Timing, magnitude and causes of flower and immature fruit loss in pin cherry and choke cherry

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Shiell, K. J., St-Pierre, R. G. and Zatylny, A. M. 2002. **Timing, magnitude and causes of flower and immature fruit loss in pin cherry and choke cherry**. Can. J. Plant Sci. **82**: 157–164. Pin cherry (*Prunus pensylvanica* L.) and choke cherry (*Prunus virginiana* L.) are two wild fruit species with potential for commercial production, but information about fruit production is limited. The objectives of this study were to determine, for both species, the timing and magnitude of flower and immature fruit loss, and to determine the primary causes of this loss, including the effects of pollen source and supplemental pollination. Sequential sampling of both pin cherry and choke cherry indicated that the primary period of abscission occurred during the first 3 wk following full bloom. Final fruit set ranged from 32.6 to 44.7% of flower number for pin cherry, and from 3.7 to 20.1% for choke cherry. Insect damage accounted for only 14% of the total observed flower and fruit abscissions in pin cherry and 7% in choke cherry. The major insect pest causing this loss in pin cherry was a sawfly (*Hoplocampa* sp., Tenthredinidae) and in choke cherry, a leafroller (*Archips argyrospila,* Tortricidae). A controlled pollination experiment was used to determine the effects of pollen source and supplemental pollination on pin cherry and choke cherry. Final fruit set for flowers that were cross-pollinated by hand in both pin cherry (mean of 51.3%) and choke cherry (mean of 56.9%) in most cases was significantly greater than flowers that were open-pollinated, self-pollinated, or not pollinated. These data suggested that the majority of flower and immature fruit loss in both pin cherry and choke cherry resulted from a lack of pollination and/or fertilization.

Key words: Choke cherry, pin cherry, flower loss, immature fruit loss, pollination, insect damage

Shiell, K. J., St-Pierre, R. G. et Zatylny, A. M. 2002. **Moment, importance et causes de la chute des fleurs et des fruits immatures chez le cerisier de Pennsylvanie et le cerisier de Virginie.** Can. J. Plant Sci. **82**: 157–164. Le cerisier de Pennsylvanie (*Prunus pensylvanica* L.) et le cerisier de Virginie (*Pensylvanica virginiana* L.) sont deux arbres fruitiers sauvages dont on pourrait entreprendre la culture commerciale, mais on manque d’information sur leur fructification. L’étude devait établir le moment et l’importance de la chute des fleurs et des fruits immatures pour chaque espèce et préciser les causes principales du phénomène, y compris les effets de la provenance du pollen et d’une pollinisation supplémentaire. Un échantillonnage séquentiel des deux espèces indique que l’abscission survient principalement au cours des trois semaines qui suivent la pleine floraison. La nouaison varie entre 32,6 et 44,7 % du nombre de fleurs pour le cerisier de Pennsylvanie et entre 3,7 et 20,1 % pour le cerisier de Virginie. Les dommages attribuables aux insectes n’expliquent que 14 % des abscissions chez le cerisier de Pennsylvanie et 7 % chez le cerisier de Virginie. Le principal ravageur de la première espèce est un tenthrède (*Hoplocampa* sp., Tenthrénidés) tandis que chez la seconde, il s’agit d’une tordeuse de la feuille (*Archips argyrospila*, Tortricidés). Les auteurs ont effectué un essai de pollinisation contrôlée afin de déterminer les effets de l’origine du pollen et ont procédé à une sur-pollinisation chez les deux sortes d’arbre. Dans la plupart des cas, la nouaison est sensiblement plus importante (moyenne de 51,3 % pour le cerisier de Pennsylvanie et de 56,9 % pour le cerisier de Virginie) quand les fleurs sont fécondées à la main plutôt que lorsqu’il y a pollinisation libre, auto-pollinisation ou absence de pollinisation. Les données laissent croire que la chute des fleurs et des fruits immatures chez les deux espèces résulte surtout de l’absence de pollinisation et/ou de fécondation.

Mots clés: Cerisier de Virginie, cerisier de Pennsylvanie, chute des fleurs, chute des fruits immatures, pollinisation, dommages dus aux insectes

Prunus pensylvanica, pin cherry, and *Prunus virginiana*, choke cherry, are native fruit species occurring in abundance across Canada and the northern United States. The fruit of both species can be used to make jams, jellies, wines and a wide variety of other products. A market study prepared by Solutions 2000+ and the Trimension Group (1994) indicated that there are potential markets for both processed pin cherry and choke cherry, which has created an interest in the commercial production of these fruit species. This interest has driven a demand for information concerning the biology and culture of pin cherry and choke cherry. The biology of both species has been examined (Hall et al. 1981; Mulligan and Munro 1981), but the information reported is not complete enough to develop an adequate understanding of their requirements for cultivation, or those factors associated with fruit production. In particular, no information about the timing, magnitude and causes of flower and immature fruit loss is available.

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Despite a consistent and heavy yearly bloom, the production of a fruit crop in both choke cherry and pin cherry is variable. In general, flower and immature fruit loss is common in fruit orchards, although the timing, duration and magnitude of the loss varies with species and cultivar (Gur 1986; Zucconi 1986; St-Pierre 1989; Lovat 1990; Westwood 1993; Anonymous 1999). Additionally, a low ratio of mature fruits to flowers due to flower or immature fruit loss is a common phenomenon among the angiosperms. The proportion of flowers developing into mature fruit varies among species, from less than 1% to 100% (Stephenson 1981). Reasons for flower and immature fruit loss include lack of pollination or fertilization, drought and frost, lack of sufficient resources, defoliation, and seed and fruit damage from feeding insects (Stephenson 1981; Lovat 1990).

The objectives of this study were to determine, for both pin cherry and choke cherry, the timing and magnitude of flower and immature fruit loss, and to determine the primary causes of this loss, including the effects of pollen source and supplemental pollination on final fruit set. Such information would contribute to a better understanding of the biology of these two important native fruit species, in addition to assisting in the development of production and management recommendations.

MATERIALS AND METHODS

Timing and Magnitude of Flower and Immature Fruit Loss

The pin cherry and choke cherry plants used for sampling were located at the University of Saskatchewan, Department of Plant Sciences field plots, Saskatoon, Saskatchewan.

Two sampling methods, non-destructive and destructive, were used to collect data on the magnitude, timing and causes of flower and immature fruit loss in both species. Non-destructive sampling allowed for the absolute determination of loss on a per cluster basis. The frequent sampling of the same clusters, and the collection and examination of incipient abscissions (yellowing, easily-detached flowers and/or fruit in the process of abscising) enabled a more precise determination of the causes of loss in particular. Destructive sampling allowed for a relative determination of the timing and magnitude of loss. This method of sampling had more inherent variability because the same clusters were not re-sampled over time. However, the much larger number of clusters sampled provided a more representative determination of the timing and magnitude of loss from the entire population of flower and fruit clusters, and therefore confirmed the validity and general applicability of the non-destructive method of sampling.

Twelve-year-old pin cherry seedlings and Schubert choke cherry seedlings (age unknown) were sampled in 1994 and 1995 using both non-destructive and destructive sampling methods. Additional non-destructive samples were collected in 1995 from choke cherry seedlings of unknown origin, and in 1996 from selected choke cherry plants in a germplasm collection of seedlings from 17 different locations in Saskatchewan.

Non-destructive sampling consisted of the arbitrary selection and tagging of a total of 30 flower clusters, each approximately 3 m apart, for both pin cherry and choke cherry. The 3 m distance was used to ensure that each tagged cluster was from a different plant. The number of flowers in each cluster at the time of tagging was recorded. In the second year of sampling, the tagging method for pin cherry was changed slightly as mechanical damage to the flower and fruit clusters occurred as a direct result of the tagging. Thirty individual branches were arbitrarily chosen and tagged. The number of clusters and the total number of flowers per branch were recorded. The tagging method for choke cherry remained the same during all years of sampling. Flower clusters were evaluated twice per week, from the time of tagging to fruit maturity. At the time of each evaluation, the number of flowers or fruit per cluster was recorded. In all study years, pin cherry and choke cherry clusters were tagged at the open flower cluster stage.

Mean values for the number of flowers or fruit per cluster for each sampling date were graphed for each season and standard errors calculated for each mean.

The destructive sampling method involved the harvest of approximately 30 arbitrarily selected flower or fruit clusters from the same pin cherry and Schubert choke cherry plants used for the non-destructive sampling. These samples were collected twice per week at the same time data were recorded from the tagged clusters. Flower or fruit clusters were removed with secateurs and were immediately placed in FAA (5 mL L^{-1} of 40% formalin, 5 mL L^{-1} of glacial acetic-acid and 90 mL L^{-1} of 70% ethanol) to preserve them for determination of damage at a later date.

Samples preserved in FAA were dissected and examined using a Wild-Leitz stereoscope. The number of flowers or fruit in each preserved cluster was recorded and each cluster was examined for visible signs of damage. Mean values for the number of flowers or fruit per cluster for each sampling date were graphed for each season and standard errors calculated for each mean.

Characterization of Flower and Fruit Damage Causing Abscission

The flower and fruit clusters of both pin cherry and choke cherry sampled non-destructively were examined for visible signs of frost, insect and disease damage. This was done during the twice-weekly evaluations of the tagged clusters. Easily detached incipient abscissions were collected and assessed for damage.

Visible damage was designated as either frost damage, insect damage, disease damage, or if no cause could be determined, unidentified damage. Frost damage was characterized by browning of the pistil tissue. Insect damage was characterized by the presence of adult or larval insects and/or by associated damage such as chewing, piercing or rasping. If the damage was known to be associated with a specific insect, it was recorded as such, otherwise it was classed as unidentified insect damage. Disease damage of fruit was identified by visual signs such as lesions and decay, or if necessary, samples were sent to the Saskatchewan Diagnostic Lab for accurate identification.

Effects of Pollen Source and Supplemental Pollination on Final Fruit Set

Controlled pollination experiments were conducted in 1995 and 1996 on pin cherry and choke cherry plants located at the University of Saskatchewan, Department of Plant Sciences field plots in Saskatoon, Saskatchewan.

The pin cherry plants used were located in a row of five year-old clonal material of the cultivar Jumping Pound. The choke cherry plants used in the pollination study were located in a row of 5-yr-old unnamed clonal black choke cherry material. All clonal plant material was obtained in 1991 from the Alberta Centre for Crop Diversification-North, Edmonton, Alberta, where it had been micropropagated.

The pollination experiment for both species was set up in a randomized complete block design with six treatments and four blocks in 1995, and four treatments with six blocks in 1996. The four treatments used in 1996 were: 1) open-pollinated (control); 2) self-pollinated by hand; 3) cross-pollinated by hand; and 4) emasculated, not-pollinated. Two treatments used in 1995 (emasculated cross- and self-pollinated flowers) were omitted in 1996 because the numbers of fruit set in 1995 from these treatments were not significantly different from the non-emasculated treatments. The number of blocks was increased in 1996 in order to decrease variability. Experimental units were arbitrarily selected branches that were tagged at the open cluster stage of floral bud development.

The flowers that were open-pollinated (control) were not manipulated and all pollination and fertilization resulted from natural cross or self-pollination. Two hives of honey bees were present in the field plots and pollinizer genotypes were available in the form of seedling accessions within 100 m of the plants used for this study. The flowers that were self-pollinated by hand were pollinated by transferring pollen within the flower by swirling the anthers against the stigmas with a camel's hair brush. The brush was sterilized in 95% alcohol between treatments. For the flowers that were cross-pollinated by hand, flowers from a mixed population of seedlings were collected, and the anthers removed and dried under a 40-W lamp to dehiscence (Moore and Janick 1983). After 12 to 24 h the pollen was used to pollinate flowers at full bloom using a blunt dissecting needle. The pin cherry and choke cherry flowers were pollinated every day during full bloom to ensure that the flowers were pollinated. In the treatment with no hand pollination, flowers were emasculated by removing the corolla and androecium with forceps.

All experimental units except the one used for the open-pollination control treatment were bagged with Delnet™ P520 pollination bags (Applied Extrusion Technologies, Inc., Middleton, Delaware) at the open cluster stage of floral bud development. Pollination bags remained on the treated branches for the entire season. All experimental units were sprayed to drip with Decis™ (50 g L^{-1} a.i. deltamethrin) at a rate of 2 mL 4.5 L^{-1} of water at the time of bagging (open cluster), to exclude the possibility of insect damage.

The number of flowers on each branch was recorded, except in the case of the emasculated treatments, where a fixed number of 10 flowers was treated. Final fruit set was counted on 17 July in 1995 and 22 July in 1996 for pin cherry, and on 14 August 1995 and 16 August 1996 for choke cherry. Data on final fruit set, expressed as a percentage of flower number, were transformed using the square root function and were analyzed by analysis of variance using SAS GLM procedure (SAS Institute, Inc., Cary, NC, 1996). Means were compared using the least significant difference (LSD) mean separation test at the 0.05 probability level.

RESULTS AND DISCUSSION

Timing and Magnitude of Flower and Immature Fruit Loss

Regardless of method of sampling, both pin cherry and choke cherry plants exhibited an approximately sigmoidal pattern of change in the mean number of flowers or fruit per cluster (Figs. 1 to 4). This pattern generally was characterized by little or no change in the mean number of flowers per cluster prior to full bloom, a substantial loss of flowers between full bloom and initial fruit set, and little or no change from initial fruit set to final fruit set. A sigmoidal pattern is common to many fruit species (Stephenson 1981; Gur 1986; Zucconi 1986; Yates and Sparks 1995).

Pin cherry and choke cherry set fruit from only a small percentage of their flowers, a phenomenon common to many other plant species (Stephenson 1981). Final fruit set for pin cherry sampled non-destructively was 4.3% in 1994 and 32.6% in 1995 (Fig. 1). Final fruit set for 1994 pin cherry clusters sampled non-destructively was very low and considered to be non-representative because additional flower and fruit loss occurred from mechanical damage caused during tagging. Final fruit set of destructively-sampled pin cherry clusters was 40% in 1994 and 44.7% in 1995 (Fig. 2).

Final fruit set of non-destructively sampled Schubert choke cherry seedlings was 7.5% in 1994, and 8.6% in 1995 (Fig. 3). Final fruit set for the non-destructively sampled seedlings of unknown origin in 1995 was 5%, and for the choke cherry germplasm collection sampled non-destructively in 1996, 3.7% (Fig. 3). Final fruit set of choke cherry obtained by destructive sampling was 12.3% in 1994 and 20.1% in 1995 (Fig. 4).

The pattern of change in the mean number of flowers or fruit per cluster for both destructive and non-destructive sampling methods was similar, despite the 1994 pin cherry data that were considered to be non-representative due to mechanical damage from tagging. However, final fruit set was greater in both destructively-sampled pin cherry and choke cherry. Some damage due to tagging of non-destructively sampled clusters in choke cherry and in pin cherry, even after the tagging method was changed, may still have occurred and may have not been readily detected. Although the destructive method of sampling had more inherent variability because the same clusters were not re-sampled over time, the much larger number of clusters sampled provided a more representative determination of the timing and magnitude of loss from the entire population of flower and fruit clusters, and confirmed the validity and general applicability of the non-destructive method of sampling.

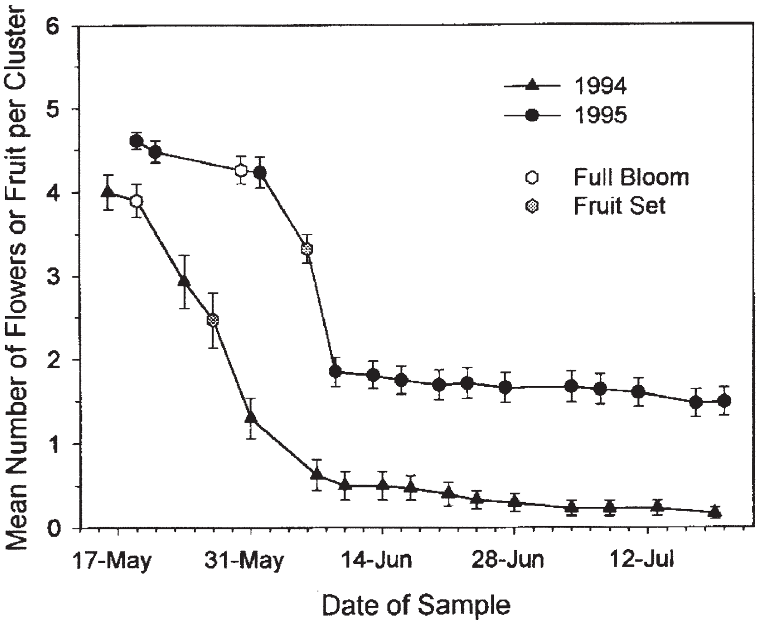

Fig. 1. Seasonal change in the mean number of flowers or fruit per cluster of non-destructively sampled pincherry in 1994 and 1995. Sample size = 30.

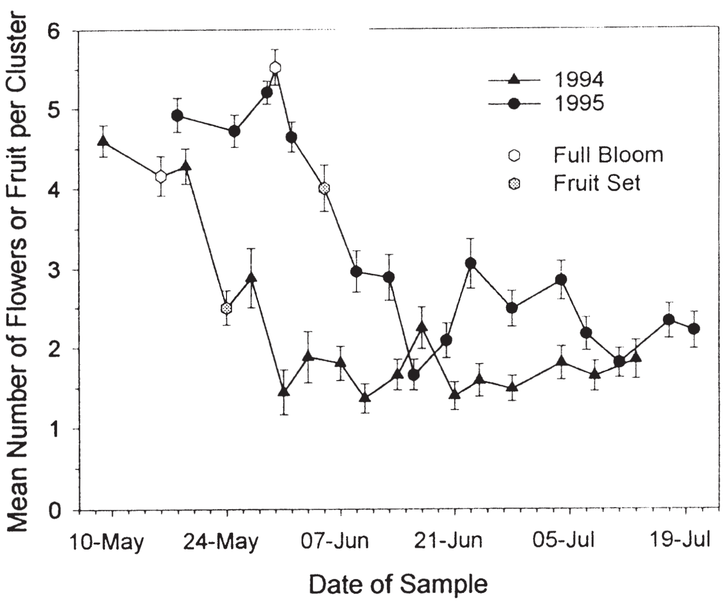

Fig. 2. Seasonal change in the mean number of flowers or fruit per cluster of destructively sampled pincherry in 1994 and 1995. Sample size = 30.

Final fruit set in pin cherry was greater than that of choke cherry, and was fairly consistent with that in commercial sour cherry (23 to 50%), as observed in other studies (Stephenson 1981). In contrast, Hall et al. (1981) recorded 95% fruit set in pin cherry under natural conditions in Nova Scotia, which greatly exceeded the levels observed in the current study. A level of fruit set of 95% also appears inconsistent with data on percent fruit set in other predominantly cross-pollinated plants (Sutherland 1986).

Characterization of Flower and Fruit Damage Causing Abscission

It was difficult to accurately determine the extent of flower and immature fruit loss as a result of specific factors such as frost, pollination, or insect and disease damage. The data collected in 1994 were not complete enough to make any numerical estimate of the extent of the factors causing flower and fruit loss. The types, causes and numbers of observed abscissions for 1995 are presented in Table 1.

The majority of immature fruit loss in pin cherry and choke cherry in 1995 occurred in the first 3 wk following full bloom. In 1995, of the total number of observed abscissions in pin cherry, 5% of the flowers were lost prior to full bloom, and 75% between full bloom and fruit set. Another 6% of immature fruit was lost between fruit set and harvest. In Schubert choke cherry, non-destructively sampled in 1995, approximately 11% of the total observed abscissions occurred prior to or during full bloom and 76% between full

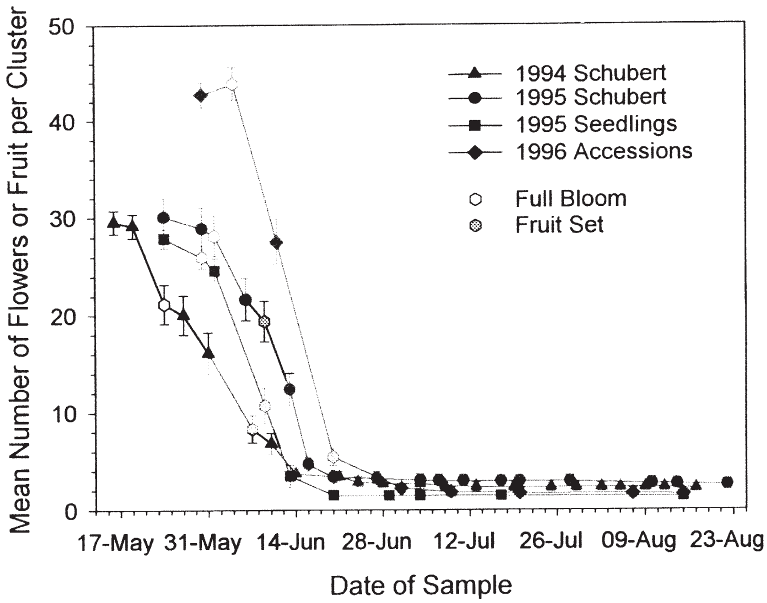

Fig. 3. Seasonal change in the mean number of flowers or fruit per cluster of non-destructively sampled chokecherry in 1994, 1995 and 1996. Sample size = 30.

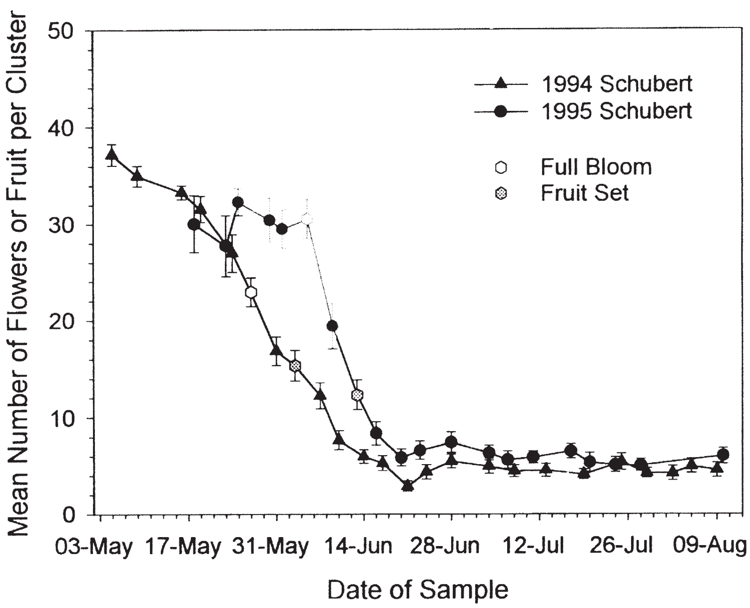

Fig. 4. Seasonal change in the mean number of flowers or fruit per cluster of destructively sampled chokecherry in 1994 and 1995. Sample size = 30.

bloom and fruit set. An additional 5% of immature fruit was lost between fruit set and harvest. In the other choke cherry seedlings sampled in 1995, of the total flowers and fruit abscissions observed, 7% of the flowers abscised prior to or during bloom, and 39% in the post-bloom period. However, in this case most of the abscissions resulting from insect damage overlapped flowering and initial fruit set making it impossible to determine the amount of abscission that would have occurred due to inadequate pollination and/or fertilization and fruit set alone regardless of insect damage. Most of the flower and fruit loss up to the point of initial fruit set was not correlated with visible damage; therefore, these abscissions were attributed to a lack of fruit set. Flower and fruit loss due to a lack of or inadequate pollination and/or fertilization has been found to occur in other fruit species (Stephenson 1981; Gur 1986; Zucconi 1986; Kaska 1989; Wood 1992). In the current study, the fruit abscising during the later stages of fruit development turned yellow prior to abscission and upon dissection were found to contain shrivelled or degenerated embryos. In other fruit species, signs such as fruit yellowing and decreased fruit size are often observed prior to fruit loss (Osborne 1973; Fukui et al. 1984; Singh 1991). These symptoms are associated with biochemical and hormonal changes in the fruit.

The remainder of the immature fruit lost in 1995 resulted from insect damage. Insect pests observed on pin cherry included a sawfly (*Hoplocampa* sp., Tenthredinidae), leafroller (*Archips argyrospila*, Tortricidae), looper (species

Table 1. Identification and number of incipient abscissions observed from clusters of non-destructively sampled choke cherry and pin cherry in 1995

Type/cause of abscission	Number of abscissions (% of total number of abscissions) Schubert choke cherry	Choke cherry seedlings	Pin cherry seedlings
Flower	48 (11%)	9 (7%)[z]	20 (5%)
No fruit set	333 (76%)	48 (39%)[z]	298 (75%)
Yellow fruit	23 (5%)		22 (6%)
Insect damage	36 (8%)	67 (54%)	55 (14%)
Total	440	124	395

[z]The number of abscissions during flowering and fruit set in the choke cherry seedlings is an underestimate due to the overlap of abscissions caused by insect damage with that which would have occurred regardless during flowering and fruit set.

unidentified, Geometridae), and the cherry fruit fly (*Rhagoletis cingulata*, Tephritidae). Insect pests observed on choke cherry included the same species of leaf-roller and looper, the choke cherry fruit gall midge (*Contarinia virginianae*, Cecidomyiidae) and the cherry shoot-borer (*Argyresthia oreasella*, Argyresthiidae). In pin cherry in 1995, 14% of the total observed flower and fruit abscissions was attributed to flower and fruit damage caused by insect pests. *Hoplocampa* species were the major cause of immature fruit loss due to insect damage accounting for approximately 11% of total observed immature fruit loss in pin cherry in 1995. Although fruit damage by *Hoplocampa* larvae was extensive in both years of the study, any egg laying, or the presence of eggs was not observed. Relatively minor damage was caused by the other insect species. *Archips argyrospila* caused approximately 3%, and the looper <1% of total observed abscissions in pin cherry in 1995.

Rhagoletis cingulata caused extensive damage and loss of fruit quality in pin cherry at fruit maturity. The exact amount of damage was not determined in 1995, as it did not affect the fruit until after they were ripe and this damage was considered to be outside the scope of the project. In 1994, 28% of a sample of 50 mature fruit were infested with *Rhagoletis cingulata* larvae. Larvae were already an extensive problem prior to 1994 in pin cherry and sour cherry trees located at the research site (R. Sawatzky, personal communication, University of Saskatchewan, Saskatoon, SK.).

In the Schubert choke cherry seedlings, 8% of total observed flower and immature fruit loss was caused by insect damage, whereas in the generic choke cherry seedlings, 54% was caused by insect damage. The major pest of choke cherry in all years of the study was *Archips argyrospila*, a leaf-roller. In 1995, larvae of this insect were responsible for 7% of the total observed flower and immature fruit loss in the Schubert seedlings and all loss in the other seedlings. The remaining insect damage in the Schubert seedlings in 1995 was caused by loopers, *Contarinia virginianae* and *Argyresthia oreasella*. Loopers caused 0.2% of the total amount of flower and immature fruit loss while *C. virginianae* caused 0.8% of the total observed abscissions. Three out of the 30 Schubert clusters sampled non-destructively were lost due to *Argyresthia* damage. Chemical control of the insect pests of pin cherry and choke cherry likely will result in an increase in final fruit set.

No major disease in pin cherry or choke cherry was observed to be a significant factor affecting flower and immature fruit loss in the current study. However, in 1994 about 28% of the choke cherry fruit sampled non-destructively had lesions caused by *Cercospora* leaf spot. These lesions did not cause fruit loss, but resulted in reduced fruit quality. Although disease was not a significant factor causing fruit loss during the study period, diseases may be more important in other locations or under different environmental conditions.

No frost events occurred at full bloom during this study and no frost or cold damage was observed in flowers or newly set fruit of either pin cherry or choke cherry. During flower bud development, the temperature did drop below 0°C on a number of nights but the flower buds were apparently hardy enough to withstand damage.

Effects of Pollen Source and Supplemental Pollination on Final Fruit Set

Few or no fruit resulted from flowers that were self-pollinated by hand (Table 2). Pin cherry also did not produce fruit in treatments that were emasculated and not pollinated. These results confirm the findings of other researchers that pin cherry is self-incompatible and does not set fruit by parthenocarpy (Hall et al. 1981). Pin cherry flowers that were cross-pollinated by hand resulted in large increases in final fruit set in comparison to flowers that were open-pollinated, although these two treatments were not significantly different in 1995 because of substantial variability in the data collected. By increasing the number of replications from four to six in 1996, treatment variation was reduced (Table 2). Because supplemental cross-pollination resulted in a greater final fruit set relative to that from open-pollinated flowers, it is likely that inadequate natural cross-pollination occurred in the open-pollinated treatment. It was also observed that final fruit set for flowers that were cross-pollinated by hand (43.2–59.3%) was similar to that obtained in the sequentially-sampled fruit loss data where all the flowers were open-pollinated (32.6–44.7%). One reason for this may have been that the row of trees used in the pollination experiment comprised a single clonal cultivar with no genetically different pollinizer trees in close proximity (the closest being more than 50 m away), whereas seedlings from a variety of sources were used in the sequentially sampled fruit loss study. The presence of this large number of differing pollen donors together at the site used for the fruit loss study may have contributed to increased levels of cross-pollination and, thus, greater fruit set. In addition, the pin cherry site used in the fruit loss study contained almost three times the number of trees as the site used for the pollination study. The larger number of pin cherry plants may have been more attractive to pollinators resulting in a greater pollen transfer. These observations and data suggest that the commercial production of pin cherry will require the interplanting of more than one cultivar as a pollen source and likely the use of honey bees to increase pollen transfer.

Table 2. Effect of controlled pollination on final fruit set in pin cherry and choke cherry in 1995 and 1996

	Final fruit set (expressed as % of flower number)			
	Pin Cherry		Choke Cherry	
Treatment	1995	1996	1995	1996
Open-pollinated	13.5*a*	3.7*b*	16.8*b*	37.7*a*
Self-pollinated by hand	0.0*b*	1.5*bc*	7.1*b*	18.8*b*
Cross-pollinated by hand	43.2*a*	59.3*a*	59.7*a*	54.0*a*
Emasculated, not-pollinated	0.0*b*	0.0*c*	5.1*b*	0.8*c*
Coefficient of variation (CV)	96.1	40.1	47.5	32.5

a, b All mean comparisons ($LSD_{0.05}$) performed using square-root transformed data. All means within the same column followed by the same letter are not significantly different.

Choke cherry flowers that were self-pollinated by hand produced fruit, confirming previous findings that choke cherry is partially self-compatible (B. Schroeder, personal communication, PFRA Shelterbelt Centre, Indian Head, SK). However, it was believed that choke cherry would not require cross-pollination to maximize fruit yield (B. Schroeder, personal communication, PFRA Shelterbelt Centre, Indian Head, SK). The results from the current study indicate that supplemental cross-pollination increased final fruit set. In 1995, choke cherry flowers that were cross-pollinated by hand resulted in a significantly higher final fruit set in comparison to all other treatments (Table 2). In 1996, choke cherry flowers that were cross-pollinated by hand resulted in a significantly higher final fruit set in comparison to the self-pollinated and not-pollinated treatments (Table 2). It is speculated that the significantly greater final fruit set of flowers that were open-pollinated in 1996, as compared to flowers that were self-pollinated by hand, was due to the natural transfer of pollen from other sources. Because the supplemental cross-pollination of flowers resulted in a greater final fruit set than that obtained for flowers that were open-pollinated in 1995, the lack of pollen transfer from other genotypes was considered to be an important factor affecting final fruit set in choke cherry in this study. Few floral visits by insect pollinators were observed during full bloom of the choke cherry. This lack of visits by potential pollinators could explain the lower final fruit set under open-pollinated conditions in comparison to those obtained by supplemental cross-pollination. As well, genetically different pollinizer trees were not in very close proximity to the clonal choke cherry trees used in this study and this may have restricted natural cross-pollination from occurring in open-pollinated flowers. Thus, the use of bees to ensure adequate pollen transfer, and the interplanting of more than one cultivar as a source of foreign pollen may result in higher numbers of mature fruit. In both years, the choke cherry flowers that were emasculated and not pollinated produced a low level of fruit set. It was not possible to determine whether the fruit set resulted from parthenocarpy, or accidental self-pollination during emasculation. Accidental self-pollination may be more likely, but parthenocarpy cannot be ruled out without further experimentation.

SUMMARY AND CONCLUSIONS

Sequential sampling of both pin cherry and choke cherry indicated that the primary period of abscission occurred during the first 3 wk following full bloom. Insect pest and disease damage accounted for a small portion of total flower and immature fruit loss and were not considered to be the primary factors contributing to reduced mature fruit number in either species. However, insect and disease problems of minor importance under natural conditions can become major problems under orchard conditions. The controlled pollinations used to determine the role of pollen source and the effect of supplemental cross-pollination of pin cherry and choke cherry suggest that the majority of flower and immature fruit loss resulted from a lack of pollination and/or fertilization. Pin cherry was found to be self-incompatible and supplemental cross-pollination increased the number of mature fruit. Choke cherry was found to be partially self-compatible, and supplemental cross-pollination also increased the percentage of mature fruit. Further research is required to determine the effectiveness of pollinators such as honey bees in increasing pollen transfer, as well as which cultivars are the best pollen sources. Although final fruit set is an important component of yield, the total weight of fruit per plant is of primary interest to a grower. From a grower's perspective, the larger-sized choke cherry fruit and the greater number of fruit per cluster may make choke cherry a more desirable commercial fruit crop than pin cherry despite the relatively low final fruit set.

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