Fruit Varieties Journal 45(3):162-165 1991

Variability of Fruit Quality and Plant Height in Populations of Saskatoon Berries (*Amelanchier alnifolia* Nutt).

CAMPBELL G. DAVIDSON AND G. MAZZA[1]

Abstract

Variability of vegetative and reproductive characters of saskatoon cultivars, open-pollinated seedlings and seedlings from controlled crosses was investigated. Fruit pH and plant height was relatively uniform across all populations. Both berry weight and soluble solid content of fruit showed considerable variation and potential for improvement through plant breeding.

Additional index words: berry size, soluble solids, serviceberry, juneberry.

Introduction

The Saskatoon (*Amelanchier alnifolia* Nutt.) has had a long history of use by native people and early settlers of North America (5). More recently commercial orchards have been established and fruit is marketed fresh and for production of jellies, jams, syrups and wine.

Saskatoon berries contain 78-81% moisture, up to 19% sugar, small amounts of protein and fat, a moderate amount of fiber and relatively large amounts of potassium, iron, magnesium and aluminum (7). Benzaldehyde comprises between 76% and 96% of the essence (8). Anthocyanins, total phenolics, pH, titrable acidity, sugars and fruit colour vary significantly when fruit is harvested at different stages of maturity (4). Soluble solids of the fruit increase with ripening and vary among cultivars. The increase in soluble solids from the red to the dark purple stage of ripeness can range from 8.1% to 61.2%. For a high sugar content and good flavour characteristics, saskatoon berries for the fresh or processing market should be harvested at the dark purple colour stage.

The development of new cultivars of saskatoons has been slow. The interest in commercial saskatoon growing has been increasing and this has led to a demand for new cultivars. The most important commercial cultivars have been selected from wild populations (5). Saskatoons in native stands are all diploids. To improve and increase fruit yield and quality, controlled crossing to combine desirable characters is essential (1, 3). Superior phenotypes must be identified as parents and superior offsprings must be selected on a scientific basis. Advancement is related to the ability of the breeder to identify and successfully propagate superior phenotypes.

The present study was initiated to identify the range of variability in both controlled crosses (emasculated) and open pollinated populations of saskatoons. This information should help establish goals and objectives for further improvement in saskatoon berry quality. Low growing, high yielding plants, with large berry size and high sugar content are highly desirable. Saskatoons are difficult to vegetatively propagate by conventional means, consequently many growers utilize open pollinated seedlings from named cultivars for commercial orchard establishment. Although the floral morphology encourages insect-mediated pollination, autogamy is possible (10). The possibility of utilizing seed derived cultivars rather than vegetatively propagated ones also requires further investigation.

[1]Agriculture Canada, Research Station, Morden, MB, Canada, R0G 1J0.

Materials and Methods

Seedling populations from both controlled and open pollinated parents had been previously planted (1984) in a random fashion at the Agriculture Canada Research Station, Morden, MB, Canada (Table 1). Cultivars and selections (Table 1) had been planted earlier (1977) and were taller and produced larger quantities of fruit.

Mature ripe fruit was harvested in July, 1988 from plants established. Care was taken to harvest only mature dark purple fruit (4). The berries were analyzed by the Association of Official Analytical Chemists (AOAC 1980) procedures. The pH of the fruit was measured by the standard glass electrode pH meter (Radiometer, Copenhagen NV, Denmark). Soluble solids were determined with a Spencer 1362 refractometer (American Optical Co., Scientific Inst. Div., Buffalo, New York). Ten-berry weight was determined on freshly harvested fruit. All above analyses were replicated three times. Plant height was recorded at the end of the growing season. The average plant height was measured by determining the mean height of all stems present, while the maximum height was measured on the tallest stem of the plant. Number of plants sampled was higher for the vegetative measurements since there was not always sufficient fruit for quality analysis.

Results and Discussion

The cultivars were taller than the seedling population due to their earlier establishment (Table 1). There was little variation within the seedling populations for both average plant height and height of the tallest shoot (Table 1). All seedling plants were approximately 1 meter tall, suggesting that overall seedling vegetative vigour was

Table 1. Plant height measurements for different cultivar selections and seedling populations of saskatoons 1988.

Cultivar[a]/Seedlings	Number of Plants Sampled	Average height of plants (m)			Height of tallest shoot (m)		
		Min	Mean ± SE	Max	Min	Mean ± SE	Max
Cultivars or selections[a]							
Smoky	3	1.2	2.0 ± 0.4	2.7	1.5	2.5 ± 0.5	3.3
Parkhill	3	1.3	2.1 ± 0.5	3.1	1.9	2.4 ± 0.4	3.2
Success	3	1.1	2.1 ± 0.5	3.0	1.4	2.6 ± 0.7	3.9
7818	3	1.3	1.7 ± 0.3	2.2	1.8	2.2 ± 0.3	2.7
8122	3	0.8	0.9 ± 0.3	0.9	1.1	1.2 ± 0.3	1.2
Controlled crosses[b]							
7818 x Success	20	0.66	1.2 ± 0.10	1.90	0.74	1.5 ± 0.10	2.7
Success x 7818	15	0.73	0.8 ± 0.02	0.93	0.84	1.0 ± 0.03	1.2
Parkhill x 7818	18	0.55	0.9 ± 0.04	1.10	0.80	1.3 ± 0.04	1.4
7818x Parkhill	16	0.60	0.9 ± 0.10	1.30	0.75	1.1 ± 0.10	1.6
Parkhill x Smoky	17	0.43	0.8 ± 0.05	1.20	0.52	1.0 ± 0.06	1.4
Open pollinated[c]							
Smokey - OP	74	0.50	0.9 ± 0.03	1.40	0.63	1.0 ± 0.04	1.6
8122 - OP	89	0.35	0.7 ± 0.01	0.90	0.45	0.8 ± 0.02	1.1

[a]Mature plants — established 1977.
[b]2-year-old seedlings planted in 1984 from controlled crosses (female x male).
[c]2-year-old seedlings planted in 1984 from open pollinated plants (only female known).

Table 2. Fruit quality characteristics for different cultivars and seedling populations of saskatoons.

Cultivar/Seedlings	Number of Plants Sampled	pH			Soluble solids (%)			10-berry weight (g)		
		Min	Mean ± SE	Max	Min	Mean ± SE	Max	Min	Mean ± SE	Max
Cultivars or selections[a]										
Smoky	3	4.1	4.2 ± 0.01	4.3	15.0	15.2 ± 0.1	15.3	6.2	7.0 ± 0.5	7.9
Parkhill	3	4.0	4.1 ± 0.04	4.2	8.9	9.9 ± 0.5	10.8	6.1	6.7 ± 0.4	7.4
Success	3	4.0	4.1 ± 0.04	4.2	18.5	18.8 ± 0.2	19.1	7.0	8.0 ± 0.3	8.7
7818	3	4.0	4.1 ± 0.03	4.2	14.5	16.5 ± 0.6	18.2	6.8	7.4 ± 0.4	8.0
Controlled crosses[b]										
7818 x Success	12	3.5	3.8 ± 0.04	4.0	15.0	17.4 ± 0.4	19.5	7.0	8.9 ± 0.4	12.8
Success x 7818	8	3.6	4.0 ± 0.05	4.1	15.9	16.5 ± 0.4	18.2	5.5	7.0 ± 0.3	8.4
Parkhill x 7818	8	3.7	3.8 ± 0.03	4.0	14.1	18.5 ± 0.9	21.8	6.3	8.6 ± 0.6	13.3
7818 x Parkhill	10	3.9	4.0 ± 0.02	4.1	14.6	17.6 ± 0.5	20.1	5.7	6.8 ± 0.2	8.5
Parkhill x Smoky	8	3.7	3.9 ± 0.09	4.1	14.2	16.6 ± 0.5	18.0	5.8	7.6 ± 0.2	9.3
Open pollinated[c]										
Smokey — OP	23	3.8	4.0 ± 0.02	4.2	14.4	17.1 ± 0.2	19.3	6.7	8.4 ± 0.2	10.3
8122 — OP	41	3.8	4.0 ± 0.02	4.2	12.1	15.2 ± 0.2	17.7	5.2	7.6 ± 0.2	10.2

[a]Mature plants — established 1977.
[b]2-year-old seedlings planted in 1984 from controlled crosses (female x male).
[c]2-year-old seedlings planted in 1984 from open pollinated plants (only female known).

similar. As the plants mature, there may be more differences in height as was noted for the 11-year-old cultivars and selections. (9).

The pH of the fruit was the least variable of the fruit quality characteristics investigated (Table 2). The widest range of pH values was in the controlled crosses between 7818 and Success. Green and Mazza (4) found that the development of anthocyanins in the berries had some dependency on the pH level, and cultivars with high acidity contained higher concentrations of anthocyanins. Green and Mazza (4) also established that pH varied little with harvest date or year of harvest. Although pH should be monitored, the variation in pH was not large, hence breeding for higher or lower pH levels would not be easy. pH can also be adjusted easily in processed products by addition of acidulants.

Percent soluble solids, which is indicative of sugar content, varied both among cultivars and within seedling populations (Table 2). 'Success' had the highest sugar percentage of the cultivars while 'Parkhill' had the lowest. Green and Mazza (4) found that soluble solids varied among cultivars and harvest date. Red purple fruit had significantly less sugar than dark purple berries. Fruit in the present study was picked only at the dark purple stage.

The range (minimum-maximum) of soluble solids for open pollinated accessions was slightly greater than for controlled crosses (Table 2). However, the mean soluble solids content for each population was higher in the controlled crosses. Selecting parents high in sugars for controlled crossing may enable more rapid improvements in sugar content compared to using open pollinated populations.

The mean berry weight for the seedling populations was similar to the cultivars (Table 2). The range of berry weights in the seedling groups was

high. The largest 10-berry weight recorded was 13.3 g which was significantly higher than berry weight for the cultivars (8.7 g). Increased berry weight should be possible by utilizing genotypes in a crossing program with high berry weights.

Conclusions

The results of this study indicate there is potential for improvement in both berry weight and soluble solids of saskatoons. Controlled crossing between individuals having high berry weight and soluble solids may produce progenies with both increased soluble solids and berry weight, thus relatively large populations can be managed without excessive time or labour costs. pH was relatively uniform for cultivars and seedling populations and measurement may not prove useful until later in the selection program. Even 6 years after planting, the seedling plants appear to be too young to begin selection for growth habits. Overall variability of characteristics for seedlings from controlled crosses and from open pollinated seedlings was similar, indicating that outcrossing in saskatoons likely occurs at a fairly high rate even though self-pollination is possible (10). The use of open pollinated seedlings from cultivars for orchard establishment should, thus, be closely monitored as high levels of outcrossing may lead to significant variation in fruit quality and affect market opportunities and product uniformity.

Literature Cited

1. Allard, R. W. 1960. Principles of plant breeding. John Wiley and Sons, New York, 485 pp.
2. AOAC. 1980. Official Methods of Analysis, 13th ed. Assoc. Official Anal. Chem., Washington, D.C.
3. Bringhurst, R. S. 1983. Breeding strategy, pp. 147-153 in Methods of fruit breeding. J. N. Moore and J. Janick (eds.), Purdue Univ. Press, Indiana.
4. Green, R. C. and G. Mazza. 1986. Relationship between anthocyanins, total phenolics, carbohydrates, acidity and colour of saskatoon berries. Can. Inst. Food Sci. Technol. J. 19:107-113.
5. Harris, R. E. 1972. The Saskatoon. Agriculture Canada Publ. 1246.
6. Mazza, G. 1979.Development of consumer evaluation of native fruit product. Can. Inst. Food Sci. Technol. J. 12:166-169.
7. Mazza, G. 1982. Chemical composition of saskatoon berries (*Amelanchier alnifolia* Nutt.). J. Food Sci. 47:1330-1331.
8. Mazza, G. and M. W. Hodgins. 1985. Benzaldehyde, a major aroma component of saskatoon berries. HortScience 20:742-744.
9. Miller, W. S. and C. Stushnoff. 1971. A description of *Amelanchier* species in regard to cultivar development. Fruit Varieties and Horticultural Digest 25:3-10.
10. Olson, R. 1983. Structural aspects of pollination in *Amelanchier alnifolis* (Maloideae). Can. J. Bot. 62:858-864.

Fruit and Growth Regulators Influence Apple Flowering

A Massachusetts study evaluated the response of 5 apple cultivars, varying in degree of biennial bearing, to applications of either BA or Alar. BA and Alar increased early appendage formation of potential flower buds, but this increase was maintained only on 'Early McIntosh' and 'Baldwin.' BA and Alar increased return bloom on all treated limbs with the exception of 'Early McIntosh.' The annually bearing cultivars 'McIntosh' and 'Delicious' initiated 20 appendages before the formation of floral parts while the biennially bearing cultivars 'Golden Delicious,' 'Baldwin,' and 'Early McIntosh' initiated 19, 18 and 22 appendages, respectively. Flower removal before bloom increased appendage formation on the biennial cultivar 'Baldwin' but not on the annual cultivar 'Delicious.' (From McLaughlin and Greene. 1991. J. Amer. Soc. Hort. Sci. 116:446-449)