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PERFORMANCE OF RED LEAF NEMAGUARD AS A ROOTSTOCK FOR DECIDUOUS FRUIT PLANTS

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ABSTRACT

Background Rootstocks have profound effect on the performance of fruit trees. Nemaguard is considered a vigorous rootstock in a wide variety of soils. Red leaf nemaguard (RLN) is a rootstock for deciduous fruit plants and resistant to nematodes and soil moisture variations.

Methodology A research investigation was conducted at Horticultural Research Station, Nowshera (Soon Valley), Khushab, Pakistan to evaluate the response of RLN as rootstock. Scions of almond, peach, apricot and plum were used as different treatments.

Results The best performance in terms of growth rate of nursery plants was observed for peach followed by plum. Different growth parameters for peach such as sprouting (82.39%), scion growth rate (6.68 cm month^{-1}) while scion and rootstock girth were found 1.96 and 1.31 cm, respectively at the end of experimentation. Moderate plant height of 46.39 cm with 53.21% success rate of budded plants was observed in peach. The results were followed by plum budded onto RLN in sprouting percentage (72.36%), scion and rootstock growth rate while highest plant height (46.71 cm) and success percentage (71.44%) were noted at the end of experimentation.

Conclusion RLN was found to be a best rootstock for successful production of peach and plum nursery at commercial level where nematodes are challenging for nursery production.

INTRODUCTION

The demand of peach and other deciduous fruit plants is increasing day by day due to commercial cultivation of peach and plum in sub-mountainous and plain areas of upper Punjab, Pakistan (Rahman et al. 2016). Field adaptation results of peach and other deciduous fruits including plum, apricot and almond indicated that these plants are facing the problems of some soil-borne diseases, particularly in heavy clay soil and nematode infested lands of the area due to the use of conventional rootstocks such as wild peach, wild apricot (Hari) and wild plum (Myrobalan). These studies were carried out to find suitable rootstock for nursery production on red leaf nemaguard (RLN) rootstock of peach due to its resistance to nematode infection and tolerance to excess soil moisture. Popular deciduous fruit plants including peach, plum, apricot and almond were budded onto the RLN rootstock to find out their compatibility performance against RLN rootstock of peach (Wongtanet and Bronprakob 2010).

The economic viability of an orchard is directly related to the production of orchard and its efficient management (Ahmed et al. 2006, 2007; Costes and Garci´A-Villanueva 2007). To obtain vigorous and high yielding plants for good economic returns, grafted plants are preferred by growers (Christ and Reighard 2008). Grafting is practiced in fruit plants on desired rootstocks to maintain the true to type characters of specific cultivars by asexual propagation. Thus, rootstocks may play a crucial role in fruit yield and quality, and proper selection of a rootstock is of vital importance to maintain a healthy orchard (Ahmed et al. 2007). Rootstocks can also affect other characters such as plant height, hardiness, flowering period and disease resistance as well as reducing the internode length of fruiting branches (Webster 2001; Seleznyova et al. 2003; Weibel et al. 2003). Greater number of leaves in peach increased the rate of

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photosynthesis and hence resulted in more carbohydrate accumulation (Akhtar et al. 2000). Growth and yield of different scion and rootstock combinations in fruit crops are mainly dependent on plant, soil and climatic conditions (Sitarek et al. 2004). Plant diseases are a major setback in fruiting plants which adversely affect the production of an orchard (Nyczepir et al. 2006). Peaches are prone to a number of diseases and root knot nematode (RKN) is one of them. Nyczepir and Becker (1998) reported that many nematodes parasitize peach roots and cause a marked reduction in tree growth and survival. However, four types of nematodes including the ring [*Criconemoides xenoplax* (Raski), *Mesocriconema xenoplax* (Raski) Loof and de Grisse], root-knot [*Meloidogyne incognita* (Kofoid and White) Chitwood, *M. javanica* (Treub) Chitwood, *M. arenaria* (Neal) Chitwood, and *M. hapla* Chitwood], lesion [*Pratylenchus vulnus* Allen and Jensen and *P. penetrans* (Cobb) Chitwood and Oteifa] and dagger (*Xiphenema americanum* Cobb) nematodes are recognized as injurious to adversely affect the plant growth, particularly in the warmer regions and sandy soils (Sherman and Lyrene 1983; Nyczepir and Becker 1998; Christ and Reighard 2008). RLN is resistant to root-knot nematode and soil moisture fluctuations for nursery production of deciduous fruit plants (Handoo et al. 2004), and is still popular in nematode infested areas. The response of RLN as rootstock for almond, peach, apricot and plum was studied to check the longevity, high note of compatibility and resistance to mortality and soil-borne issues, particularly nematodes.

MATERIALS AND METHODS

A study was conducted to evaluate the different rootstocks (i.e. almond, peach, apricot and plum) for deciduous fruits at Horticultural Research Station, Nowshera (Soon Valley), Khushab, Pakistan during 2015-16. For this, seeds from RLN (*Prunus persica* L. Batsch) trees were harvested, fruit flesh removed and pits dried at room temperature for 3-4 days and stored under dry conditions in a paper bag at room temperature. Before sowing, seeds were stratified at 5°C for 30 days in perlite filled trays and sown in nursery at the end of November, 2015 to induce seed germination. Seedlings were germinated during the end of February, 2016. Best cultural practices were adopted to raise the rootstock well in time for budding of scion cultivars. Physicochemical properties of experimental soil are mentioned in Table 1. Buds of peach (Earligrande), plum (Red beaut), almond (Nonpareil) and apricot (Narai) cultivars were obtained from mother blocks of the gene pool bank and budded at the end of May, 2016 by T-budding method. Twenty seedlings were considered for each treatment and the treatment was replicated for four times. The experiment was laid out according to randomized complete block design (RCBD). Data were recorded bimonthly till the end of December, 2016 during the period of studies.

Germination percentage

Germination percentage of the rootstock pits was calculated according to the following formula:

$$\text{Germination percentage} = \frac{\text{Number of germinated pits}}{\text{Total pits sown}} \times 100$$

Scion sprouting percentage

The sprouted buds in each treatment were counted 30 days after budding and sprouting percentage of bud was calculated with the following formula:

$$\text{Scion sprouting percentage} = \frac{\text{Total sprouted buds}}{\text{Total buds inserted}} \times 100$$

Growth rate of scion

Growth of scion shoot was measured bimonthly with the help of measuring tape. Growth rate was calculated by the following formula:

$$\text{Growth rate of scion (cm)} = \frac{\text{Length of scion shoot}}{2}$$

Where two (2) is bimonthly interval for data recording.

Scion girth growth rate

Scion girth growth rate was calculated bimonthly with the help of measuring tape from the point nearest to bud union and calculated by the following formula:

$$\text{Growth rate of scion girth} = \frac{\text{Circumference of scion shoot}}{2}$$

Where two (2) is bimonthly interval for data recording.

Rootstock girth growth rate

Rootstock girth growth rate was calculated bimonthly with the help of measuring tape from the point nearest to bud union and calculated by the following formula:

$$\text{Growth rate of rootstock girth} = \frac{\text{Circumference of rootstock}}{2}$$

Where two (2) is bimonthly interval for data recording.

Plant height

Height of plants was measured using a measuring tape. One end of the measuring tape was placed on the budded portion and the other was extended to the top of the shoot in order to get actual length.

Success percentage

The sprouted buds were counted 60 days after budding and the success percentage was calculated by using the following formula:

$$\text{Success percentage} = \frac{\text{Total sprouted buds}}{\text{Total buds taken}} \times 100$$

Statistical analysis

Experimental data were subjected to analysis of variance. For mean separation Duncan's test at p = 0.05 was used (Duncan, 1955).

RESULTS

Germination percentage showed non-significant differences among treatment groups in this study (Table 2). Good germination percentage was observed in pit germination of rootstock which is important character of RLN rootstock of peach. Scion sprouting percentage (Table 2) showed highly significant results in peach (82.39 %) followed by plum (72.36%) while apricot (67.15%) and almond (64.81 %) remained at par with each other, but significantly differed with rest of the treatments. Growth rate of scion was maximum in plants budded with peach (6.68 cm), however, it was also at par with apricot (6.11cm) and plum (6.33 cm). Almond gave lowest growth rate of scion (4.29 cm) on RLN. Scion girth growth rate depicted no significant difference among peach, plum, apricot and almond as shown in Figure 1. Similarly, non-significant results were attained regarding rootstock girth growth rate (Figure 1). Hence, it was proved that almond, apricot, peach and plum had no significant effect on rootstock girth growth rate at nursery stage. Maximum plant height was noted in plum (46.71 cm) and peach (46.39 cm) followed by apricot (41.57 cm), statistically at par with each other as shown in Figure 2. However, almond showed significantly less plant height (31.21 cm). Data regarding success percentage showed that maximum success was achieved in plum (71.44 %) as compared to other treatments (Figure 3). Apricot and peach attained the success rate of 56.23% and 53.21%, respectively. Plum, apricot and peach significantly differed from almond due to its lower success rate (44.58%).

Table 1 Physicochemical properties of experimentation soil

Soil properties	Value
Textural class	Sandy clay with stones
pH	7.62 ± 0.02
ECe (dS m^{-1})	2.79 ± 0.05
Soil organic matter (g kg^{-1})	8.98 ± 0.51
Total soil N (mg kg^{-1})	1563 ± 29.83
Soil available P (mg kg^{-1})	9.43 ± 1.16
Available soil K (mg kg^{-1})	179.8 ± 9.73

±: Standard error of means

DISCUSSION

Rootstock plays an important role for tree health, longevity and soil adaptation (Rahman et al. 2016). Compatible rootstock for a specific fruit crop helps it to survive in adverse soil conditions (Costes and Garci´A-Villanueva 2007). Orchard success depends on quality rootstock with particular characters such as resistance to drought, salinity and soil borne diseases (Sitarek et al. 2004). Commercial varieties of plum, peach, apricot and almond are facing soil-borne problems particularly nematode infestation. RLN is an exotic peach rootstock which is resistant to nematode infestation (Handoo et al. 2004). High germination percentage of RLN could be helpful for economic returns of nursery business as it was observed during the trial. Better germination percentage of RLN could be due to its good quality seed and genetic character (Malcolm et al. 2003). Best scion sprouting percentage of peach than plum, apricot and almond budded on RLN rootstock might be due to its higher compatibility (Akhtar et al. 2000). These results also confirmed the findings of Gautam et al. (1991) who reported the highest budburst (65%) in peach with T-budding on local peach rootstocks. Highest growth rate of scion in peach might be due to compatibility difference within different types of fruits, and due to presence of greater number of leaves in peach which increased the rate of

Table 2 Performance evaluation of exotic peach rootstock on nursery growth

Treatments	GP	SSP	GRS	SGGR (cm)	RGGR (cm)	PH (cm)	SP
T1: Almond	96.00ns	64.81c	4.29b	1.90ns	1.21ns	31.21b	44.58c
T2: Peach	89.00	82.39a	6.68a	1.96	1.31	46.39a	53.21b
T3: Apricot	94.25	67.15c	6.11ab	1.81	1.22	41.57a	56.23b
T4: Plum	91.00	72.36b	6.33ab	1.92	1.20	46.71a	71.44a
LSD value ($p \leq 0.05$)		8.57	2.25			9.70	6.56

Means not sharing the same letters differ significantly at 5% probability level, ns = Non significant; GP: Germination percentage, SSP: Scion sprouting percentage, GRS: Growth rate of scion, SGGR: Scion girth growth rate, RGGR: Rootstock girth growth rate, PH: plant height, SP: Success percentage

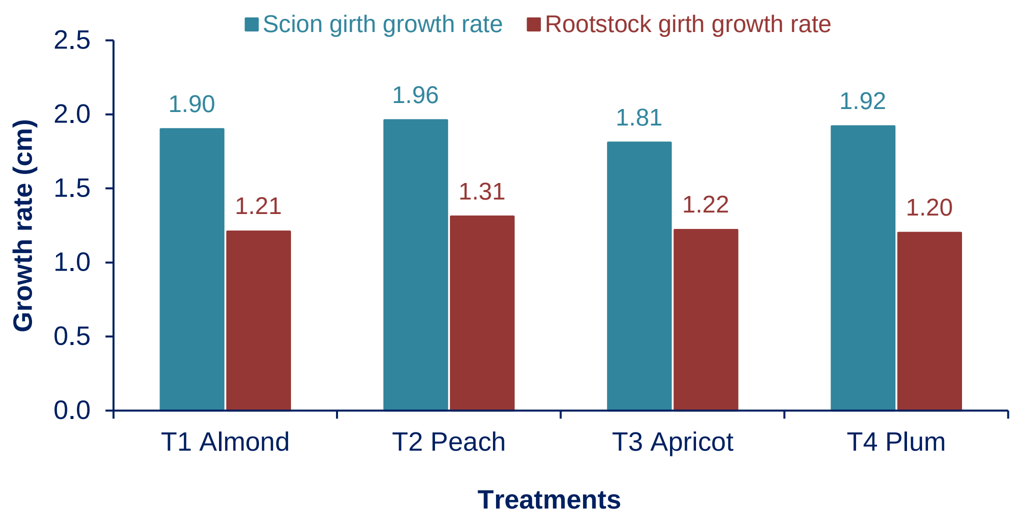

Figure 1 Effect of rootstock on scion and rootstock girth growth rates

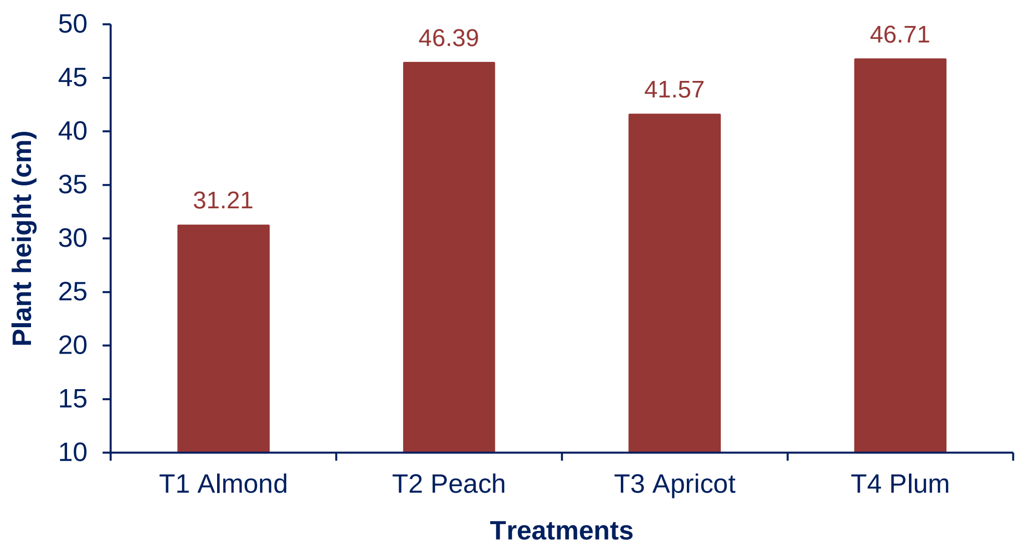

Figure 2 Effect of rootstock on plant height

photosynthesis and hence increased carbohydrate formation (Sitarek et al. 2004). Similar conclusions were drawn by Akhtar et al. (2000) for apricot on peach rootstock.

Scion and rootstock girth rates were statistically similar in all scion and rootstock combinations at nursery stage. Balance in scion and rootstock girth rate might be due to observation at early stage as it was supported by Sitarek et al. (2004) who found similar outcomes in their investigation on different scion and rootstock combinations of plum at nursery stage. Similar results were also reported by Webster (2001) for scion and rootstock girth rates of apple, pear, plum and sweet cherry.

Reduction in plant height and success percentage of almond might be due to less bud union compatibility as compared to other scions (Nyczepir et al. 2006). It could also be the dwarfing effect of RLN rootstock on almond as it was reported in previous studies of different rootstocks (Weibel et al. 2003; Ahmed et al. 2007). Better performance of plum for plant height and success percentage might be due to its faster growth rate as compared to other treatments as previously reported by Sitarek et al. (2004). These

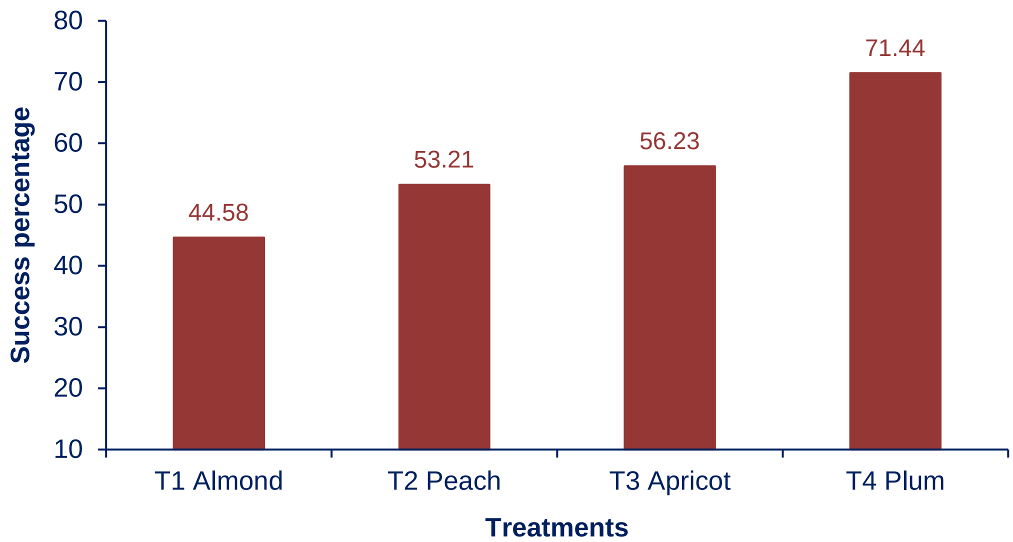

Figure 3 Effect of rootstock on success percentage

outcomes were in conformity with the results of Weibel et al. (2003).

CONCLUSION

It was proved that RLN could be successful rootstock for commercial nursery production of peach, plum and apricot where nematodes and excess soil moisture were the problems for nursery production. Almond nursery production might not be economical when budded onto RLN due to poor stock-scion union.

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