NEW PEACH ROOTSTOCKS UNDER CHANGING CLIMATIC SCENARIO

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Abstract : In India, peach occupies third rank after apple and pear in terms of area and production among temperate fruits. It is grown commercially in Jammu and Kashmir, Himachal Pradesh and Uttarakhand. In limited scale, it is also grown in the hills of south India and north- eastern parts of the country. Low chilling peaches are also grown in sub-mountainous regions of Punjab, Haryana and western Uttar Pradesh. Rootstock influences various characteristics of the scion cultivar. New rootstocks with desirable characteristics are needed the world over under climatic change scenario. Breeding programmes are presently active the world over for the selection of such rootstocks. Number of new peach rootstocks have been evolved which can be adopted under varied climatic conditions. Some of these are Bailey, Lovel, Stark Red Leaf, Penta, Garnem, Kuban 86, Sharpe and Greenpac etc.

Keywords : Peach, Rootstocks, Climatic conditions, Cultivation

INTRODUCTION

Peach (*Prunus persica* (L.) Batsch) is a drupaceous temperate fruit of excellent appearance and quality. It originated near the city of Xian, China. Chinese records infer that the peach was cultivated 3,000 years ago, during the Shou Dynasty. Peach belongs to family *Rosaceae,* sub family *Prunoideae and* genus *Prunus* with 8 basic and 16 somatic chromosome numbers.The most distinctive feature of genus *Prunus* is the deposition of lignin inside the fruits to form the stone. Peach fruits are rich source of vitamins (carotenes, thiamine, riboflavin and niacin), minerals (calcium, potassium, magnesium, phosphorous, iron and zinc) and fibres.

Rootstocks mainly determine the vigour of fruits trees and also influences frost resistance and fruit yield of the cultivated fruit tree. Peach trees are prone to low temperatures and are prone to bark and wood diseases. Thus, there is a need for such a rootstock which can diminish growth vigour and at the same time limit the necessity of pruning. Breeding programmes for peach rootstocks are presently active in North and South America, Europe, Africa, Australia and Asia. The objectives of peach rootstock breeding programs worldwide include selecting rootstocks tolerant to unfavourable soil properties such as alkalinity, high bulk density, waterlogging and drought. Other important goals are breeding for resistance to nematodes (*Meloidogyne spp., Pratylenchus spp. Mesocriconema xenoplax*, and *Xiphenema americanum*), soil root rot fungi (*Armillaria spp., Phytophthora spp*. and *Verticillium dahliae*), soil bacteria (*Agrobacterium tumefaciens*), peach tree borers (*Synanthedon spp*.) and aphids (*Myzus spp*.). Adaptation to regional climates (cold temperate regions) and orchard replant sites are also important criteria in the evaluation of rootstocks for peach. Rootstocks are being developed for replant sites to reduce the incidence of perennial canker (*Leucostoma spp*.), the peach tree short life and bacterial canker (*Pseudomonas syringae*) complexes found in peach production regions having light textured soils (Loreti, 2008).

Peach Rootstocks Selections :

Lovel :

It was orginated in winters, California and was named in 1882. It is suitable in heavy soils where root knot nematode is not the problem, compatible with all the peach varieties, lacks suckering. This rootstock is less vigorous than nemagaurd. It is sexually propagated with high seedling uniformity. It is suitable to well drained sandy-loam soils and susceptible to root lesion and root-knot nematodes, bacterial canker (less than nemaguard), phytopthora and oak root fungus, crown gall in high lime soils and high salt in soil and water (sodium, chloride, boron).

Bailey :

It was originated in 1890 at west Branch, Iowa, Circa. This rootstock is known to have compatability with peach. It is propagated sexually with good seedling uniformity, medium in vigour, less than Lovell. It is most cold hardiest known rootstock among peach. Tree and root system is slightly less cold hardy than Siberian C. Fair tolerance to root lesion nematode. It is an old peach cultivar and is a very hardy peach that produces small, white-fleshed, freestone fruits having no commercial culinary value. Pits germinate readily, and scion cultivars budded on to Bailey seedlings develop into uniform trees that are medium-to-large in size. Bailey propagates easily, is compatible with recommended scions, productive and tolerant to cold winter temperatures. This rootstock has been reported to confer some degree of cold hardiness on some scion cultivars. In addition, tree survival on this rootstock has been good after severe winters.

Stark Redleaf :

Origin: Stark Bro's Nurseries and Orchards Co.
Parentage: Selection of a 'Tennessee Natural' type rootstock
Compatibility: Compatible with peach
Propagation: Propagates sexually
Vigor: Similar to Lovell in the Southeast
Other: Redleaf character to eliminate bud misses in nursery.

Prunus empyrean 2, Penta :

A selected seedling of *Prunus domestica* 'Imperial Epineuse' trees produced on Empyrean 2 are reported 15% less vigorous than on peach seedling. Compatible with peach, plum, almond and apricot. A clonal *Prunus domestica* rootstock for peach, as well as apricot and plum originated in ISF Rome Italy. Trees budded to Penta are well anchored, more vigourous and higher yielding than trees budded on peach seedling. Penta is non-suckering and better adapted to heavy soils than peach seedling. Good compatibility with almond and plum cvs tested. Penta is the same size as GF677. Resistant to wet, heavy soils, Verticillium, Phytophthora resistant, root knot nematode, high pH, nematodes, and many others. The yield efficiency on this rootstock is good and is known very well on problem sites.

Prunus empyrean 3 :

A selected seedling of *Prunus domestica* 'Imperial Epineuse' trees produced on Empyrean 3 are reported 15% less vigorous than on peach seedling. Trees budded to Penta are well anchored and display vigor and Yield similar to trees budded on peach seedling. Tetra is non-suckering and better adapted to heavy soils than peach seedling. Good compatibility with plum and almond cvs. tested. 10% smaller than Penta. Resistant to wet, heavy soils. *Phytophthora* resistant. Hardwood cuttings same as Penta except trees should be slightly less vigorous than seedling. Shows no resistance to root knot nematode in California (similar to Lovell.

Siberian C :

It is reported to dwarf standard peach clones by 10-15%. Siberian C promotes early defoliation, precocious bearing and increased bud hardiness of scion cultivars. Siberian C is one of the hardiest rootstocks available for peach production. Siberian C is root hardy.

Hybrid Rootstocks :
Peach x almond hybrids :
GF 677 (*P. persica x P. amygdalus*)
Hybrid of *P. persica* and *P. amygdalus* selected by INRA, Grande Ferrede, Bordeaux (France). Excellent performance in the nursery for spring, summer and autumn bud grafting and micrografting. Rootstock for peach, plum and almond varieties. Vigorous, resistant to calcareous soils (more than 11% active lime) and drought conditions. Sensitive to waterlogging (but less than peach seedlings). Suitable for poor soils and tolerant to replant diseases. Fairly resistant to *Fusicoccum* and *Coryneum*, medium sensitive to *Verticilium* and *Phytophtora cactorum*, very susceptible to *Stereum purpureum*, *Agrobacterium tumefaciens*, *Armillaria mellea* and to root-knot nematodes. All varieties show perfect grafting compatibility and high yield efficiency.

Garnem (*P. amygdalus x P. persica*) **:**

Clone selected from progeny obtained in Spain from the cross between the Spanish almond 'Garfi' and the North American peach 'Nemared'. Garnem has been granted European Community Plant Variety rights, number 16363. This rootstock has been selected primarily for almond, peach and nectarine varieties and shows excellent grafting compatibility. Plants in the nursery grow very well and vigour is similar to or higher than that of GF677. Plants have upright growth with little or no feathering during the first growth season. Good performance in the nursery for spring, summer and autumn bud grafting and micrografting. The percentage of bud take is high for all known peach, nectarine and almond varieties. Tolerant to drought conditions and to poor soils; the level of tolerance to iron chlorosis is lower than GF677; low tolerance to asphyxia caused by waterlogging; performs well in replant situations. Plants grafted on this rootstock are more vigorous than those grafted on GF677 and need summer pruning to avoid excessive shoot growth and shading inside the canopy with negative effects on fruit size and quality. Tolerant to the main root-knot nematode species affecting prunus, including *Meloidogine arenaria, M. hispanica, M. incognita and M. javanica.* Susceptible to the root-lesion nematode *Pratylencus vulnus.* Susceptible to crown gall caused by *Agrobacterium tumefaciens*, this rootstock can replace GF677 in soils with nematodes, but its tolerance to waterlogging and calcareous soils are lower than that of the well-known and tested GF 677.

Nemaguard :

It is a root-knot nematode resistant rootstock which was released in 1961 by the USDA research station at Byron, Georgia. Scion on Nemaguard is more vigorous than on Lovell. It utilizes higher proportion of its photosynthate for production of new leaves as compared to lovell. It possesses low root-shoot and root-leaf ratio, may compensate for this by exhibiting a higher rate of water uptake which is mediated by it higher amount of transpirational surface/unit times (high leaf-root ratio) (Werner and Young, 1982). Young and Sherman (1977) clearly demonstrated the resistance of nemaguard to root knot nematodes but it's resistance decreased with the already infested nemaguard rootstocks which were replanted in

nematode infested soils. Basile *et al.* (2003) studied the effect of water relation on the growth of nemaguard and observed that it has minimum stem water potential which led to extensive shoot growth.

Sharpe :

Origin : 'Sharpe' is a putative plum hybrid rootstock of unknown origin discovered in Florida by the late Prof. Ralph Sharpe and tested under the designation of FLA1-1 (Sharpe, 1974). 'Sharpe' appears to be a hybrid of Chickasaw plum [Prunus angustifolia (Marsh.)] with an unknown plum species (Beckman, personal observation).

Description : Unbudded trees of 'Sharpe' display moderate vigor and a semi-upright form. Flowers are small and white with yellow anthers. Fruit are small (typically 3 to 4 cm in diameter), soft, and sweet with yellow skin and flesh. 'Sharpe' is readily propagated through softwood or hardwood cuttings.

KRYMSK 86 (Kuban 86) :

A true *Prunus persica x Prunus cerasifera* hybrid originated in Krasnodar region Russia. Compatible with peach, plum and apricot and is also reported to be compatible with almond. Compatibility of peach with the advantages of plum rootstocks. It is a good choice for replant sites. It is susceptible to root knot nematode and highly resistant to lesion nematode. The rootstock has very good adaptation to may soil types and soil problems. Trees look precocious and Yield efficient. Possible low chill. Vigour similar to Lovell. Good compatibility with everything. Very vigourous root system when established; similar to peach for tree size; very resistant to stress like high pH soils, wet soils; tolerates salt, asphyxia; root anchorage excellent; 1 year old hardwood cuttings have roots like cables; roots mine for water and nutrients well.

Greenpac :

Origin: Greenpac is a new peach hybrid rootstock *Prunus persica* (L.) Batsch × *P. davidiana* (L.) Batsch] × *P. dulcis* (Mill.) D.A.Webb × *P. persica*] developed by Agromillora Iberia, S.L., Barcelona, Spain, for use mainly as a rootstock for peach and nectarine cultivars but can also be used for almond. The original seedling was selected from a cross made between the peach×almond hybrid 'Felinem' as a female parent (Felipe, 2009) and the hybrid peach 'Cadaman' (*P. persica* × *P. davidiana*) as the pollen donor. 'Felinem' was chosen for its high level of tolerance to iron chlorosis. 'Cadaman_' was chosen for its broad resistance against root knot nematodes (Pinochet *et al.*, 1995), good adaptation to Mediterranean environments, and high cropping efficiency with peach and nectarine cultivars (Edin and Garcin, 1994). Trees are green leaf with a vigour comparable to that of 'GF 677' or 'Garnem' (Felipe, 2009). 'Greenpac' is root knot nematode-resistant to the main species found in the Mediterranean area such as *Meloidogyne incognita* (Kofoid and White) Chitwood and *M. javanica* (Treub) Chitwood. 'Greenpac' performed well on a calcareous soil, whereas the trees grafted on PAC 9917-26, BH-4, and PAC 9903-01 showed symptoms of iron chlorosis. Iron deficiency induction of in vivo root FC reductase is a recent evaluation method that enables early detection of iron chlorosis. In such tests, 'Greenpac' showed a moderately tolerant response similar to 'Garnem' and superior to 'GF 677' (Jimenez *et al*., 2008).

Clonal Rootstocks :

Pumiselect :

It is a clonal *Pumiselect pumila* rootstock for peach and apricot and was selected by Prof. F. Jacob in Geisenheim Institute. In USA, this rootstock is tested in many experiments as 'Rhenus 2'. The preliminary results suggest that Pumiselect belongs to dwarf or dwarf rootstock. The vegetative growth of peach on this rootstock is 65% smaller than those budded on Nemaguard and apricot trees are 50% smaller than those on seedling rootstocks. The peach and apricot trees on Pumiselect rootstock are characterized by early bearing (2-3 year after planting) and about 50 % higher yield efficiency than those budded on Nemaguard. Another virtue of Pumiselect rootstock is good cold endurance and resistance to *Plum pox virus* as well as good adaptation to heavy soil and drought. However, the trees on Pumiselect should not be grown on wet soil. Pumiselect rootstock propagates readily from hardwood or softwood cuttings, stool beds or tissue culture (Okie, 2002). Gudarowska and Malanczuk (2006) reported that the use of hardwood cuttings is a suitable method for propagating Pumiselect rootstock.

Dames 1869 :

Febi and Fiorini (1981), found that the peach rootstock resistance of peach cultivars and rootstocks on iron Damas co 1869 is highly resistant to iron chlorosis.

OTHER IMPORTANT ROOTSTOCKS :

BARRIER

Interspecific hybrid of *P.davidiana x P. persica* selected by CNR in Florence (Italy). Italian patent no. 1760, 1987. Tolerance to iron chlorosis is lower than GF677; susceptible to root-knot nematodes (*Meloidogyne incognita, M. javanica, M. arenaria, M. halpa and M. hispanica*) and *Pratylenchus vulnus*. Less susceptible to *Agrobacterium tumefaciens* and *Phytophtora* than GF677. Barrier is suitable for most soil conditions. Trees grafted on this rootstock are slightly less vigorous than those on GF677 and show good yields with high quality fruits. Flowering and fruit ripening occur 5-7 days later than in plants grafted on peach seedlings. This rootstock shows very good grafting compatibility with all peach and nectarine varieties. It is suitable for poor, dry, calcareous soils (not more than 5-6%

lime content) and tolerant to replant diseases. Due to its later blooming and fruit ripening, it is not recommended for early ripening cultivars, while it is recommended for late ripening varieties and in areas with spring frosts.

Cadaman

Hybrid of *P.persica* x *P. davidiana* obtained by GYDV of Budapest (Hungary). EU patent no. 1270, 1996. Cadaman is less sensitive to waterlogging than GF677 but less resistant to iron chlorosis. Plants are medium-susceptible to *Verticillium* and resistant to *Meloidogyne incognita* and *M. arenaria*; sensitive to *Meloidogyne javanica*, *M. halpa* and to *Pratylenchus vulnus.* Good grafting compatibility with peach and nectarine varieties. Tree vigour and yield efficiency are similar to those grafted on GF677. Suckering activity is very low.

Adesoto

Clonal selection from open pollinated population of 'Pollizo di Murcia' (*Prunus insititia)*, obtained by the Aula Dei Experimental Station, Zaragoza (Spain) in 1970. EU patent no. 9574, 2002. Adesoto is resistant to waterlogging, iron chlorosis and medium-high soil lime content (about 10% active lime). Tolerant to *Meloidogyne javanica*; susceptible to *M. incognita, M.arenaria, M. halpa , M. hispanica* and to *Pratylenchus vulnus.* Peach and nectarine varieties grafted on this rootstock are about 20% less vigorous than those grafted on GF677. Fruit ripening occurs 3 to 5 days earlier than in trees grafted on GF677. Suckering activity is usually high. This rootstock can be used also for almond, some apricot varieties and plum. Suitable rootstock for heavy soils contaminated by *Armillaria mellea.*

Ishtara

Complex interspecific hybrid of (*Prunus cerasifera x P. salicina*) x (*P. cerasifera x P. persica*) obtained by INRA, Bordeaux (France) in 1950. Italian patent no. 1564 of 1989. This rootstock is more sensitive to waterlogging than the peach seedlings, fairly sensitive to iron chlorosis and tolerant to drought conditions. It is resistant to *Meloidogyne* nematodes, susceptible to *Pratylenchus vulnus, Pseudomonas syringae, Verticillium dahliae* and *Armillaria*. Ishtara is a polyvalent rootstock (peach, nectarine, almond, plum and apricot varieties) which reduces tree vigour by about 20% compared to peach seedlings. No suckering activity. Transplantation from nursery to orchard can sometimes be critical.

HR1 and HR2 :

They have been selected from interspecific crosses of peach and almond, using F1 14-11 red leaf peach as the male parent and Ne plus Ultra almond as the female parent at the Hermosillo Coast research station. HR2 is resistant to *Meloidogyne incognita, M. arenaria* and *M. javanica* and HR1 is resistant to *M. incognita, M. javanica* but tolerant to *M. arenaria*. Both rootstocks are vigorous, red leaved and resistant to high pH soils and are easily propagated by hardwood cuttings. They have also been selected also for their low chilling requirements which allows good production of shoots under warm climates (Javier and Leon, 1989).

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