EFFECT OF BUD FORCING AND ROOT PRUNING ON THE GROWTH OF DAISY MANDARIN BUDDED ON ROUGH LEMON

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Abstract

In an experimental trial carried out in 2020-2021 at the nursery of Khalsa College Amritsar four forcing methods (Bending, lopping, notching and cutting off) and root pruning were evaluated to access their effectiveness on Daisy mandarin (Citrus sinensis (L.) Osbeck) budded on rough lemon (Citrus jambhiri) rootstock in the field conditions. As a result of the study bending proved to be the superior to other methods in producing outstanding bud growth and increased the scion length, girth, leaves, leaf area, roots and whole plant dry weight. Root pruning reduced bud break, scion growth, scion leaves, root growth and dry weight of the scion and roots. Bud break, sprouting and survival were also significantly better for cutting–off treatment than others under study. Hence there was an immense advantage of bending forcing method in forcing scion bud growth for propagating Daisy mandarin on rough lemon rootstock

Keywords: *Bending, Cutting -off, Lopping, Mandarin, Notching, Sprouting, Survival*

INTRODUCTION

A standard operation in producing budded citrus plants in the nursery is to force the bud. This practice induces the inserted bud to break (grow) by eliminating the apical dominance of the rootstock top. Scion buds sometimes grow slightly without stimulation (Young and Soule 1979). Various forcing methods are to be adopted for greater tree growth such as cutting-off, lopping, bending and notching.

In cutting-off, for instance, removes a substantial part of the food- production portion of the plant and also tends to force many latent buds on the rootstock into growth (Morris *et al* 2005). Bending and lopping are more favorable might be due to the fact that carbohydrates and photosynthates available in the leaves which was attached to the plants translocated toward developing roots and scion of the mandarin (Williamson and Maust 1996). Lopping interferes with cultural operations in the nursery, e.g., weeding. The results of the research study are in consonance with the findings of Williamson *et* al 1992and Williamson (1997) in citrus. Nauer and Goodale (1964), Rouse (1988), Bowman (1999) in Carizo and Ito *et al* (2004) also reported the same. Root pruning in horticultural crops is an old and varied practice (Hawley and Smith 1998). According to Watson and Syndor (1987) root pruning increased number and amount of surface area of roots in the root ball. They also reported that root pruning reduced an average diameter of root and increased the number of absorbing roots which helped in survival and reducing transplanting shock. But McArtney and Belton (1992) stated that root pruning limits the supply of carbohydrates which lead to poor vegetative and reproductive growth of plants. Sylvertsen and Hanlon (2008) concluded that root pruning led to a decrease in organic matter of the trees.

The present study attempts to investigate the effects of the forcing methods on the increase in dry matter content and to study the transfer of photosynthates from terminal portion of seedling to other plant parts with the following objectives:

1) To investigate the effect of different forcing methods on the growth of Daisy mandarin. 2)To investigate the effect of root pruning on the growth of Daisy mandarin.

The hypothesis of the study was that bud forcing method and root pruning would affect the growth of budded “daisy mandarin” on rough lemon rootstock.

MATERIALS AND METHODS

Location of research site

The investigation was carried out at Nursery of Department of Horticulture, Khalsa College, Amritsar during 2020-21. Geographically, Amritsar is situated at 31.6°N latitude and 74.9°E longitude at an altitude of 236 m above the mean sea level. The climatic conditions prevailing in the sub-tropical humid zone of Punjab state. It receives a highest rainfall from July to September and dry season with low rainfall is from December to February. The maximum temperature is about 38.50° C in the month of July and minimum temp is about 1.94° C which occur in the mont of December. During winter, frost is of common occurrence while in summer, the atmospheric temperature occasionally reaches up to 48° C.

Experimental treatment and design

Budding was done in 2nd of September 2020. Bud sources (scion) was Daisy mandarin free of phytophthora, exocortis or any other disease and obtained from the orchard of Khalsa college, Amritsar. The treatment comprised four forcing methods namely: cutting-off, bending, lopping and notching. Cutting-off was carried out by pruning away the rootstock top about 2 to 5 cm above the inserted scion bud. Bending in which the rootstock was bent above the inserted scion bud and was tied it to the base of the plant. In lopping the rootstock was cut half to two-third of the way through the rootstock stem 2.5 cm above the bud union and breaking over the stem but leaving it attached. Notching comprised of making an inverted V incision through the bark and into the wood on the rootstock stem directly above the scion bud. Root pruning was done by inserting the shovel on the medium containing the plants and cutting all the roots 5 cm from the stem of the plants in all the directions of the polythene bag. The experiment was completed when all the plants that forced a scion bud had completed tree scion growth. Flushes of scion bud break was recorded at 30 days intervals for all the selected plants. At the conclusion of the experiment all the plants were harvested and separated into scion leaves, stems, roots and shoots. All plant parts were dried in an oven at 70° C for 48 hrs and were weighed using a electronic scale and weight expressed in grams.

The above treatments were replicated three times in a randomised bock design. Analysis of variance (ANOVA) and mean separations within columns by Duncan’s multiple range test at 5% level. All these statistical analysed were done using SAS Institute software.

Results

Forcing method significantly increased the scion length of budded plants and bending resulted in highest scion length than lopping, notching and cutting-off in that order (Table 1). Conversely, root pruning had least effect on scion length of the plants. Scion girth and dry weight also highest in bending than lopping, notching and cutting-off. Root pruning produce minimum result (Table 1). Number of scion leaves and other leaf parameters such as leaf area and dry weight of leaves produced greater by bending forcing method followed by lopping, notching and cutting-off. Root pruning reduced the dry weight and leaf area of the scion leaves (Table 2). Root length was maximum in bending followed by notching, lopping and root pruning. Minimum root length was obtained by cutting-off (Table 3). Root volume and dry weight of roots was also highest in bending followed by notching, lopping and root pruning. Cutting-off produce minimum root volume and dry weight (Table 3).

Table 1 Effect of forcing methods and root pruning on growth and survival of buds.

Forcing method	Bud break (days)	Per cent bud break	Bud survival (per cent)
Bending	21.00^{cz}	63.66^{c}	86.76^{a}
Lopping	20.00^{c}	80.66^{a}	86.30^{a}
Notching	23.00^{b}	76.13^{b}	84.12^{b}
Cutting-off	18.33^{d}	82.83^{a}	82.22^{c}
Root pruning	25.00^{a}	58.83^{d}	81.11^{c}
SE (m)	1.03	2.27	0.86
Mean	21.46	72.46	84.10

^{z}Mean separation within columns by Duncan's multiple range test, 5% level

Table 2 Effect of forcing method and root pruning on the growth of scion parameters.

Forcing method	Scion length (cm)	Scion girth (mm)	Dry weight of scion (g)
Bending	20.08^{az}	3.06^{a}	0.61^{a}
Lopping	18.15^{b}	2.96^{b}	0.36^{ab}
Notching	17.75^{b}	2.90^{b}	0.33^{abc}
Cutting-off	10.83^{c}	2.73^{c}	0.09^{bc}
Root pruning	8.87^{d}	2.06^{d}	0.06^{c}
SE (m)	1.02	0.04	0.14
Mean	15.14	2.74	0.29

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 3 Effect of forcing method and root pruning on the growth of scion leaf, leaf area and dry weight of leaves.

Forcing method	Scion leaf	Leaf area (cm^2)	Dry weight of leaves (g)
Bending	18.60^{az}	12.94^{a}	1.63^{a}
Lopping	18.04^{a}	11.97^{a}	1.21^{ab}
Notching	14.71^{b}	8.44^{b}	0.89^{b}
Cutting-off	11.42^{c}	5.61^{c}	0.36^{c}
Root pruning	9.62^{d}	7.27^{b}	0.08^{c}
SE (m)	0.51	0.71	0.24
Mean	14.48	9.24	0.83

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 4 Effect of forcing method and root pruning on the growth of root parameters.

Forcing method	Root length (cm)	Root volume (cm^3)	Dry root weight (g)
Bending	40.83^{az}	34.66^{a}	7.54^{a}
Lopping	33.60^{c}	30.80^{b}	5.78^{a}
Notching	37.36^{b}	32.13^{b}	6.83a
Cutting-off	27.73^{e}	13.36^{d}	2.59^{b}
Root pruning	30.33^{d}	15.70^{c}	3.12b
SE (m)	1.14	1.11	1.00
Mean	33.96	25.33	5.17

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

DISCUSSION

Scion bud break was excellent for the cutting-off method but was slowed for the other forcing methods. Bending forcing method was superior in all other growth parameters (scion growth, leaf number and area etc) than lopping, notching and cutting-off. This is in favoured with workers (Amih 1980, Rouse 1988, Williamson *et al* 1992). The superiority of the bending method may be attributed to the presence or attached leaf portion to the plant which provide photosynthates for the growth and development of scion but not present in cutting-off (Williamson and Maust 1995). So, for the better and quicker nursery plant production, nursery man used bending forcing method instead of other methods.

Root pruning in fruit, forest and landscape tree nurseries ia an old and varied practice (Hawley and Smith 1998). In a research study Gilman (1990) suggested that root pruning increased the dry weight of roots but reduced the dry weight of growth parameters in trees. Moya *et al* (2002) carried out a research study on salt tolerance in citrus seedlings and reported that root pruning reduced the shoot growth in plants. Mullin (1988) studied that root pruning produced sturdier tree, more compact fibrous root system. In his study he also reported that root pruning retarded top growth and increased transplant survival and post-transplant growth.

However, in the present study root pruning produce more fibrous roots bur reduce the growth of budded scion and produce weaker and slow growing plants.

CONCLUSION

Conflicting research results the forcing methods and root pruning demonstrate that bending method of forcing proved to be advantageous for propagation of Daisy mandarin than notching, cutting–off and root pruning to force scion growth. Our research concluded that with bending forcing method greater nursery plant growth can be achieved which can prove beneficial for the commercial growers of mandarin.

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