspberry	<i>R. parvifolius</i> ^a	26	22 gh
	<i>R. phoenicolasius</i> OP	26	8 ij
	Ark. 7-9-4 OP	26	1 j
	Mandarin OP	26	0 j
	Ark. 1-8-4 OP	26	0 j
Black raspberry	Iowa 17-15 OP	26	0 j
	Wild black raspberry	26	0 j

^aOP = open pollinated.

^yMean separation by Duncan's multiple range test ($P \leq 0.05$).

^aArk. 57-4-4 OP.

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(67%) blackberry populations had >40% germination. The thornless blackberry populations ranged from 1% to 16% germination. Of the red raspberries, *R. parvifolius* Hemsl. and *R. phoenicolasius* Max. seeds had the highest germination percentage. The seeds of two red raspberry populations did not germinate. None of the black raspberry seeds germinated.

The germination reported here is higher than that reported by Moore et al. (1974) for nonstored seeds of similar genetic background. In their study, 'Comanche', a 'Darrow' x 'Brazos' hybrid, had 32%, 'Brazos' OP 7.5%, and 'Darrow' OP 7.2% germination. In our study, 'Darrow' x 'Brazos' had 44% and 'Brazos' OP 70% germination after 25 and 23 years of storage, respectively. The thornless blackberry OP populations had much lower germination overall than the thorny populations, an occurrence that is common in breeding thornless blackberries (J.N.M., unpublished data). Overall, the findings here are valuable to those interested in breeding blackberries or

maintaining blackberry germplasm. Long-term seed storage seems to be a viable method of maintaining blackberry germplasm, with highest success for thorny populations.

Except for *R. parvifolius* and *R. phoenicolasius* red raspberries, raspberry germination percentage was very poor. This could have been due to a loss of viability during storage, overscarification, or some other factor. A larger group of red and black raspberry genotypes needs to be studied before conclusions can be drawn on the longevity of their seeds in storage.

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