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An Assessment and Illustration of Winter Injury to Selected Apple Cultivars in Nova Scotia, 1980-81

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Abstract

Of nine apple cultivars grown commercially in Nova Scotia, Gravenstein, Wayne and Northern Spy were the most sensitive to low temperature stresses of December, 1980. Injury occurred on the trunk below the lower limbs and in the crotch area of the main limbs. The extent of damage to the trees was evident following removal of dead bark and adjacent tissue where it had not exfoliated. The percent of healthy tissue lost was recorded and is illustrated in a series of photographs. No injury could be found in the rootstock at or just below the soil line.

Introduction

Apple trees are generally hardy to mid-winter weather in Eastern Canada. The attainment of maximum hardiness is gradual, beginning with certain physiological changes within the tree, triggered by the photoperiod (9). The distal or terminal portions of the tree are the first to harden; the trunk portions, last (1). Low temperature extremes in early winter may subject the unhardened lower portion of the tree to stress beyond its recovery capability.

Extensive damage to apple orchards was reported after late fall or early winter cold extremes in Eastern Canada in 1933 (2) and in 1980 (8). The present paper presents an analysis of the impact of this latter cold stress on orchard plantings in Nova Scotia.

Study Area and Method of Investigation

The Morristown area of the Annapolis Valley was selected for this study for two reasons. It is a concentrated centre of fruit growing representative of the soil and climate in the area. A Nova Scotia Department of Agriculture & Marketing survey of damage revealed that this locale had as much damage as any other area in the fruit growing district. In July 1982, representative rows were selected from two commercial orchards planted in 1964 and 1965. The combined area was 36 hectares. Each tree in the row was carefully examined for evidence of injury. A 15 cm bar tool was used to remove dead bark, phloem and cambial tissue down to dry xylem wood. A sharp knife was used to cut through bark, phloem and cambium around

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Figs. 1 & 2. 1. A Wayne tree, prior to removal of dead bark, phloem and cambium. 2. Dead tissue has been removed. New shoots are growing from roots, lower undamaged trunk and on a lower limb. Partly girdled limbs had light yellow foliage; limbs on the undamaged side of the tree were apparently normal. This tree was rated at 65% injury.

the damaged zone, thereby revealing the margin between healthy and dead tissue (Fig. 3).

The injury rating (Table 1) reflects a percentage loss of healthy tissue from the circumference of the tree at the point of maximum damage. Whole limb death was not rated as it was always traced to a complete girdling of the limb at the trunk or crotch area by damaged tissue (Fig. 3). McIntosh and King cultivars were established on Beautiful Arcade rootstocks whereas the other cultivars were on seedling rootstock of unknown parentage. Yield histories prior to and including 1979 were considered average to good by the growers.

Observations

The Gravenstein cultivar was found to be the most sensitive to winter injury (Table 1). Approximately 450 Gravenstein trees had been removed in 1981 because of extensive injury to the trunk and lower limbs, wihch was assumed to exceed 50%.

Wayne and Spy were rated at approximately 50% and 40% injury, respectively, while King and Golden Delicious rated just over 20% (Table 1). Cortland and Spartan trees showed almost no injury while McIntosh and Red Delicious were found to be almost as hardy (Table 1).

Injury to the cultivars was generally confined to the main trunk below the

Table 1. Susceptibility of selected apple cultivars to 1980-81 winter temperatures.

Cultivar	Number of trees examined	Trunk injury % loss of healthy tissue
Gravenstein	See note	>50
Wayne	15	50
Spy	150	39
King	62	22
Golden Delicious	30	21
Red Delicious*	27	4
McIntosh	38	8
Spartan	64	<1.0
Cortland	108	<1.0

*Starkrimson strain

NOTE: Considerable mortality and extensive damage was evident in the spring of 1981 therefore all Gravenstein trees were removed prior to the damage assessment but it was likely above 50%.

branches, although injury in the crotch area was also common (Fig. 3, 4 & 5). When damage extended to the lower trunk it stopped abruptly at or slightly above the ground. It was also noted that trunk damage was not related to any particular exposure (i.e., southwest).

Fruit or vegetative bud damage was not common in Nova Scotia and the 1981 crop in the Annapolis Valley was average. Abnormally low temperatures in late December 1980 were recorded in eastern Ontario, Quebec, New Brunswick and Nova Scotia (Table 2). Nova Scotia reported the least damage (Table 3) consistent with the highest minimum temperatures (Table 2).

Discussion

Waring (7) in Maine found Gravenstein very susceptible to injury in the 1933-34 winter whereas Cortland, McIntosh and Red Delicious cultivars were amongst the most hardy. Gravenstein, King and Northern Spy were grouped among the tender and McIntosh was considered hardy by Chandler following the 1917-18 winter damage in New York (3). These observations coincide with the results of this assessment where Gravenstein was classed as the most tender cultivar, with Wayne, Spy, King and Golden Delicious also rated as tender and Cortland, McIntosh, Red Delicious and Spartan rated as hardy.

Blair (2) observed injury in Eastern Canadian apple regions following the 1933-34 winter that was confined to the main branches, crotch and the part of the trunk from the ground to a few feet up the branches. Rawlings and Potter (5), New Hampshire, and Waring (7), Maine, also found, as in this report, that trunk damage stopped at

Table 2. Minimum temperatures in eastern Canadian apple regions, December 1980.

Orchard Region	Date and Minimum Temperature °C 22	23	24	25	26	27	28	29	30
Smithfield. Ont.	—12.0	— 7.5	— 9.0	—30.0	—26.0	—16.0	—19.0	— 0.5	—15.5
Rougemont, Que.	—24.0	— 9.5	—11.5	—33.0	—31.0	—16.5	—23.0	— 1.0	—18.0
Fredericton, N.B.	—29.0	—27.5	—13.0	—23.5	—31.0	—23.5	—28.5	—10.0	— 3.5
Kentville, N.S.	—19.5	—20.0	— 6.0	—16.0	—23.0	—16.0	—20.0	—12.5	0.0

Source - Canada. Atmospheric Environment Service. Monthly record: meteorological observations in Eastern Canada. December 1980.

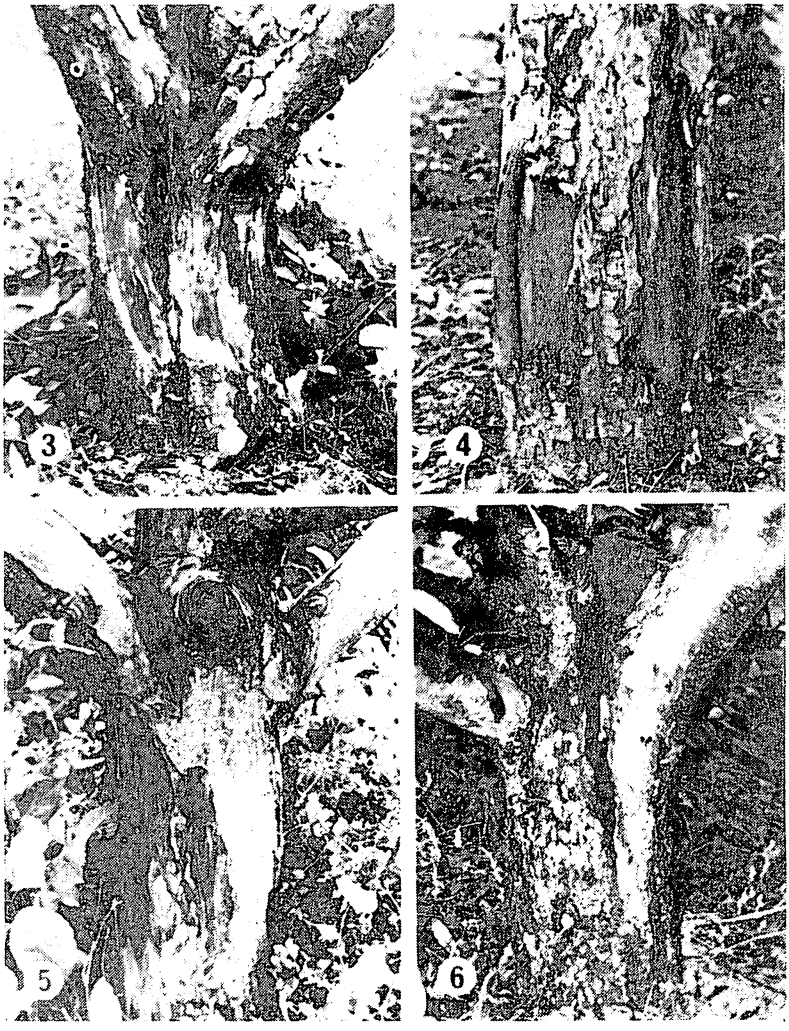

Fig. 3. Extensive damage illustrated on the trunk of Northern Spy just below the lower limbs. Damage extended into the narrow crotches at the center of the tree. The clear white strips at the lower edge of the damaged zone and the white patches at the base of the limbs show actively growing, healthy tissue. The injury rating for this tree was 55%.

Fig. 4. This McIntosh tree demonstrated excellent regrowth around the perimeter of the affected area. In 1982 this tree carried a commercial crop with terminal growth and foliage color similar to trees without damage. It was rated at 30% damage.

Fig. 5. This Golden Delicious tree demonstrated susceptibility to damage on the lower trunk and on the upper part of the crotch areas even when the angle was greater than 45°. This tree was rated at 60% injury.

Fig. 6. Red Delicious Starkrimson strain did not show extensive damage in either orchard block. Even around the narrow crotch angles damage was only slight. This tree with an injury rating of 3% was one of the most seriously affected.

Fig. 7. This King tree was rated as having lost 80% of formerly healthy trunk tissue. While tissue death occurred in 1980 exfoliation did not occur until 1982. There was leaf, flower and fruit development in 1982 but severe stress was obvious in August except immediately above the surviving 20% of the trunk.

Fig. 8. The trunk of the tree in Fig. 7. The upper portion of a major root above ground, to the right behind the tree, was uninjured. A number of shoots are evident at the base of the tree and have grown from the lower trunk and roots below the injured zone.

or slightly above the ground (Fig. 4), thus failing to implicate the rootstock.

McNicholas and Forshey (4) and Warner (8) describe damage from the 1980-81 winter to orchards in New York and Eastern Ontario, respectively. Detail of flower bud damage was well documented but cause of whole tree mortality, likely trunk damage, was only briefly described. By contrast, lower trunk damage was the focus of injury in the Annapolis Valley.

Weather conditions in Nova Scotia were a few degrees warmer than New Brunswick, Quebec or Ontario where mortality and injury were more severe (Tables 2 & 3), indicating an apparent proximity to the critical temperature for trunk damage.

Conclusion

Gravenstein, Wayne and Spy were the most sensitive to low temperature injury while Cortland and Spartan showed almost no injury. Variety, therefore, must be considered an important variable in combatting this type of damage.

This assessment and others (5), (6), (7) observed injury only above ground following early winter cold injury illustrating the lack of susceptibility of the rootstock (Figs. 7 & 8).

Injury in Nova Scotia was primarily on the trunk below the lower limbs and was best illustrated by exfoliation of the cambium, phloem and outer bark (Figs. 1 & 2) during the second summer following injury.

Table 3. Apple tree losses in eastern Canada from winter injury, 1980-81.

Orchard Region	Number of trees	% of total trees
Eastern Ontario	28,000	4.0
Quebec	300,000	31.0
New Brunswick	26,000	15.5
Nova Scotia	7,000	1.0

Acknowledgement

Appreciation is expressed to L. Hutchinson and O. Rainforth for the use of their orchards.

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History of Fruit Growing Errata

A serious error was made in the "Utah" chapter of the A.P.S. "History of Fruit Growing. . . ." In the listing of department heads, page 137, the list should be as follows:

F. M. Coe	1927-1934
Alma Wilson	1935-1943
(Office vacant)	1944-1946
S. W. Edgecombe	1947-1952
R. M. Bullock	1952-1953
Leonard Pollard	1954-1963

Until 1954 there were two departments at Utah State. Dr. Pollard was head of the vegetable crops department. The horticulture department included pomology and ornamentals and was headed by the men shown above. After 1954 the two departments were combined, with Pollard as head.

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