Four 'Summerland Crab' Pollinizers

W. David Lane, M. Meheriuk, and R.A. MacDonald

Research Centre, Agriculture and Agri-Food Canada, Summerland, B.C.
V0H 1Z0, Canada

Additional index words. *Malus floribunda*, *Malus baccata*, crabapple, nectar, flower characteristics

These four crabapple cultivars are being introduced because of their suitability as pollinizers for fruiting apple cultivars. Crabapple pollinizers can simplify orchard management when blocks of a single fruiting cultivar are grown and when no suitable fruiting cultivar blooms at the appropriate time to pollinate the primary cultivar. They are useful as pollinizers for triploid cultivars and for increasing pollinizer density in existing orchards because they can be planted in the same rows as bearing trees. Goldschmidt-Reischell (1993) and Ngeki et al. (1982) have reported on the evaluation of ornamental apple cultivars for pollination.

The four pollinizer cultivars are named 'Summerland Crab One', 'Summerland Crab Two', 'Summerland Crab Three', and 'Summerland Crab Four'. 'Summerland Crab One' and 'Summerland Crab Two' bloom before 'Summerland Crab Three' and 'Summerland Crab Four'. The four provide a bloom period sufficient to pollinate all cultivars in the apple collection at Summerland, B.C. Their duration of pollen availability is longer than that of most fruiting cultivars. 'Summerland Crab One', 'Summerland Crab Three', and 'Summerland Crab Four' are *Malus floribunda* Sieb. seedlings. 'Summerland Crab Two' is a *Malus baccata* (L.) Borkh. seedling.

Origin

Open-pollinated seed was collected from mature trees of three crabapple cultivars in the collection at Summerland: 'Makamik' and 'Van Eseltine' (*M. floribunda*) and an *M. baccata* seedling. These seed parents were chosen because they flowered prolifically and had medium-sized flowers with petals upturned to form a cup shape, synchrony between flower (petal) opening and anthesis, and an upright tree growth habit.

Seed collected in Fall 1979 was stratified and germinated the following spring. Seedlings were grown in the greenhouse until ≈ 30 cm tall and then transplanted to a nursery. The population of 3000 seedlings consisted of about equal numbers of plants from each seed source. Plants were spaced 20 cm apart in the nursery rows and trained to a single shoot to avoid

crowding and to overcome juvenility quickly. Most seedlings bloomed in their fourth leaf. The 24 most desirable seedlings were selected from this population and transplanted to a field where they were evaluated in more detail. An additional 10 trees of each of these 24 selections were propagated on M.26 rootstock and planted in a separate field at the station. The seedling selections (transplanted from the nursery) were observed for three subsequent years. The four best selections were observed on M.26 in their third and fourth leaf and subsequently less formally at Summerland and in several grower orchards.

Description

The 'Summerland Crabs' were selected for their pollen availability period and suitable flower and tree characteristics. All the cultivars are vigorous, but 'Summerland Crab One' was significantly larger in trunk cross-sectional area than the others (Table 1). All selections are upright and all bloom on 1-year-old wood. They flower annually (8 years of observations) at nearly every node and spur. 'Summerland Crab One' fruit is pale purple and ≈ 2 cm in diameter; 'Summerland Crab Two' is red with a yellow ground color and 1.5 cm in diameter; 'Summerland Crab Three' is pale red and 1 cm in diameter; and 'Summerland Crab Four' is red and 1 cm in diameter.

Resistance to common leaf pathogens is not fully known, but no significant levels of mildew or other leaf pathogens were observed at Summerland where a spray program recommended for local orchards was followed. The seed parent cultivars of the 'Summerland Crab' pollinizers are known to be cold hardy. 'Makamik' is a common ornamental on the Canadian prairies. 'Van Eseltine' was developed at the New York Agricultural Experiment Station and survives at Ottawa, Ont. Most *M. baccata* seedlings are hardy. None of the 'Summerland Crabs' were injured at Summerland by -28°C in Dec. 1990. Their chilling requirements have not been determined.

Pollen availability

The Crab pollinizer cultivars provided pollen coincident with the bloom periods of commercially important cultivars (Fig. 1). Availability of pollen was determined by flagging three branches per cultivar and examining and counting flowers with pollen every 2 or 3 days, depending on the rate of opening. There were 86 to 281 flowers per branch. Branches chosen

were nonshaded 1- and 2-year-old wood, oriented upward. The criterion for pollen availability from a flower was the presence of one or more dehiscent anthers with healthy pollen. The 'Summerland Crab' pollinizers had pollen available when petals first opened. Attractiveness to bees was judged to be equal to or better than that of nearby fruiting trees after numerous observations of bee activity. Commercial testing has confirmed the effectiveness of the 'Summerland Crabs' as pollinizers in local orchards.

Seedlings with large spreading petals were rejected since they could be used as landing platforms by side-feeding bees (*Apis mellifera* L.), resulting in reduced pollination. The 'Summerland Crabs' have medium-sized flowers (Table 2) and are cup-shaped to ensure that bees land on the anthers. Seedlings with double flowers were avoided because a high filament count, of ≈ 40 per flower, restricted the space within the receptacle where nectar could accumulate and appeared to reduce bee access to the nectar.

Total sugar quantity ranged from $\approx 180\ \mu\text{g}$ to nearly $500\ \mu\text{g}$ per flower (Table 3). A large sugar quantity was considered desirable and selections with low quantities were deleted. Quantity of sugars was determined by collecting 10 newly opened flowers at 1400 HR on four consecutive days. Petals and anthers were removed and the receptacle washed with 80% ethyl alcohol (2.0 ml/flower). The 25-ml sample collected from the 10 flowers was evaporated to 2 ml and then analyzed for glucose, fructose, and sucrose using gas chromatography (Meheriuk et al., 1987). Work by Meheriuk et al. (1987) showed 'Crab Two' to have a nectar content similar to that of 'Golden Delicious' and higher than other crabapples tested ('Crab Two' is selection 1-1 in Table 2 of the published paper). 'Crab Two' continued to have a high nectar sugar content in the present study (Table 3).

Pollen stainability was determined by hydrating pollen in 10% sucrose containing 2% toluidine blue. Large symmetrical grains were considered fertile and small asymmetric ones infertile. Counts were in the 80% to 90% stainability range from pollen samples collected in 1989 and 1990 (Table 3). Three samples of 500 to 700 pollen grains were counted each year. Percent stainability of pollen from other cultivars was 58, 82, 96, 86, and 78 for 'McIntosh', 'Sinta', 'Jonafree', 'Jonagold', and 'Manchurian', respectively.

Pollen of the four 'Summerland Crabs'

Table 1. Tree characteristics of the 'Summerland Crab' pollinizers. Data are the average values of 8 to 10 trees propagated on M.26 rootstock in their eighth leaf.

Crab cultivar	TCSA ^a	Leaf color	
		Young	Mature
One	27.2 a ^b	Red	Green
Two	11.9 c	Green	Green
Three	15.8 bc	Green	Green
Four	19.4 b	Green	Green

^aTrunk cross-sectional area (square centimeters).

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

Received for publication 18 Oct. 1994. Accepted for publication 23 Mar. 1995. Summerland Research Centre Contribution no. 723. 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.

Fig. 1. Bloom duration and peak bloom of 'Summerland Crabs' One to Four. The beginning and end of the bloom range diagram indicates the time when open bloom with adequate pollen availability equalled 20% or more of the flower count on the day with the most open flowers. Fewer flowers were available for pollination before and after this time. The widest point on the diagram indicates the day with maximum pollen availability, e.g., open flowers. The primary pollination interval for fruiting apples was 4 days in 1986 (a year with a long bloom period) and only 3 days in 1987. The beginning of the diagram corresponds to bloom availability as follows: 'McIntosh', 40% (side blooms open); 'Golden Delicious', 20%; 'Spartan', 40%; 'Delicious', 5% of flowers open. These were chosen to match the most favorable pollination time for each cultivar.

Table 2. Flower characteristics of the 'Summerland Crab' pollinizers.

Crab cultivar	Color		Flower ^z		
	RHS ^y	Description	Anthers/flower	Diam (cm)	No./cluster
One	52D	Pink	15.6	2.4	4.8
Two	White	White	20.0	2.3	6.0
Three	49D	White	20.3	2.5	6.9
Four	50C	Pale red	19.5	2.6	5.4

^zAverage of 20 flowers.

^yRoyal Horticulture Society Colour Chart.

Table 3. Pollen stainability and sugar content of 'Summerland Crab' pollinizers. Average of composite samples of 10 flowers each collected on four consecutive days from each cultivar.

Crab cultivar	Pollen stained (%)	Sugar (mg/10 flowers)			
		Glucose	Fructose	Sucrose	Total
One	88	0.38	0.23	1.23	1.84
Two	89	1.49	1.30	1.94	4.73
Three	81	0.52	0.43	1.00	1.95
Four	85	0.72	0.58	2.32	3.62

was applied to emasculated flowers of 'McIntosh', 'Delicious', 'Golden Delicious', 'Jonagold', and 'Sinta' in two successive years. Fruit set was normal (data not shown), based on our experience with other controlled crosses.

Flower color was considered during the selection process because bees are unresponsive to portions of the visible spectrum (McCrea and Levy, 1983). Color criteria for the Crab pollinizers were based on the results of Kendall and Smith (1975). They documented bee constancy with 'Cox's' as the fruiting cultivar and grafts of three crabapples varying in color from crimson [*M. aldenhamensis* (Gibbs)] to red [*M. floribunda* 'Hillierii') to white [*M. sieboldii* (Reg.) 'Golden Hornet']. Their results indicated a constancy to cultivars of similar color of $\approx 60\%$ for bees first observed on red 'Hillierii' or white 'Golden Hornet', but stronger constancy of $\approx 95\%$ for bees first observed on crimson *M. aldenhamensis*. Since commercial cultivars are white or pink, seedlings with crimson, maroon, and other dark colors were rejected, and only pale red, pink, or white crabs were considered in our selection procedure. Mayer et al. (1989) stated that honeybees, but not bumblebees (*Bombus* sp.), and anthophorid bees exhibit a constancy to cultivars based on flower color (particularly blue reflectance) and shy away from white-flowered or white/pink cultivars (commercial cultivars) if working crimson, red, rose, or pink-colored but not white crabapple cultivars. These results differ from those of Kendall and Smith (1975), who found the bees response to white and red cultivars to be equal but less constant than to crimson.

Availability

Limited quantities of virus-free scionwood for testing and foundation stock is available from the Plant Improvement Co., c/o Research Centre, Agriculture and Agri-Food Canada, Summerland, B.C. V0H 1Z0, Canada, or from the authors.

Literature Cited

- Goldschmidt-Reischel, E. 1993. Use of ornamental apples for pollination of dessert cultivars. *Acta Agr. Scandinavica Sect. B. Soil & Plant Sci.* 43:176-180.
- Kendall, D.A. and B.D. Smith. 1975. The foraging behavior of honey bees on ornamental *Malus* spp. used as pollinizers in apple orchards. *J. Appl. Ecol.* 12:465-471.
- Mayer, D.F., C.A. Johansen, and J.D. Lander. 1989. Honey bee foraging behavior on ornamental crabapple pollinizers and commercial apple cultivars. *HortScience* 24:510-512.
- McCrea, K.D. and M. Levy. 1983. Photographic visualization of floral colors as perceived by honeybee pollinators. *Amer. J. Bot.* 70:369-375.
- Meheriuk, M., W.D. Lane, and J.W. Hall. 1987. Influence of cultivar on nectar sugar content in several species of tree fruits. *HortScience* 22:448-450.
- Ngeki, J., M. Soltesz, M. Toth, F. Gyuro, and A. Terpo. 1982. Possibilities of pollinating single variety orchards with *Malus* species. *Acta Agron. Acad. Sci. Hungaricae* 31:252-256.
- Royal Horticulture Society. 1986. Royal Horticulture Society colour chart. Royal Hort. Soc., London, Flower Council of Holland, Leiden.