1981 Bregger Student Essay Award Winning Paper:

Rubus arcticus L., the Arctic Raspberry

PATRICIA S. HOLLOWAY[1]

Rubus arcticus L., the arctic raspberry or nagoonberry is recognized widely in northern regions of the world for the unique flavor and aroma of its fruit. The berries are processed into soft drinks, liqueurs and preserves in the Scandinavian countries, the Soviet Union and Alaska. Research into cultivation and plant improvement has occurred for nearly fifty years particularly in Finland.

R. arcticus L. is a member of the *Cylactis* subgenus of the family Rosaceae. It is considered by Hultén (4) to be a single species with three subspecies, *arcticus, acaulis* (Michx.) Focke and *stellatus* (Sm.) Boiv. emend. Hult. Others (1, 6) recognize these as three separate species with *R. stellatus* Sm. being a possible hybrid between the other two species (6). Welsh (12) prefers the single specific designation, *R. arcticus* L., with no subdivisions. He maintains that the criteria used for dividing the species such as petal width, sepal pubescence and shape, flower number and plant height occur in "haphazard recombinations" throughout the range of the complex. Despite the nomenclatural confusion most authors recognize three groups which differ not only in the characteristics listed by Welsh (12) but also in fruit quality and geographic distribution. Only plants of the *arcticus* group exhibit the commercially desirable berry flavor and aroma (8).

The *arcticus* group of arctic raspberries is distributed throughout subarctic Eurasia primarily between 60° and 70°N latitude in Europe and betwen 50° and 70°N latitude in Asia (5, 6, 9). In North America it is native only to Alaska and the Yukon Territory (4). The *acaulis* group is found in Canada primarily between 50° and 60°N latitude and in Alaska. Plants of the *stellatus* group grow in the southern half of Alaska, the Yukon Territory and throughout the Aleutian Islands and Kamchatka. Plants of each group hybridize readily wherever their ranges over-lap (4, 5, 9).

Wild populations of arctic raspberries grow abundantly in bogs, wet meadows and open spruce-hardwood forests. In addition, large populations are found in burned or cleared areas and along streams and ditches. Common features of all habitats include little or no shade and a moist substrate with a high organic content (9).

R. arcticus produces herbaceous stems up to 35 cm, high from rhizomes or slender crowns (1). The leaves are 3-foliate and resemble young strawberry leaves. The slender, upright stems support 1 to 3 pink flowers, each of which may contain up to 45 carpels. The fruit consists of numerous pale-red drupelets, 0.8 to 1.4 cm in diameter, which are often difficult to separate from the calyx and receptacle when ripe (1, 6). Fruit production in the wild is limited by poor pollination and self incompatibility (10).

Plants of the *acaulis* and *stellatus* groups resemble *arcticus* plants except for a smaller stature (1 to 10 cm. high) and a single flower per stem. The growth habit of *acaulis* and *stellatus* plants resembles that of a strawberry with several short, leafy stems originating from a crown. The single flower often is hidden beneath the foliage. *Arcticus* plants on the other hand, more closely resemble the cul-

[1]Graduate Student, Department of Horticulture, University of Minnesota, St. Paul, MN 55108.

tivated raspberry with single, elongate stems originating from rhizomes and flowers fully exposed at the stem apex (1, 6, 9).

In Scandinavia the arctic raspberry blooms from late-May through July with maximum flowering occuring in June. Fruit begins to ripen in July and continues through September and sometimes into October (9). In Alaska this period is much shorter with full bloom occuring in June and maximum fruit ripening in August (5).

Carl von Linné first cultivated the arctic raspberry in 1762, but intensive efforts at plant improvement did not begin until 1933 in Finland at the North Savo Agricultural Experiment Station at Maaninka (63°N latitude) (9). Research has also been reported from Sweden and the Soviet Union, but cultural practices rather than plant breeding and selection have been emphasized (9).

In Finland plants initially were collected from wild populations located throughout the country. Two selections from these populations were clonally propagated and released as the cultivars Mespi and Mesma in 1972. Commercially Mespi has been considered more important for fruit production while Mesma has been used as the pollinator (8).

These cultivars exhibited several undesirable features including low productivity, small fruit size and a protracted fruiting season. In addition, strong adherence of the drupelets to the receptacle and calyx made harvesting very difficult (3). Efforts to eliminate some of these characteristics led to crosses between *R. arcticus* and *R. idaeus* L., the specific purpose being to capture the flavor and aroma components of the arctic raspberry while maintaining the growth habit and productivity of the cultivated raspberry (3, 6). Only one plant resulted from repeated hybridization attempts. It was intermediate morphologically between the parents, exhibiting spineless, annual shoots reaching 50 cm. in height and large pink flowers. The leaves were similar to the raspberry only less coarse, smaller and thinner (3). The flowering season was much longer and flowers more abundant than either of the parent species (11), and the typical *arcticus* flavor and aroma were not captured fully in this single F_1 plant (2). This plant and its progeny were given the name nectarberry or nectar raspberry (3).

The best selection from the F_3 population was released as the cultivar Merva in 1965. Merva exhibited extremely low fruit productivity and was consequently not released for commercial production. Merva was further crossed with *R. idaeus* cv. Malling Promise and a selection was released as the cultivar Heija in 1975. Heija resembled the cultivated raspberry in vegetative and reproductive morphology and growth habit, and the *arcticus* flavor and aroma hardly was perceptible (3).

Breeding work is continuing in Finland with an emphasis on backcrossing different generations of the *R. idaeus* x *arcticus* hybrid with other *R. idaeus* cultivars (3). The primary hindrance to this breeding program is the substantial loss of the unique *arcticus* flavor and aroma in the progeny. This is not surprising considering that approximately 60 different components constitute berry flavor (2, 3), and sterility barriers prevent the recovery of recombinants in the F_1 generation.

In order to avoid this problem, but also obtain larger fruit size and greater productivity Larsson (7) attempted to induce polyploidy in *R. arcticus* by soaking seeds in a 0.5 percent colchicine solution. Tetraploids were obtained which had larger but fewer drupelets per fruit. Larsson recommended that these plants be incorporated into future breeding programs, but to date, further research has not been reported.

Literature Cited

1. Fernald, M. L. 1970. *Gray's Manual of Botany.* 8th ed. D. Van Nostrand Co., New York.
2. Hiirsalmi, H., H. Kallio, T. Pyysalo, R. Linko and P. Koponen. 1974. The ionone content of raspberries, nectarberries and nectar raspberries and its influence on their flavor. *Ann. Agric. Fenn.* 13:23-29.
3. Hiirsalmi, H. and J. Sako. 1976. The nectar raspberry, *Rubus idaeus* x *Rubus arcticus* — a new cultivated plant. *Ann. Agric. Fenn.* 15:168-174.
4. Hultén, E. 1968. *Flora of Alaska and Neighboring Territories.* Stanford. Univ. Press, California.
5. Hultén, E. 1971. *The Circumpolar Plants II. Dicotyledons.* Almqvist, & Wiksell, Stockholm.
6. Larsson, E. G. K. 1969. Experimental taxonomy as a base for breeding in northern Rubi. *Hereditas.* 63:283-351.
7. Larsson, G. 1957. Tetraploid *Rubus arcticus* L., framstalld genom colchicinbehandling. *Bot. Notiser.* 110:151-159.
8. Ryynanen, A. 1972. Arctic bramble (*Rubus arcticus* L.), a new cultivated plant. *Ann. Agric. Fenn.* 11:170-173.
9. Ryynanen, A. 1973. *Rubus arcticus* L. and its cultivation. *Ann. Agric. Fenn.* 12:1-76.
10. Tammisola, J. and A. Ryynanen. 1970. Incompatibility in *Rubus arcticus* L. *Hereditas.* 66:269-278.
11. Vaarama, A. 1948. Cytogenetic studies on two *Rubus arcticus* hybrids. *J. Sci. Agric. Soc. Finl.* 20:67-69.
12. Welsh, S. A. 1974. *Anderson's Flora of Alaska and Adjacent Parts of Canada.* Brigham Young Univ. Press. Provo, Utah.