

Evaluation of growth and fruit production characteristics of 15 saskatoon (*Amelanchier alnifolia* Nutt.) cultivars at maturity

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St-Pierre, R. G., Zatylny, A. M. and Tulloch, H. P. 2005. **Evaluation of growth and fruit production characteristics of 15 saskatoon (*Amelanchier alnifolia* Nutt.) cultivars at maturity.** Can. J. Plant Sci. **85**: 929–932. The objective of this study was to quantitatively evaluate the growth, yield, fruit size and ripening characteristics of mature plants of 15 saskatoon (*Amelanchier alnifolia* Nutt.) cultivars. Data were collected from two sites in Saskatchewan over 5 yr (1999–2003). The cultivars included Bluff, Buffalo, Forestburg, Honeywood, JB30, Martin, Nelson, Northline, PAR 90, Parkhill, Pearson II, Pembina, Smoky, Success, and Thiessen. Mean annual growth of shoots ranged from 10.5 cm yr⁻¹ for Parkhill to 21.4 cm yr⁻¹ for JB30. The number of days for fruit to change from 10 to 90% ripe did not differ among the cultivars and averaged 13.8 d. The Julian date to attain 50% ripe fruit ranged from 196 to 209. Fruit of PAR 90, Honeywood, JB30, Martin, Success and Thiessen matured 4–13 d earlier than fruit of Bluff, Northline, Parkhill, Buffalo, Nelson, and Pembina. Marketable yields, which averaged 93.4% of the total harvested yields, ranged from 0.72 to 4.16 kg plant⁻¹. Pearson II, Honeywood, and Smoky had greater marketable yields (4.1–4.16 kg plant⁻¹) than did PAR 90, Parkhill, Nelson, Success, and Pembina (0.72–2.49 kg plant⁻¹). Thiessen, Martin, PAR 90 and JB30 had the largest fruit (13.3–13.9 mm), and Success and Bluff had the smallest (10.8–10.9 mm). Data from this study provide a basis on which to evaluate currently available cultivars and new cultivars or future selections that may be developed.

Key words: *Amelanchier alnifolia*, fruit size, shoot growth, cultivar evaluation, ripening

St-Pierre, R. G., Zatylny, A. M. et Tulloch, H. P. 2005. **Évaluation des paramètres de la croissance et de la production fruitière de 15 cultivars d'amélanchier (*Amelanchier alnifolia* Nutt.) parvenus à maturité.** Can. J. Plant Sci. **85**: 929–932. L'étude devait permettre une évaluation quantitative de la croissance, du rendement, du calibre des fruits et des caractéristiques du mûrissement des plants adultes de 15 cultivars d'amélanchier (*Amelanchier alnifolia* Nutt.). Les données ont été recueillies à deux endroits de la Saskatchewan pendant cinq ans (de 1999 à 2003). Les cultivars en question s'appelaient Bluff, Buffalo, Forestburg, Honeywood, JB30, Martin, Nelson, Northline, PAR 90, Parkhill, Pearson II, Pembina, Smoky, Success et Thiessen. La croissance annuelle moyenne des pousses varie de 10,5 cm par année chez Parkhill à 21,4 cm par année chez JB30. Le nombre de jours nécessaires pour que la proportion de fruits mûrs passe de 10 % à 90 % ne varie pas d'un cultivar à l'autre et se situe à 13,8 jours en moyenne. La date ordinale correspondant au mûrissement de la moitié des fruits varie de 196 à 209. Les fruits de PAR 90, Honeywood, JB30, Martin, Success et Thiessen parviennent à maturité 4 à 13 jours plus tôt que ceux de Bluff, Northline, Parkhill, Buffalo, Nelson et Pembina. Le rendement en fruits commercialisables, qui s'établit en moyenne à 93,4 % du total des fruits récoltés, fluctue de 0,72 à 4,16 kg par plant. Pearson II, Honeywood et Smoky ont enregistré un meilleur rendement en fruits commercialisables (de 4,1 à 4,16 kg par plant) que PAR 90, Parkhill, Nelson, Success et Pembina (de 0,72 à 2,49 kg par plant). Thiessen, Martin, PAR 90 et JB30 portaient les plus gros fruits (13,3 à 13,9 mm) alors que Success et Bluff portaient les plus petits (10,8 à 10,9 mm). Les données de cette étude permettront d'évaluer les cultivars actuellement disponibles sur le marché et les variétés ou obtentions qui pourraient être développées ultérieurement.

Mots clés: *Amelanchier alnifolia*, calibre des fruits, croissance des pousses, évaluation de cultivar, mûrissement

The saskatoon (*Amelanchier alnifolia* Nutt.) is a fruit-bearing shrub or small tree native to the North American prairies. In the United States, it is commonly known as a juneberry or serviceberry. Its berry-like pome fruit, once widely used by indigenous people and early settlers on the prairies, are popular today among the local population as fresh fruit, or processed as jams, syrups and pie fillings (Harris 1970). Interest in the commercial production of the saskatoon has increased substantially in recent years, with approximately 1200 ha currently planted on the Canadian prairies. However, despite having been commercially culti-

vated for approximately 35 yr, many aspects of the biology and culture of this native fruit species have not been quantified or well-defined (St-Pierre 1997a).

There are approximately 26 named cultivars of saskatoons, all of which have been selected from the wild or as an open-pollinated seedling of a named cultivar; none of these cultivars are the progeny of controlled crosses (St-Pierre 1997b). In the past, saskatoon cultivar descriptions and recommendations were based on non-replicated trials, and qualitative and/or anecdotal information. The first extensive replicated cultivar trials of saskatoon were established by the University of Saskatchewan, Saskatoon, SK. The objective of the current study was to evaluate the growth and fruit production characteristics of mature (8- to 12-yr-old) plants of 15 fruit-bearing cultivars of saskatoon presently under

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evaluation in replicated cultivar trials in Saskatchewan. Comparative growth and yield data for juvenile and still-maturing plants of saskatoon cultivars are available (Zatylny et al. 2002), but comparable data for mature plants are not. This research will allow a more accurate quantitative characterization of growth and yield of the cultivars evaluated, irrespective of the effects of year or location, and will provide a basis on which to make cultivar recommendations to growers, and to evaluate the performance in commercial orchards of currently available cultivars and any new cultivars or future selections that may be developed.

MATERIALS AND METHODS

Fifteen saskatoon cultivars were planted in replicated trials at the University of Saskatchewan in Saskatoon, Saskatchewan (Lat 52°7'N, Long 106°36'W; soil classification – Orthic dark brown Chernozem of the Sutherland association), and at a grower-managed site approximately 15 km southwest of the city of Saskatoon (Moonlake; Lat 52°2'N, Long 106°45'W; soil classification – Rego dark brown Chernozem of the Alluvium association).

The trial consisted of a randomized complete block design with three blocks at each of the two sites. The linear plots of each cultivar contained five plants. The 15 cultivars tested were: Bluff, Buffalo, Forestburg, Honeywood, JB30, Martin, Nelson, Northline, PAR 90, Parkhill, Pearson II, Pembina, Smoky, Success and Thiessen. Of these, the cultivars Parkhill and Success originated in the United States, and appear to be hybrids of *A. stolonifera* with *A. alnifolia* (Weir 1995); all other cultivars are *A. alnifolia*.

The experimental plantings were established in 1991 from 1-yr-old plants. The cultivars JB30, Pembina and Smoky were propagated from cuttings; all other cultivars were micropropagated. Plant spacing was 1 m within rows and 4.5 m between rows. Because of difficulties in propagation, not all cultivars were available in 1991. PAR 90 and JB30 (at both sites) and Forestburg (at Moonlake) were planted in 1992; Nelson was planted at both sites in 1993. Plants that did not survive were replaced in the spring and fall of 1992 and 1993, and in the spring of 1994. It was considered unlikely that method of propagation and year of planting would confound the results of the current study. Unpublished data indicated that method of propagation did not influence subsequent growth and yield; rather, quality of plant material as it was received from the propagator, and time and method of transplanting, were more important. Additionally, the data presented in the current study were collected from mature plants, 8–12 yr of age, all of which had been subjected to regular orchard management including pruning. It is quite likely that pruning, which removed all stems greater than 2.5 cm at ground level, including most, if not all, of the stems that originated from the initial planting, would have obscured any remaining effects of propagation method and year of planting.

The sites were maintained using recommended management practices (St-Pierre 1997a). No soil amendments were used. Weed control was accomplished using dichlobenil (Casoron 4G) at the recommended rate and timing, manual weeding and cultivation. Propiconazole (Topas 250E) and

deltamethrin (Decis 5.0 EC) were used at the recommended rates and timing for disease and insect pest control, respectively. Both sites were irrigated when necessary. Diseased and damaged wood and low-lying branches were removed each year as required. Annual rejuvenation pruning of the plants, involving the removal of stems with diameters greater than 2.5 cm at ground level, commenced in the spring of 2000 (St-Pierre 1997a).

Data on shoot growth, yield, and fruit size were collected in the years 1999–2003 from both sites. Ripening data were collected from both sites but only in the years 1999 and 2000.

Each year, fruit were mechanically harvested in two harvests from two randomly selected plants within each plot. Timing of the first harvest was when at least 60% of the fruit were ripe. The second harvest was done when the majority of the remaining fruit were ripe. The fruit from each sampled plant were mechanically harvested with hand-held shakers (BEI, South Haven, MI), which were raked along the branches causing the fruit to fall into catch frames below. Mechanical harvesting removed some under-ripe fruit. Total harvested fruit was the total weight obtained from both harvests. Marketable yield was the yield remaining once the immature, diseased, damaged or shrivelled fruit were sorted out by hand.

Fruit size was measured as equatorial fruit diameter, and was based on measurements of 30 randomly selected fruit from those harvested from each plot. Evenness of ripening was determined as the number of days required for the fruit of the plants within a plot to mature from 10 to 90% ripe. Fruit were visually assessed as ripe when they turned purplish-black in colour, as described by Rogiers and Knowles (1997). The average ripening date of each cultivar was assessed as the date when 50% of the fruit on the plants within each plot appeared to be fully ripe. The use of soluble solids as a measure of ripening was not practical given the extent to which ripening varied within fruit clusters, and within and between plants.

Shoot growth was measured annually from 15 shoots per plot randomly selected from the mid-portion of the plants. Measurements were recorded in August after shoot growth had ceased.

Data for all years and sites were combined for statistical analysis. The data were checked for normality and transformed when necessary using a square root transformation prior to statistical analysis. The data were analyzed using the Mixed procedure of SAS (SAS Institute, Inc., Cary, NC). Sites and years were considered as random factors with blocks nested within both. Cultivar separation was accomplished by LSD using the LSMEANS option of SAS software at a probability level of ≤ 0.05 . A Pearson correlation was performed between total harvested and marketable yields using SYSTAT Version 8.0 (SPSS, Chicago, IL).

RESULTS AND DISCUSSION

Annual Shoot Growth

Annual shoot growth ranged from 10.5 to 21.4 cm and differed among the cultivars (Table 1). Annual shoot growth

Table 1. Growth, yield, fruit size and ripening characteristics of 15 saskatoon cultivars, grown at two sites in Saskatchewan (the University of Saskatchewan and Moonlake) from 1999 to 2003

Cultivar	Annual shoot growth (cm)	Days from 10 to 90% ripe fruit ^z	Julian days to 50% ripe fruit ^z	Total harvested yield (kg plant ⁻¹)	Marketable yield (kg plant ⁻¹)	Equatorial fruit diameter (mm)
Bluff	16.9cde	11.5	201bcde	3.04bcde	2.76cde	10.9a
Buffalo	14.8bcde	14.8	202de	3.86cde	3.18cde	11.4b
Forestburg	15.6bcde	14.3	198abc	4.09cde	3.72de	12.4c
Honeywood	14.2bcd	13.8	198ab	4.67e	4.16e	12.1c
JB30	21.4f	14	197ab	3.97cde	3.62de	13.3d
Martin	17.6def	14.4	197ab	3.25bcde	2.88cde	13.8e
Nelson	15.2bcde	15.4	203e	2.14ab	1.88bc	12.1c
Northline	15.0bcde	13.3	201cde	4.14cde	3.74de	12.2c
PAR 90	18.5ef	13.2	196a	2.78bcd	2.49cd	13.7de
Parkhill	10.5a	15.4	201cde	2.73bc	2.46cd	11.5b
Pearson II	13.0ab	13.9	198abcd	4.7e	4.16e	12.2c
Pembina	14.2bcd	11.8	209f	1.36a	0.72a	11.4b
Smoky	13.3abc	15	198abcd	4.58de	4.1e	12.1c
Success	N/A ^y	11.8	197ab	1.32a	1.23ab	10.8a
Thiessen	18.5ef	14	197ab	3.94cde	3.56de	13.9e
Mean	(3.94) ^x	13.8	199.6	(1.81)	(1.69)	12.3
SE ^w	(0.574)	1.87	1.50	(0.216)	(0.201)	0.197

^zData from 1999 and 2000 only.^yData not available.^xThe transformed mean and transformed standard error are presented in parentheses when the data were transformed prior to analysis. Back-transformed cultivar means are presented for data that were transformed.^wStandard error of the mean.*a-f* Means within a column followed by the same letter are not significantly different by LSD ($P \leq 0.05$).

was greater for the cultivars JB30, PAR 90 and Thiessen (18.5–21.4 cm) than for Honeywood, Pembina, Smoky, Pearson II and Parkhill (10.5–14.2 cm). The remaining cultivars were intermediate in their annual shoot growth, which ranged from 14.8 to 17.6 cm. These differences in shoot growth provide an indication of differences in the form of the plants. For example, the cultivars with the greatest annual shoot growth, including JB30, Thiessen, Martin and PAR 90, tend to have a growth habit that is somewhat spreading or sprawling. Those cultivars with low annual shoot growth, such as Parkhill, Pearson II and Smoky, tend to be somewhat smaller in size and/or put more energy into sucker production. However, the relationship between annual shoot growth and plant habit in saskatoon is not well-defined.

On average, annual shoot growth in the mature plants evaluated over the 5 yr of this study was 52% of that of pre-mature (juvenile or still-maturing) plants (Zatylny et al. 2002), indicating that shoot growth decreased as the plants matured, although climatic differences may also have been a factor. Cultivar rankings for annual shoot growth also differed between pre-mature and mature stages. Martin, Pearson II, Smoky and Thiessen ranked highest among the cultivars in annual shoot growth in pre-mature plants (Zatylny et al. 2002). In contrast, Thiessen and Martin ranked second and third, respectively, in annual shoot growth in mature plants, whereas Pearson II and Smoky both ranked 14th. This suggests that there was a differential rate of decrease in shoot growth among the cultivars as the plants matured.

Ripening

The number of days for fruit to change from 10 to 90% ripe ranged from 11.5 to 15.4 and did not differ among cultivars

(Table 1). On average, it took approximately 2 wk from the onset to completion of ripening (Table 1).

The date at which 50% of fruit ripened differed among the cultivars and varied by 13 d (Table 1). Fruit of the cultivars PAR 90, Honeywood, JB30, Martin, Success and Thiessen, matured 4–13 d earlier than fruit of Bluff, Northline, Parkhill, Buffalo, Nelson, and Pembina. Fruit of Pembina ripened later than that of all of the other cultivars by 6–13 d.

Time to ripening and variability in the speed of ripening are important to the timing, length, and ease of harvest. Even ripening is a desirable trait when mechanical harvesters are used, as it improves the efficiency of once-over harvesting. The saskatoon cultivars currently propagated and available to growers are characterized by substantial variability in time of ripening within and between plants, and within fruit clusters.

Yield

Total harvested yields ranged from 1.32 to 4.7 kg plant⁻¹, and marketable yields ranged from 0.72 to 4.16 kg plant⁻¹ (Table 1). On average, marketable yields were 88.0% of total harvested yields. Total and marketable yield were highly correlated among cultivars ($r = 0.99$, $P < 0.001$). Pembina had a much lower percentage of marketable fruit than did all the other cultivars except Success. Both Pembina and Success had fruit that tended to shrivel on the plant soon after ripening, which would account for their greater percentage of unmarketable fruit.

The cultivars differed in both total harvested and marketable yields. Total harvested yields of Pearson II and Honeywood, and marketable yields of Pearson II, Honeywood, and Smoky were greater than those of PAR 90,

Parkhill, Nelson, Success, and Pembina (Table 1). The total harvested yields of Success and Pembina were lower than those of all other cultivars except Nelson. The low yields of Success and Nelson were likely associated with their characteristically small plant stature.

Cultivar rankings of yield for the current study were similar to the rankings of cumulative yield over the first 5 yr of production (Zatylny et al. 2002) with the exception of Parkhill and JB30. Parkhill, a precocious producer, initially outyielded a number of the cultivars but, when mature, ranked among the less productive cultivars (Table 1). Yields of JB30 from its first 5 yr of production (Zatylny et al. 2002) were low relative to most of the other cultivars, whereas mature plants of JB30 ranked among the higher-yielding cultivars.

Yields of Smoky, Honeywood, Forestburg and Northline in the current trial agree with previous observations of these cultivars (McConkey 1979; St-Pierre 1997b); however, that of Pembina does not. Pembina has been reported to be very productive (McConkey 1979; St-Pierre 1997b), which is contrary to our findings. Pembina is an older cultivar, having been introduced in 1956 (Zatylny and St-Pierre 2003). It is possible that the plants in this study were not true Pembina clones, but perhaps derived from a seedling of Pembina that unknowingly was propagated and sold as Pembina.

Fruit Size

Equatorial fruit diameter ranged from 10.8 to 13.9 mm among the cultivars (Table 1). The cultivars fell into four distinct groups according to equatorial fruit diameter. The cultivars with the largest fruit included Thiessen, Martin, PAR 90, and JB30 with a mean diameter of 13.7 mm. The fruit of Smoky, Nelson, Honeywood, Northline, Pearson II, and Forestburg fell into the second largest category with a mean diameter of 12.2 mm. Buffalo, Pembina and Parkhill were in the third category with a mean fruit diameter of 11.4 mm. Success and Bluff fell into the fourth category with the smallest fruit. Cultivar rankings of fruit size were similar overall to those reported by Zatylny et al. (2002).

Both Martin and PAR 90 are open-pollinated seedlings of Thiessen and these, as well as Thiessen, were selected and named as cultivars partly on the basis of fruit size. The cultivars Thiessen and Martin are favourites in U-Pick orchards as consumers prefer the large size of the fruit. JB30 also may have potential for this use, but PAR 90, despite its large-sized fruit, ranks as one of the less productive cultivars.

CONCLUSIONS

Data from the current study have provided a more accurate quantitative characterization of growth and yield of 15

saskatoon cultivars based on an evaluation of mature plants in replicated trials at two sites over 5 yr. The results represent a unique set of data, which will provide a basis on which to make cultivar recommendations to growers, and to evaluate the performance in commercial orchards of currently available cultivars and new cultivars or future selections that may be developed. High-yielding cultivars with large fruit are important for the commercial production of saskatoons, and an orchard of cultivars with different harvest times would have an extended harvest period. Of the cultivars tested, eight have high potential for commercial production based on yield and fruit size. Those with high yields and large-sized fruit included JB30, Thiessen and Martin. The cultivars Pearson II, Honeywood, Smoky, Northline and Forestburg had high yields of medium-sized fruit. Of these eight cultivars, JB30, Thiessen, Martin and Honeywood fruited earlier in the season than Northline.

In addition to yield and fruit size, other factors need to be considered when choosing a cultivar for production. These include disease and insect resistance, suckering, alternate-bearing, blossoming time, post-harvest storage, fresh fruit composition, and suitability for processing. Considerably more screening of cultivars and new selections remains to be done to evaluate these characteristics.

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