ognizing the value of this discovery and encouraging the small fruit industry to evaluate the 'Thornless Evergreen' blackberry as a commercial cultivar.

Literature Cited

1. Bean, W. J. 1916. Trees and Shrubs Hardy in the British Isles. John Murray, London. Vol. II, pp. 461-2.
2. Carey, C. W. 1922. History of Oregon. Pioneer Historical Publishing Company, Chicago-Portland. Vol. 1, p. 804.
3. Darrow, George M. 1931. A Productive Thornless Sport of the Evergreen Blackberry. *Journ. Heredity*. 22:405-6.
4. Douglas, David. 1914. Journal of David Douglas During His Travels in North America – 1823-1827. William Wesley and Son, London.
5. Hartman, Henry. 1923. *Oregon Agricultural Experiment Sta. Circular* 48.
6. Hedrick, U. P. 1925. Small Fruits of New York. J. B. Lyon Company, Albany. pp. 189-191.
7. Lawton, C. W. 1882. Report from Washington Territory, Amer. Pom. Soc. Proc. 18:129.
8. Schuster, C. E. 1926. Ore. State Hort. Soc. Proc. 18:95.
9. Waldo, G. F. 1938. Ore. State Hort. Soc. Proc. 24:61.
10. Watson, W. R. C. 1958. Handbook of the Rubi of Great Britain and Ireland. University Press, Cambridge. p. 14.
11. Willdenow, C. L. 1809. Berlinische Baumzucht. G. C. Wauck, Berlin. p. 416.

Scion and Rootstock Influence on Winter Survival of Peach Trees

D. P. ORMROD AND R. E. C. LAYNE[1]

Abstract

Survival ratings were made of 11 scion-rootstock combinations of 5-year old peach trees following a severe winter in which minimum air temperatures of –31°C were recorded. Tree survival was a function of scion cultivars and rootstock seed sources, but was affected more by the scion than the rootstock. Tree survival averaged over the four rootstocks was best for 'Siberian C' scions (95%), intermediate for 'Harrow Blood' scions (63%), and poorest for 'Elberta' scions (43%). The survival of 'Elberta' scions was significantly affected by rootstock seed sources with survival being best on seedlings of 'Siberian C' (67%), intermediate on seedlings of 'Bailey' (32%), and poorest on seedlings of 'Rutgers Red Leaf' (18%).

Cold injury is an important limitation to peach culture in Canada and the Northern United States (2). Genetic differences in the cold hardiness of peach cultivars are a significant factor in tree survival (4, 6, 7). Recently, it has been shown that peach seedling rootstocks exert a modifying influence on the expression of scion hardiness (1, 4, 6), although the exact nature of this influence is not known (4). Rootstock seedlings of 'Siberian C' peach have been found to exert an enhancing influence on scion hardiness, more so than other peach seedling rootstocks studied (4). Peach seedling rootstocks have also been shown to affect tree survival indirectly through their effects on canker (*Leucostoma* spp.) infection (3, 4, 5).

In an earlier study (6), we showed that cold acclimation of young peach trees was affected by temperature, photoperiod, cultivar and rootstock. The largest effects were associated with temperature and cultivar, while photoperiod and rootstock had smaller but detectable effects. At the completion of those studies the remaining trees of the various scion-rootstock combinations were planted outdoors

[1]University of Guelph, Guelph, Ontario, and Agriculture Canada Research Station, Harrow, Ontario, respectively. The authors thank Dr. V. A. Dirks of the Harrow Station for statistical advice and L. Pyear of Guelph for technical assistance.

at Cambridge, Ontario. Their survival of a test winter in 1975-76 forms the basis of this study.

Materials and Methods

Peach trees that were grown in pots since 1972 and used formerly in controlled environment studies (6), were planted outdoors in 1973 during their second year of growth. The trees were planted at the University of Guelph Horticultural Experiment Station at Cambridge, Ontario, in adjacent rows with in row spacings of 3.1m and between row spacings of 6.2 m. The various scion-rootstock combinations were randomly assigned to each row. A practice of clean cultivation was followed each year. The soil type was Fox sandy loam. Daily readings of air temperature were taken at a site approximately 2 km distant from the experimental site and at similar elevation. Almost all trees survived the first two winters outdoors. The winter of 1975-76 was unusually severe with temperatures as low as –31.2°C (Table 1) and about 60% of the trees died. In June 1976, when surviving trees were leafed out, a record was made of the status of each scion-rootstock combination. Trees were judged to be alive if any leafing out had occurred and were considered dead if no leaves grew. The survival data were then placed in contingency tables and analyzed by Chi-square (8). Data were first grouped by rootstocks to test the scion effects on tree survival (Table 2), then by scion cultivars (Table 3) to test rootstock effects on survival.

Table 1. Daily maximum and minimum temperatures (°C) at Cambridge, Ontario, during winter 1975-76.

Date	Temperature Maximum	Temperature Minimum
Jan. 16, 1976	–0.1	–16.7
17	–14.9	–28.9
18	–15.3	–30.0
19	–2.2	–26.8
20	0.6	–5.6
21	–5.0	–12.8
22	–12.8	–27.8
23	–15.6	–31.2
24	–12.6	–22.2
25	0.6	–16.1
26	6.0	–2.2

Results and Discussion

Tree survival was affected by scion cultivars and by rootstock seed sources (Tables 2 and 3). Scion survival averaged over all rootstocks showed that the cultivar effect on tree survival was highly significant ($x^2 = 45.96^{**}$). 'Siberian C' scions were the hardiest, 'Harrow Blood' scions were intermediate, and 'Elberta' scions were least hardy with respective overall survival percentages of 95, 63, and 43 (Table 2). This general order of survival was in agreement with previous findings on the relative hardiness of these cultivars (6, 7). Cultivar differences in scion survival were detectable when the scions were on 'Siberian C' seedling rootstocks (Table 2). This was thought to be due to the effect 'Siberian C' has as a rootstock in enhancing scion hardiness (4). 'Harrow Blood' has also been found to enhance scion hardiness (1, 4). The average scion survival on these two rootstocks was 79 and 73%, respectively (Table 2). In previous studies (4) neither 'Bailey' nor 'Rutgers Red Leaf' seedling rootstocks were found to enhance scion hardiness and in this study average scion survival on each of these rootstocks (64%) was less than on 'Siberian C' or Harrow Blood.' Differences in survival among scion cultivars were greatest on 'Rutgers Red Leaf' seedling rootstocks (Table 2), presumably because this stock had the least effect of those studied on the expression of genetic differences in scion hardiness.

The rootstock effect on tree survival averaged over all scion cultivars was almost significant ($x^2 = 5.24$, $p = 0.15$). The effect of the four rootstocks on the survival of 'Siberian C' scions, however, was not significant (Table 3). The rootstock effect on survival of 'Harrow Blood' scions was not significant either, but was larger and closer to being significant than that on 'Siberian C' scions. However, with 'Elberta' scions the rootstock effect on scion survival was significant (Table 3). Survival of 'Elberta' scions was best on seedlings of 'Siberian C' (67%), intermediate on those of 'Bailey' (32%), and poorest on those of 'Rutgers Red Leaf' (18%). A similar effect of these rootstocks on survival of other peach scions has been recently reported (4).

The rootstock effect on tree survival was smaller than the scion effect (Tables 2 and 3), and it appeared that temperatures closer to the killing point for a particular scion would be required before rootstock effects would be detectable. As both 'Sibe-

Table 2. Scion influence on survival of peach trees exposed to a minimum outdoor air temperature of —31°C at Cambridge, Ontario, 1976.

Scion	Seedling rootstock	Tree number Alive	Tree number Dead	% Survival	x^2
Siberian C	Siberian C	22	2	92	
Harrow Blood	" "	27	8	77	
Elberta	" "	14	7	67	4.28
Overall survival				79	
Siberian C	Harrow Blood	14	0	100	
Harrow Blood	" "	13	10	57	6.28*
Overall survival				73	
Siberian C	Bailey	21	1	95	
Harrow Blood	"	15	10	60	
Elberta	"	6	13	32	18.21**
Overall survival				64	
Siberian C	Rutgers Red Leaf	24	1	96	
Harrow Blood	" " "	12	11	52	
Elberta	" " "	2	9	18	22.64**
Overall survival				64	

Table 3. Rootstock influence on survival of peach trees exposed to a minimum outdoor air temperature of —31°C at Cambridge, Ontario, 1976.

Scion	Seedling rootstock	Tree number Alive	Tree number Dead	% Survival	x^2
Siberian C	Siberian C	22	2	92	
" "	Harrow Blood	14	0	100	
" "	Bailey	21	1	95	
" "	Rutgers Red Leaf	24	1	96	1.43
Overall survival				95	
Harrow Blood	Siberian C	27	8	77	
" "	Harrow Blood	13	10	57	
" "	Bailey	15	10	60	
" "	Rutgers Red Leaf	12	11	52	4.68
Overall survival				63	
Elberta	Siberian C	14	7	67	
"	Bailey	6	13	32	
"	Rutgers Red Leaf	2	9	18	8.57*
Overall survival				43	

rian C' and 'Harrow Blood' were sufficiently hardy as scions, the temperature stresses in 1975-76 were probably insufficient to produce detectable rootstock effects on hardiness. On the other hand, 'Elberta,' which is known to be substantially less cold hardy than the other two scions (6), was apparently closer to its killing point, thus rootstock effects on its hardiness as a scion were more readily detected.

The occurrence of a test winter (−31°C) provided the opportunity to demonstrate that 'Siberian C' and 'Harrow Blood' as scions were substantially more cold hardy than 'Elberta.' Rootstock seedlings of 'Siberian C,' and to a lesser extent those of 'Harrow Blood,' were shown to confer some additional cold hardiness to scion cultivars when compared with seedlings of 'Bailey' and especially those of 'Rutgers Red Leaf.'

References

1. Chaplin, C. E. and G. W. Schneider. 1974. Peach rootstock/scion hardiness effects. *J. Amer. Soc. Hort. Sci.* 99:231-234.
2. Layne, R. E. C. 1974 Breeding peach rootstocks for Canada and Northern United States. *HortScience* 9:364-366.
3. ————. 1976. Influence of peach seedling rootstocks on perennial canker of peach. *HortScience* 11:509-511.
4. ————, H. O. Jackson and F. D. Stroud. 1977. Influence of peach seedling rootstocks on defoliation and cold hardiness of peach cultivars. *J. Amer. Soc. Hort. Sci.* 102:89-92.
5. ————, G. M. Weaver, H. O. Jackson and F. D. Stroud. 1976. Influence of peach seedling rootstocks on growth, yield and survival of peach scion cultivars. *J. Amer. Soc. Hort. Sci.* 101:568-572.
6. Ormrod, D. P. and R. E. C. Layne. 1974. Temperature and photoperiod effects on cold hardiness of peach scion-rootstock combinations. *HortScience* 9:451-453.
7. Quamme, H. A., R. E. C. Layne, H. O. Jackson and G. A. Spearman. 1975 An improved exotherm method for measuring cold hardiness of peach flower buds. *HortScience* 10:521-523.
8. Steele, R. G. D. and J. H. Torrie. 1960. Principles and Procedures of Statistics. 481 p. McGraw Hill Book Company, Inc., New York.

'Autumnglo,' a Late Ripening, Freestone Peach[1]

CATHERINE H. BAILEY AND L. FREDRIC HOUGH

'Autumnglo' is a very good quality, large, firm-fleshed, yellow, freestone peach ripening a week after 'Rio Oso Gem.' In several test winters it has come through with more bloom than other commercial cultivars ripening after 'Elberta' and 'Jerseyqueen.'

Origin

'Autumnglo' is the result of the cross 67239 x 'Merrill Fiesta' made in 1961; 67239 was the result of a cross between 'Candoka' and a nectarine seedling, 25032, selected from Tennessee natural pits.

The first fruits of 'Autumnglo' were seen in 1965. In 1966 it was assigned the introduction number NJ232. The first trees were planted in growers' orchards in New Jersey in 1967.

Fruit Characteristics

'Autumnglo' is a large, round, yellow-fleshed freestone peach with a moderate amount of red at the pit. It has very firm, melting flesh of high dessert quality. At the time of harvest the skin is ½ to ¾ covered with red which may be slightly dull, over a greenish-yellow ground color. The

[1]Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Horticulture and Forestry, Cook College, Rutgers University—The State University of New Jersey, New Brunswick, New Jersey 08903. This research was supported in part by Hatch Funds.