Differential Sensitivity of ‘Com-Pact Redhaven’ and ‘Redhaven’ Peach Shoot Tips to BA in Vitro

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Abstract. Shoot tip cultures of ‘Redhaven’ peach [Prunus persica L. (Batsch)] and its compact mutant ‘Com-Pact Redhaven’ reacted differentially to exogenous BA in vitro. ‘Com-Pact Redhaven’ produced the highest number of axillary shoots at 30 µM BA, while the maximum proliferation of ‘Redhaven’ occurred at 10 µM BA, with a significant decrease in proliferation at 30 µM BA. At 100 µM BA, axillary shoot proliferation was more than twice as high in ‘Com-Pact Redhaven’ as in ‘Redhaven’ cultures. Maximum increase in total fresh weight of explants occurred at 10 µM BA for both cultivars, but, at 30 µM BA, fresh weight increase of ‘Redhaven’ was less than half that of ‘Com-Pact Redhaven’. This study suggests that compact growth habit in peach can be selected in vitro based on reaction to BA. Chemical names used: N-(phenylmethyl)-1H-purin-6-amine (BA), 1H-indole-3-butyric acid (IBA).

Apple tree growth habit mutants have been shown to respond differentially in vitro to levels of exogenous BA (5). The use of selective media based on BA concentration was proposed for the isolation of compact apple tree mutants in vitro; the authors suggested that endogenous cytokinins may play a key role in compact growth.

Compact growth in apples is determined by a single dominant gene (7), as is compact growth in peach (10). Compact peach trees have been isolated as spontaneous mutations of standard cultivars (1), as have compact apples (8). Both compact apples and peaches have shorter internodes, increased budbreak, and darker green leaves than standard cultivars (2, 6, 12). In other aspects of growth, compact apples and peaches differ (Fig. 1). Compact apples form many spurs, but few long lateral shoots (6). Compact peaches form many long lateral shoots (12), although we have noted the development of short spur-like shoots in older, unpruned compact trees (unpublished data). Compact apple trees have narrow branch angles and an upright, columnar growth habit. Compact peach trees have wide angle branches that give trees a low, wide, pendulous aspect. Although peach and apple compact trees appear to be dissimilar in some growth characteristics, the differential response to BA between standard and compact apple genotypes in vitro suggested that compact peach tree growth habit might also respond differently to growth regulators in vitro.

The purpose of this study was to test the effects of exogenous BA levels on in vitro shoot proliferation of two peach genotypes presumably differing only in the presence or absence of the dominant compact allele and to ascertain the feasibility of selection for peach growth type in vitro.

‘Com-Pact Redhaven’, a mutation of ‘Redhaven’ (1, 14), has been shown to be heterozygous for the compact character (10). ‘Com-Pact Redhaven’ and ‘Redhaven’ shoot tips = 5 mm long were collected in the spring from mature, field-grown trees. Shoot tip cultures were disinfested and established on shoot elongation medium (3) with 0.7% Phytagar (GIBCO). Shoots were maintained on this medium for 8 weeks followed by 3 weeks on the same basal medium with 10 µM BA and 0.05 |µM IBA (4), which improved shoot vigor. Following this initial culture establishment period, the base of each shoot, including any axillary shoots that formed, was removed. The fresh weight of individual shoot tips was recorded. Initial mean fresh weight of ‘Redhaven’ and ‘Com-Pact Redhaven’ was 61 and 84 mg, respectively. Shoot tips were placed on the basal media and maintained on shoot elongation medium for 8 weeks.

Fig. 1. Standard apple ‘Jonathan’ (A). Compact apple ‘McIntosh Wijcik’ (B). Standard peach ‘Redhaven’ (C). Compact peach ‘Com-Pact Redhaven’ (D).

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medium with 0, 1, 3, 10, 30, or 100 μM BA and 0.01 μM IBA. Twenty shoots of each cultivar were placed on each treatment. Shoot tips were transferred to fresh medium every 3 weeks. After 6 weeks, 10 shoot tips from each treatment were harvested. Axillary shoots that could be clearly defined as such were counted. These shoots were generally >2 mm long. Each explant, including the original and axillary shoots, was blotted dry and weighed. The original weight of the shoot tip was subtracted from the final explant weight to determine the fresh weight increase. This process was repeated for the remaining 10 explants in each treatment after 9 weeks of culture.

Maximum shoot proliferation depended on BA concentration and growth habit, both after 6 and 9 weeks of culture (Fig. 2 A-D). 'Redhaven' produced the highest number of axillary shoots at 10 μM BA (3.6 at 6 weeks; 8.8 at 9 weeks), while 'Corn-Pact Redhaven' proliferated the highest number of shoots at 30 μM BA (4.9 at 6 weeks; 8.1 at 9 weeks) (Fig. 2 A and B). Both 'Redhaven' and 'Com-Pact Redhaven' had similar fresh weight increase maxima at 10 μM BA, but, at 30 μM BA, the fresh weight increase of 'Redhaven' dropped 64% from the maximum at 6 weeks and 78% at 9 weeks, while that of 'Com-Pact Redhaven' dropped only 9% at 6 weeks and 40% at 9 weeks (Fig. 2 C and D). Decreases in dry weight associated with increases in shoot number may be due to a reduction in leaf size on shoots produced under high BA levels.

As in apple compact mutants, the compact mutant of 'Redhaven' peach tolerated higher levels of BA in vitro, as indicated by axillary shoot proliferation and explant fresh weight. The increase in fresh weight recorded in our study reflects, at least in part, the higher production of axillary shoots. The slight increase in 'Redhaven' fresh weight at 100 μM BA (Fig. 2 C and D) may have been the result of callus proliferation at the base of explants.

Compact peach and apple trees have a high percentage of lateral budbreak. It is notable that both of these phenotypes are more tolerant of high BA levels in vitro than the genotypes from which they mutated. 'McIntosh Wijcik' compact apple has been found to contain high levels of endogenous cytokinin compared with other 'McIntosh' strains (9). While the levels of endogenous cytokinin in compact peach trees are, to our knowledge, unknown, foliar application of exogenous BA to standard peach trees has been shown to induce buds to form lateral branches and spurs, reducing growth of the main leader (11). Such a treatment would produce a growth type similar to the naturally occurring compact peach. High endogenous cytokinin levels in 'Com-Pact Redhaven' are also suggested by elevated chlorophyll content (2) and delayed leaf senescence when compared with 'Redhaven'. The growth habit-dependent reaction to cytokinins in vitro further indicates that cytokinins are, in some way, at least partially responsible for differences in tree growth (5). The high percentage of lateral budbreak common to both the compact apples and peaches most likely is the aspect of tree form that is influenced by endogenous cytokinin. Our results suggest that compact peach mutants could be selected in vitro in a medium containing 30 to 100 μM BA. While the compact growth habit in peach is undesirable due to the dense branch growth, it may be possible through the use of induced mutation and selection under high BA levels to produce mutants of standard cultivars representing a range in compact and spur-type growth habit (13). Work with apple (5) suggests that differential responses to BA con-

Fig. 2. Number of axillary shoots (A and B) and increase in explant fresh weight (C and D) of 'Com-Pact Redhaven' and 'Redhaven' peach shoot tips after 6 and 9 weeks of in vitro culture in media containing various concentrations of BA.
Interactive Effects of Temperature, Photoperiod, and Cultivar on Tuberization of Potato Cuttings

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Abstract. Cuttings of young potato plants (Solanum tuberosum L.) were used as a technique for evaluating the influence of temperature and photoperiod on the degree of tuber induction. Growth chambers were used to create four combinations of two air temperature regimes ("hot", 30°C day/25°C night, or "cool", 20°C day/15°C night) and two photoperiods ("long photoperiod", 16 hr of light, or "short photoperiod", 10 hr of light). The six cultivars and clones tested exhibited varying degrees of induction. Early maturing cultivars, such as 'Norchip' and 'CI-884', were less affected by increased temperature with short photoperiod or by longer photoperiod under cool temperatures than were other cultivars. Raising the temperature under short photoperiod caused a reduction of about 50% in tuber dry weight from 'Katahdin'. Long photoperiod intensified the effects of higher temperature in reducing induction, especially with later-maturing cultivars such as 'Katahdin' and 'Déésiree'.

Tuber induction of potatoes is favored by short days and cool temperatures (8). The degree of induction at a given photoperiod varies with temperature and among cultivars and clones (5), but little is known about the interactions among temperature, photoperiod, and cultivars for tuberization. Cuttings provide a useful tool to study this question, since tuberization on cuttings reflects the degree to which a plant has been induced to tuberize (5). The ability of cuttings from plants with a long critical photoperiod to form tubers at the buried bud has been correlated with early tuberization in the whole plant (5, 12). Early maturing cultivars, such as 'Norchip' and 'CI-884', were less affected by increased temperature with short photoperiod or by longer photoperiod under cool temperatures than were other cultivars. Raising the temperature under short photoperiod caused a reduction of about 50% in tuber dry weight from 'Katahdin'. Long photoperiod intensified the effects of higher temperature in reducing induction, especially with later-maturing cultivars such as 'Katahdin' and 'Déésiree'.

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