Peach Rootstock/Scion Hardiness Effects

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Abstract. Cold resistance of current season shoots of 'Redhaven' peach in the nursery as affected by 4 rootstocks was determined by electrical conductance. Significant conductance differences were noted on scion due to rootstock effects, and the most effective time for determining this difference appeared to be in early winter. There were significant differences due to late N applications. Late winter determinations showed that rootstock effects tend to diminish except at critical temperatures. There was variance in relative hardiness of stocks from 1 temperature to another or on different dates but, in general, 'New' and 'Harrow Blood' transmitted more hardiness to scions that did 'Siberian C' or 'Rutgers Red Leaf'. 'Siberian C' was generally better than 'Rutgers Red Leaf'.

Studies on the effect of rootstocks on scion cold hardiness, with apples, have yielded conflicting results. Most early workers (1, 6, 16, 19) stated that scion cold hardiness was independent of the rootstock. Filewicz (9) found a reciprocal effect of stock and scion with apples. Stuart (18), however, stated that the scion affects hardiness of the stock but he found no reciprocal effect. Edgerton (7) found 'Montmorency' cherry trees on Mahaleb rootstock were more cold resistant in both fumigated and unfumigated nematode-infested soil than those on Mazzard understocks. However, he attributed this to more meadow nematode resistance of the Mahaleb and also to the fact that more of the Mahaleb roots were below the 30 cm depth which was below where most of the nematodes were found. A new peach rootstock 'Siberian C' has been thought to transmit cold hardiness to its scion cultivar in the fall since it hardens off earlier than most other rootstocks. Research (14) indicated that it does transmit fruit bud hardiness to the scion. The delayed maturity and decreased hardiness resulting from late summer N application is well known (10, 15, 20). Lapins (12) showed that cold hardiness can be assessed on young trees in their juvenile stages since the relative hardiness of juvenile versus mature zones is similar.

In the fall of 1971 we observed that 3 seedling stocks suffered tip kill. These were 'Harrow Blood', 'Rutgers Red Leaf' (R.K.L.), and a hardy white designated as 'New' and probably quite similar to 'Boone County Seedling'. A fourth, 'Siberian C' had no terminal shoot damage. 'Siberian C' had lost some leaves, but the others had not, and were not visibly hardened. Thus, the present test was undertaken to determine if any of the 4 rootstocks had an effect on fall and early winter hardiness of scion wood of peach trees in the nursery.

We intended to gather several years data in this experiment, but the trees were lost from "wet feet" in the spring of 1973. Since rootstock research is of wide interest and the data were uniformly reliable we felt that little additional information could be gained to justify delaying this report for several years.

Literature Cited

Materials and Methods

'Redhaven' was budded to 4 seedling rootstocks, 'Siberian C', 'Harrow Blood', 'R.R.L.' and 'New' in August, 1971. The trees grew well during the summer of 1972 and many lateral branches developed. An application of NH\textsubscript{4}NO\textsubscript{3} (114 g per tree) was applied to part of the trees in August to keep them growing later in the fall.

Samples were collected for freezing tests on Nov. 17, Dec. 4, and March 2. Sampling was limited to these 3 times because of lack of suitable wood for more tests. There was not enough wood on the trees in the N fertilized plots for the March 2 tests. The March test also compared injury between the terminal and second 15 cm increments of growth. Samples consisted of 4 lateral shoots 30-45 cm long for each treatment in each of 3 replicates. They were frozen in a freezing chamber similar to that described by Chaplin (3). The temp was lowered at approximately 1.7°C per hr, except that it was held at each removal temp for approximately 1 hr.

After removal from the freezer all samples were placed overnight in a refrigerated room at 4°C. Samples for the first 2 tests were then prepared for exosmosis by discarding the terminal 1.24 cm of the shoots and clipping the next 15 cm into 1.25 cm lengths. The March tests consisted of two 15-cm segments of each shoot cut into 1.25 cm increments. They were then weighed and 5 times their wt of glass distilled water was added. They were allowed to set overnight at room temp and the electrical conductance in micromhos (mmho) was determined. The samples were then autoclaved at 5 lb pressure for 10 min and allowed to set overnight. Then the electrical conductance was again determined and the percentages of total solutes exosomed due to cold treatments were calculated. High conductance values or high percent solutes indicate more injury to the tissue from freezing.

The Dec. 4 percentages could not be calculated because the identifying markings became illegible after autoclaving. However, later data showed that the total solute content did not vary significantly between treatments and mmho readings were equally valid. Lapins (11) found similar F values for variation due to cultivar differences in comparisons of mmhos vs. percentage of total electrolytes.

Results and Discussion

November Test. Very little leaf fall had occurred on the N-fertilized plots by Nov. 7 when the first samples were frozen. About one-fourth of the leaves had fallen from the unfertilized trees. No differences between leaf fall and other visual hardening criteria were noted due to rootstock. In close nursery plantings of apples the correlation between tree maturation in the fall and cold hardiness was low even though there were marked differences in leaf fall, earliness of fall color, stage of development of terminal and lateral buds, and the extent of lignification of woody tissues in shoot tips (11). Chaplin (3) showed that peach flower buds were hardier in early October than the wood, for on most cultivars the bark was badly injured at -11°C (12°F) and the tips at -9.4°C (15°F) even though flower buds were not injured.

Analysis of variance of our data showed that late N application significantly reduced cold hardiness of the wood of young trees. Since there was no N-stock interaction the data presented are the averages of both fertilizer treatments. There were no significant differences between rootstock hardness effects within the control and -8°C samples. 'New', however, had significantly more hardening effect on the scion at -10°C than did other rootstocks. At -13°C 'H. Blood' contributed the most hardiness to the scion. The reversal of relative hardiness of 'New' and 'H. Blood' from -10°C to -13°C could mean that 'H. Blood' had an injury threshold near -10°C and did not show more injury at -13°C. Quamme et al. (17) have shown that different tissues are involved in different freezing exotherms.

This could also account for this reversal. At -18°C differences were small. Apparently the -18°C temp caused injury to the most hardy stock-scion combination. Another test at an intermediate temp would have been desirable.

FIG. 1. The effects of rootstocks and N fertilization on peach scion winter hardiness in the nursery as measured by electrical conductance, Nov. 17, 1972. Mean separation by Duncan's multiple range test at the 1% level.

December Test. The Dec. 4 hardiness determinations were the most useful in determining the effect of rootstocks on scion cold hardiness (Fig. 2). Lapins (13) and Emmert and Howlett (8) found much greater differences between cultivars in early winter than in late winter.

Figure 2 shows that samples of 'R.R.L.', 'H. Blood' and 'New' from the control plots liberated less solutes than did 'Siberian C'. At -20°C 'New' and 'H. Blood' rootstocks contributed more hardiness to the scion than 'R.R.L.' 'New', 'H. Blood' and 'Siberian C' were not different.

Shoots from 'Redhaven' trees on 'R.R.L.' stocks frozen at -20°C on Dec. 4, lost 70% more solutes than unfrozen (control) ones from the same trees. Those on 'Siberian C' lost 14% and 20% more, respectively, than unfrozen 'Redhaven' shoots on the same stock.

When frozen at -23°C 'Redhaven' shoots on 'H. Blood' were significantly more hardy than those on other stocks. Those on 'New' were harder than those on 'R.R.L.' or 'Siberian C'. These conclusions are based on comparative amounts of solute released by frozen and unfrozen 'Redhaven' tissue as discussed in the preceding paragraphs.
Fig. 3. The effects of rootstocks on peach scion winter hardiness of mature trees, Dec. 4, 1972.

Fig. 4. Effects of rootstocks on peach scion winter hardiness as measured by electrical conductance, Mar. 2, 1972. Mean separation by Duncan's multiple range test at the 5% level.

Scion shoots on 'H. Blood' were significantly harder than those on 'R.R.L.' and 'Siberian C' but no better than those on 'New' at -26°C. 'New' and 'Siberian C' were significantly better than 'R.R.L.' at this temperature.

At -30°C there was considerable damage to all samples but again 'H. Blood' was significantly better than the other 3 rootstocks in imparting cold hardiness to the 'Redhaven' scion.

Another test using older trees was conducted during the Dec. 4 freezing trials. Samples from mature trees of 2 cultivars growing on 'Siberian C' and common rootstocks in a grower's orchard at Henderson, Ky., were frozen as described above. Figure 3 shows the difference in hardiness of the 2 cultivars. 'Harken' was significantly harder at all temps than was 'Harmony' on both rootstocks. Rootstocks had no effect on hardness of either cultivar except at -23°C where the common stock imparted more hardiness than 'Siberian C'.

March Test. The March freezing tests showed no significant differences in hardiness due to rootstocks, when shoots were frozen at -19, -22, -23 and -25°C, at any one freezing temp. There was considerable damage to scions on all rootstocks at -30°C. There was significantly more damage to the terminal 15 cm than to the next section. Scions on 'New' showed more wood hardiness than others on this date. 'H. Blood' and 'Siberian C' were significantly harder than 'R.R.L.'.

Our data show definite effects of peach rootstock on scion winter hardiness. Further studies should be made with other rootstocks. Vegetatively reproduced rootstocks should also be used to further improve experimental precision.

Literature Cited

Effect of Seed Size on Uniformity of Pimiento Transplants (Capsicum annuum L.) at Harvest Time

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Abstract. Replicated field plots of small, medium, and large pimiento seeds, cv. Truhard Perfection, were planted in mid-February of 1972 and 1973. Compared to seedlings produced by small seeds, those from medium and large seeds emerged 2 days earlier to a significantly better stand, and attained in 71 days the growth, the hardened condition, and the root system required of usable transplants by canners. Transplants from small seeds failed to reach these requirements within the 75-day duration of this study.

The nation’s pimiento (Capsicum annuum L.) transplant-growing industry is centered around Bartow in Polk County, FL. Seed plantings are made in open fields from late January to mid-February. Most transplants are usually ready for once-over hand harvest within 70 to 75 days, or as soon as they have attained a height of 22-23 cm, a well-developed root system, and become adequately hardened. Frequently 10 to 15% of them fail to meet canner requirements, due to lack of size, and have to be discarded. This often causes economic problems for the commercial transplant grower. In an effort to regulate size uniformity at harvest, some growers have reduced their seeding rates as much as 15%, while others have tried clipping the taller plants by mechanical means to let the smaller ones increase in size. Both practices have aided the cause but not to the extent desired. Seed size was thought to be involved, especially since the results of research with other vegetable crops (1, 3, 5, 6, 7, 8, 9, 10, 11) suggest such a relationship. We studied the influence of this factor on the uniformity of field-grown pimiento transplants at harvest.

Materials and Methods

Company seed stocks of cv. Truhard Perfection (2) were used. Their disc-like shape and absence of pubescence permitted good separation of the seeds into small, medium and large sizes (Table 1) by using metal screens with round perforations of 3, 4, and 5 mm, respectively, diameter.

Experiments were conducted in 1972 and 1973 in level fields equipped with sprinkler irrigation. The fine sandy loam soil was well supplied with organic matter from the incorporation of green manure crops of begger weed (Desmodium tortuosum). The soil had a pH of 6.5. Land preparation, seeding, and management of the transplants were in accordance with commercial practices for the central FL plant-growing area. The 3 treatments were replicated 4 times in randomized complete blocks. Singlerow plots 12.2 m long and 30.5 cm apart were used and the seeding rate was 3.63 kg per ha. The plots were planted on February 15 in 1972, and February 16 in 1973. The date of first seedling emergence was recorded for each treatment and stand counts were made 14 days later. Height measurements of 20 typical plants in each replicate were taken 30, 45, 60, and 75 days after seeding. The data were subjected to analysis of variance, and mean differences were tested by Duncan’s multiple range test (4).

Results and Discussion

Seedling emergence and plant stands. Compared to seedlings from medium and large seeds, those from small seeds emerged 2 days later and had a 10% lower stand (Table 2). Similar relationships occurred in the greenhouse but the time elapsed was

Table 1. Distinguishing characteristics of small, medium, and large pimiento seed.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>diam mm</th>
<th>wt mg</th>
<th>No./kg</th>
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<tr>
<td>Small</td>
<td>2.99</td>
<td>5.87</td>
<td>170,358</td>
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<tr>
<td>Medium</td>
<td>3.54</td>
<td>7.20</td>
<td>138,889</td>
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<tr>
<td>Large</td>
<td>4.19</td>
<td>8.08</td>
<td>123,763</td>
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1Average of 10 determinations of 20 seeds each.