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Verification of the Parentage of Presumed Peach x Almond Hybrids by Isozyme Analyses

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Abstract

Leucine amino peptidase (LAP) and 6-phosphogluconate (6-PGD) isozyme analyses were used to confirm the suspected F_1 hybrid origins of 'Hann' almond, 'Pollardi' (PI 113650), 'Rogani Goy' (PI 113452) and PI 117679. The 'Peach x divaricata' clone was demonstrated to be a later generation derivative of a peach x almond hybrid and not a peach x plum hybrid.

Introduction

Peach x almond hybrids have been known since the 16th century, and in recent years, have been used in breeding to develop vigorous rootstocks tolerant to lime-induced chlorosis that produce few suckers (8). Unfortunately these hybrids are more difficult to propagate clonally than peach (10). The almond's spur growth habit has also been noted as a potentially useful trait in the development of spurry peach cultivars that would require less pruning (13).

Isozyme analysis is a powerful tool in the study of evolutionary, taxonomic and genetic relationships among organisms (5, 7). It has been used to aid in the identification of cultivars (14) and to verify intraspecific (9, 15) and interspecific parentage (2, 6, 11) in a wide range of fruit and nut crops. Peach x almond hybrids can be readily recognized with isozyme analysis of LAP (6) or 6PGD (2).

The objective of this paper is to establish, with the use of isozyme analysis, whether the clones, 'Pollardi,' 'Hann' almond, 'Rogani Goy,' 'PI 117679' and 'Peach x divaricata' ('Pchxdiv') are peach x almond interspecific hybrids. 'Pollardi,' 'Rogani Goy' and 'PI 117679' were introduced as peaches into the United States in the 1930's (Table 1). 'Pollardi,' although introduced from Italy, may be the same clone as 'Pollardii' which was introduced in Victoria, Australia in 1904 by Mr. Pollard. 'Pollardii' is a peach x almond hybrid. It blooms very early and has large showy flowers (3), as does the clone 'Pollardi' (13). 'Rogani Goy' is assumed by some to be a peach (9) and by others to be a peach x almond (13). 'Hann' almond has been used by the Rutgers fruit breeding program and is assumed to be a peach x almond hybrid (10). Its origin is unknown, but it has been suggested that it may be the same as 'Hall's Hardy' almond which is suspected of being a peach x almond hybrid (1). 'Pchxdiv' was introduced from Poland by Rutgers University. It is very fruitful, which is not expected for a peach x plum hybrid, whereas peach x almond hybrids can be very fruitful. As compared to peaches, these clones are readily differentiated by several traits typical of almonds (early blooming, spurry growth habit, dry-fleshed fruit, and thicker leaves).

Materials and Methods

'Hann' almond, 'Polardi,' 'Rogani Goy,' 'PI 117679' and ' Pchxdiv' were analyzed for LAP and 6PGD as were several peach rootstocks (Nemaguard, Nemared), known peach x almond rootstocks ('GF557,' 'GF677' and seedlings derived from a 'Titan' almond x Nemared cross) and almonds ('Titan,' 'Star,' 'Texas').

For these analyses young leaves collected from the field at College Station were put in plastic bags and on ice. Some material was collected from the

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Southeastern Fruit and Tree Nut Research Station (Byron, GA) and the Rutgers Fruit Research and Development Center (Cream Ridge, NJ). These samples were collected, cooled and sent by overnight mail or hand carried to Texas A&M University. Once in the laboratory, the samples were stored in a refrigerator at 4°C. All electrophoretic runs were done within a week of collection.

Approximately 300 mg of diced leaf tissue and 0.1g of polyvinyl polypyrrolidone was put into 3.5 ml of cold extraction buffer (100 ml Na-phosphate buffer, pH 7.3; 5 g PVP40, 1 ml mercaptoethanol, 0.125 ml Tween 80) in a 18 mm x 150 mm test tube which was maintained in an ice bath. The samples were homogenized (27,000 rpm, 10-15 s) with a Kinematica homogenizer fitted with a Brinkmann PTA 10s generator. The generator was chilled in an ice bath before use. The homogenate was decanted into a 1.5 ml microcentrifuge tube and centrifuged at 13,750 rpm for ten minutes in a cold room (4°C). The supernatant was absorbed into a filter paper wick and inserted into a 12% starch gel (2 Sigma:1 Connaught) and run overnight (14-18 hours). The morpholine citrate (16) gels were run at 32-36 Ma and stained for 6PGD. Lithium borate (12) gels were run at 200 volts and stained for LAP. The enzyme staining procedures were modified from Conkle et al. (4) for both enzymes.

The bands observed for each presumptive locus were designated with respect to the common electromorph found in the peach control (TAES Y5-34). This band was designated as '100.' Other electromorphs and their corresponding alleles were designated numerically as to the percent of migration compared to the '100' allele. For enzymes with multiple isozymes, the locus with the greatest anodal migration was designated as 1; loci with slower migration rates received progressively higher designations.

Results and Discussion

Figure 1 shows a diagrammatic representation of the peach, peach x almond materials examined for 6PGD and LAP. The peaches examined for this study as well as several hundred others all display the same zymogram for 6PGD (100/100 and 100/100 for locus 1 and 2 respectively) and LAP (100/100 and 100/100 for locus 1 and 2 respectively). The almonds surveyed were invariant for 6PGD (112/112 and 66/66 for locus 1 and 2 respectively) and LAP-2 (110/110), but revealed two alleles (98,95) for LAP-1. Since peach and almond are different at all four loci, peach x almond hybrids should reveal hybrid banding patterns for all loci. All known peach x almond materials show the hybrid enzyme patterns. With 6PGD, this results in

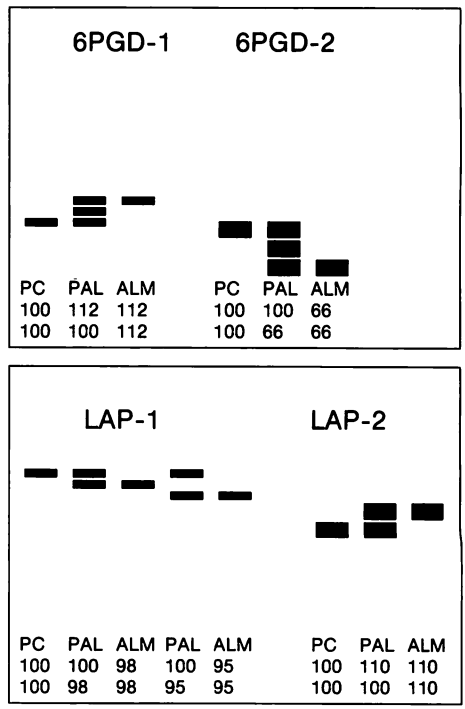

Figure 1. Interpretative diagrams and the presumed genotypes of 6PGD and Lap zymogram patterns observed for peach (PC), peach x almond (PAL) and almond (ALM).

Table 1. Background information on the five clones suspected to be peach x almond hybrids.

Clone	Alias	Origin	Comments[z]
Hann almond	Hall's Hardy?	Obtained in 1937 by Rutgers University, from William Hann of New Brunswick, N.J.	Early blooming, spurry tree which produces good crops of dry-fleshed fruit with hard shells.
Pollardi	PI 113650 Pollardii?	Imported as a peach from Italy in 1936	Very early blooming, spurry tree with large showy flowers. It produces good crops of small dry-fleshed, late-maturing fruit.
Rogany Goy	PI 113452 Rogani Gow	Imported as a peach from USSR in 1935	Early blooming, spurry tree with small, cup-shaped showy flowers and leaves that are wider than those of a peach. It produced good crops of small, white, late-maturing, dry-fleshed fruit.
PI 117679	#01370 Sel.	Imported as a peach from USSR in 1932	Early blooming, spurry tree with small, cup-shaped showy flowers and leaves that are wider than those of a peach. It produces good crops of small late-maturing dry-fleshed fruit.
Peach × divaricata	— —	Imported as almond buds with notation: (Peach × divaricata) OP, by Rutgers Univ. from Poland in 1964	Small, spurry tree with red leaves and large showy flowers. It produces good crops of small, late-maturing, white, dry-fleshed fruit.

[z]Observations from GA (Byron, USDA), NJ (Cream Ridge, Rutgers University), TX (College Station, Texas A&M University) and WV (Kearneysville, USDA).

triple-banded patterns since it is a dimeric enzyme. On a gel, 6PGD-1 appears to be a thick band, but is actually composed of three overlapping enzyme bands, whereas with 6PGD-2, the three bands are distinct. Hybrid LAP patterns are double-banded due to the enzyme's monomeric structure (2, 6).

'Hann,' 'Pollardi,' 'Rogan Goy' and PI 117679 exhibit the hybrid patterns characteristic of peach x almond hybrids (Table 2). 'Pchxdiv,' however, appears morphologically to be a peach x almond hybrid although it is labeled as a peach x plum (*P. cerasifera* Ehrh. = *P. divaricata* (Ledeb.) Bailey) hybrid. The electrophoretic information does not support the hypothesis that it is a peach x almond F_1 hybrid because it showed the hybrid triplets for only 6PGD-2. However, the plant is not a peach x plum F_1 hybrid because its 6PGD-1 locus does not contain the '121' allele which is fixed in all plums thus far examined (unpublished data). The '112' allele that is present has been reported to be fixed in California almond cultivars (6). Therefore, 'Pchxdiv' is probably a later generation derivative of a peach x almond hybrid. Consequently, it should be relabeled to avoid further confusion.

This study employed a simple electrophoretic technique to verify the suspected peach x almond F_1 origin of four genetic materials and showed that 'Pchxdiv' is not a peach x plum hybrid but rather a later generation derivative of a peach x almond hybrid. This

Table 2. Presumptive genotypes of peach, almond and peach x almond hybrid and suspected hybrids for 6PGD and LAP.

Cultivar	6PGD-1	6PGD-2	LAP-1	LAP-2
Peach				
Nemared	100/100	100/100	100/100	100/100
Nemaguard	100/100	100/100	100/100	100/100
Almond				
Titan	112/112	66/66	98/98	110/110
Star	112/112	66/66	95/95	110/110
Texas	112/112	66/66	95/95	110/110
Known Peach x Almond				
GF677	112/100	100/66	100/95	110/100
GF557	112/100	100/66	100/95	110/100
Titan x Nemared	112/100	100/66	100/98	110/100
Unknown				
Hann Almond	112/100	100/66	100/98	110/100
Pollardi	112/100	100/66	100/98	110/100
Rogani Goy	112/100	100/66	100/98	110/100
PI 117679	112/100	100/66	100/98	110/100
Pchxdiv	112/112	100/66	100/100	100/100

method could also be used to determine the purity of almond x peach hybrid seed lots such as those presently being commercially produced.

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'Rio Oso Gem' and 'Loring' Peach Flower Bud and Wood Hardiness as Affected By Different Rootstocks

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Abstract

Fourth leaf 'Rio Oso Gem' and 'Loring' peach (*Prunus persica* (L.) Batsch.) on their own roots or budded to nine rootstocks (Tzim Pee Tao, Harrow (H) 7141041, H7141049, H7338013, H7141064, H7338001, H7141137, Lovell, Halford, or Sinung Chumi) were evaluated for rootstock effects on flower bud hardiness after field exposure to -23°C in 1987 and -26°C in 1988. 'Rio Oso Gem' flower buds were hardier on H7141064 compared to H7141049 in 1987. 'Loring' flower buds were hardier on H7338001 compared to Tzim Pee Tao, H7141041, Sinung Chumi, self-rooted and H7141137 in 1988. In addition, 'Loring' flower buds on Lovell were hardier than on H7141137 or self-rooted 'Loring' trees. Pooled yearly data suggests that 'Loring' flower buds on H7338001 were hardier than 'Loring' on Tzim Pee Tao, H7141137 and self-rooted trees. No significant rootstock effect on 'Rio Oso Gem' flower bud hardiness was detected with pooled data. Controlled freezing tests indicated both a date and a rootstock effect on 'Loring' wood hardiness. Wood hardiness was low in November and increased to a maximum in January and March. 'Loring' wood hardiness on Tzim Pee Tao decreased in March compared to January. 'Loring' wood hardiness in January was lower in trees budded to Lovell compared to 'Loring' budded to H7338001, Sinung Chumi or Tzim Pee Tao.

Introduction

The major limiting factor preventing consistent peach production in much of the eastern US is the lack of sufficient flower bud hardiness. Selection of appropriate rootstocks which enhance flower bud hardiness could increase the likelihood of consistent cropping (1, 2, 3). Identification of suitable rootstocks is necessary before such an approach can be implemented. Limited information on specific rootstock effects on flower bud hardiness is available. 'Redhaven' flower buds budded to Siberian C were hardier than those budded to Harrow Blood or Rutgers Red Leaf (2) or when budded to Lovell (6).

Rootstock also affects wood tissue hardiness (2, 3, 6, 8). 'Redhaven' wood was hardier when budded to Lovell, Halford or NA 8 than when budded to Siberian C, Harrow 208, NRL 4 or 152AI-2 (7). Enhanced wood hardiness of 'Redhaven' on Siberian C has been reported (2) and was partially attributed to early scion dormancy on Siberian C compared to other rootstocks. This study was initiated to determine the effects of rootstock on scion flower bud and wood hardiness of 'Rio Oso Gem' and 'Loring.'

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