RESEARCH ARTICLE

EFFECT OF DIFFERENT CONCENTRATION OF IBA ON ROOTING OF PLUM (*PRUNUS DOMESTICA* L.) CUTTINGS CV. SANTA ROSA UNDER VALLEY CONDITION OF GARHWAL HIMALAYA

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Abstract: A field investigation entitled "Effect of Different Concentration of IBA on Rooting of Plum (*Prunus domestica* L.) Cuttings cv. Santa Rosa under Valley Condition of Garhwal Himalayas" was conducted during winter season 2015-16 at orchard Section, Horticultural Research Centre and Department of Horticulture, H.N.B. Garhwal University (A Central University), Srinagar Garhwal, Uttarakhand, India. The cuttings treated with 2500 ppm IBA showed the maximum number of sprouted cuttings (6.67), minimum number of un-sprouted cuttings (1.67), minimum number of dead cuttings (1.66), maximum number of sprout (10.53), length of sprout (20.66 cm), diameter of sprout (0.41 cm) number of leaves on new shoots (81.90 cm), maximum percentage of rooting (73.33 %), number of primary roots (42.80), number of secondary roots (91.40), length of longest root (28.12 cm), diameter of thickest root (0.21 cm), fresh weight of roots (1.88 gm) and dry weight of roots (1.02 gm). On the basis of result achieved in the present study, it can be concluded that among the different concentration of IBA, IBA @ 2500 ppm may be suggested for best shoot and root growth of plum cv. Santa Rosa under valley condition of Gharwal Himalaya.

Keywords: Cutting, Diameter, Rooting, Percentage, Investigation, *Prunus domestica*

INTRODUCTION

Plum (*Prunus domestica* L.) is an important temperate fruit. It belongs to genus *Prunus* of subfamily *Prunoideae*, family *Rosaceae* and order Rosales and ranks next to peach in economic importance. It is a delicious fruit prized both for its exquisite fresh fruit flavour, aroma and in fruit preservation industry. The fruits are fairly attractive but usually are soft, clingstone, round and heart shaped (Teskey and Shoemaker, 1978).

In India, plum is predominantly grown in Jammu and Kashmir, Himachal Pradesh, and hills of Uttarakhand and also to some extent in Nilgiri hills. In Jammu and Kashmir state plum occupies an area of 4543 hectares with an annual production of 8218 metric tonnes (NHB, 2015). Santa Rosa is a leading commercial cultivar of Plum (*Prunus domestica* L.). It is the result of cross between *Prunus salicina* as a female parent with *Prunus simoni* and *Prunus americana* as a pollen parent (Salaria, 2009). It is known for its fair quality, characteristic flavour and is widely grown in Kashmir valley. It is used as a pollinizer for other cultivars but has got tendency towards overbearing which leads to limb breakage that invariably makes way to silver leaf disease. Due to its perishable nature, it cannot be stored for longer duration. Plum fruit contain copious amounts of natural phenolic phytochemicals, such as flavonoids, phenolic acids, anthocyanins, and other phenolics, which may function as effective natural antioxidants in our daily diet (Weinert *et al*., 1990; Gil *et al*., 2002; Cevallos-Casals *et al*., 2006; Vizzotto *et al*., 2007; Kristl *et al*., 2011). It is an established fact that plum fruit have several times higher total antioxidant capacity than apples (Wang *et al*., 1996). Plum can be propagated through sexual method (by seeds) as well as vegetative methods (hard wood, semi hard wood cuttings) seeds of plum is hardy and cannot be germinate easily and it required specific temperature (chilling temp.) for germination so it is a big problem in plum .To sort out this problem, vegetative method specially cuttings may be an alternative method for plant multiplication in plum. Asexual means of propagation preserve the original characters of a plant species . In plum propagation by cutting as such give lower percentage of success. Plant growth regulators have been well tested in promoting the roots in cutting. To achive high percentage of success in asexual propagation of plum through cutting, there is a need to standardized the concentration of IBA under valley conditions of Garhwal regions. In vegetative propagation of fruits, bioregulators play a very important role. Since the discovery of indole -3 acetic acid (IAA) as an active plant growth regulator, indole -3 butyric acid (IBA) and NAA have been freely used to boost vegetative propagation of plants specially rooting of cutting . Among all the bioregulators IBA is more effective, cause no damage to cutting.

MATERIAL AND METHOD

Detail of experiments

The experiment was conducted under the open condition at Horticultural Research Centre, Chauras Campus, HNB Garhwal University (A Central

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Concentration	Notation
IBA @500 ppm	T_1
IBA @1000 ppm	T_2
IBA @1500 ppm	T_3
IBA @2000 ppm	T_4
IBA @2500 ppm	T_5
Control	T_0
Cultivar	Santa rosa
Experimental design	Randomized Complete Block Design
Number of replications per treatment	3
Number of cuttings per treatments	10
Number of treatment	6
Total number of cuttings	3x10x6 = 180

Preparation of rooting media

For preparing the rooting media, the sandy soil and farm yard manure (FYM) in 1:1 were mixed thoroughly. The mixture was filled in polythene bags (1 kg capacity) tightly leaving one inch space at the top.

Preparation of IBA solution

For the preparation of IBA solution of 500 ppm, 1000 ppm, 1500 ppm , 2000 ppm and 2500 ppm, the required the amount of IBA (125 mg , 250 mg, 375 mg, 500 mg 625 mg. respectively) was weighted. These amounts of IBA, then dissolved in small amount of alcohol containing few drops of ammonium hydroxide and finally diluted with distilled water. The final volume of each solution was maintained 250 ml.

Treatment of cuttings

Quick dip method was adopted for treatment of the cuttings with IBA solutions. The basal portions of cuttings up to 2.5 to 3.0 cm were soaked with solution for 2 minutes.

Planting of cutting

The treated cuttings with different IBA concentration were planted carefully in the polythene bags with the help of dibbler without any injury to the buds. One third basal portion of the cuttings was inserted into rooting media. Each polythene bag was planted with two cuttings were maintained and thus 5 bags with 10 cuttings were maintained under each treatment of each replication. The soil around the cuttings was tightly pressed and watered immediately.

Observations recorded

Shoot Observations

1. Number of sprouted cuttings
2. Number of un-sprouted cuttings
3. Number of dead cuttings
4. Number of sprouts per cuttings
5. Length of sprouts(cm)
6. Diameter of sprouts (cm)
7. Number of leaves on new shoots

Root observations

1. Percentage of rooted cuttings
2. Number of primary roots
3. Number of secondary roots
4. Length of longest roots (cm)
5. Diameter of thickest root per cutting (cm)
6. Fresh weight of roots per cutting (g)
7. Dry weight of roots per cutting (g)

Statistical analysis

Data recorded during the course of investigations were subjected to statistical analysis under randomized block design as described by Snedecor and Cochram (1968).Valid conciliations were drawn after the determination, of significance of difference between the treatments, at 5 per cent level of probability. Critical difference was calculated in order to compare the treatment means.

RESULT AND DISCUSSION

In this chapter an attempt has been made to discuss the experimental findings obtained during the course of present investigation with possible explanations and evidences which were necessary in order to find out the cause and effect relationship among different treatments with respect to various character studies and to sort out information of practical value. Commercial propagators have developed technologies that successfully manipulate environmental conditions to maximize rooting and survival percentage of cutting. Among various factors, climatic factors, adequate plant bio regulator application and right planting time for a particular agro climatic condition are of paramount important for rooting and sprouting of semi hardwood cutting of plum.

Shoot Observations

A perusal of Table 1 indicated that the number of sprouted cutting was increased significant in respect of IBA concentrations. The maximum number of sprouted cuttings (6.67) were recorded under T_5 (2500 ppm) treatment. The minimum number of sprouted cuttings (4.33) were recorded under T_0 (control) treatment. Panwar *et al*., (2001) and Singh *et al.,* (2014) reported the same result in pomegranate. Tahir *et al.,* (1998) also observed best

performance of IBA treatments in hard wood cuttings of guava with respect the survival percentage.

Data of present study revealed that in respect of un-sprouted cuttings treatment T_1 (500 ppm), T_2 (1000ppm) and T_5 (2500 ppm) showed the lowest number of (1.67) un-sprouted cuttings. The maximum number of un-sprouted cutting (3.00) were recorded under T_0 (control) treatment. Finding of present investigation are more or less match with the result of Panwar *et al.,* (2001) and Singh *et al*., (2014) who observed the best survival of pomegranate cuttings under IBA treatment. Tahir *et al.,* (1998) in guava also observed better survival of hardwood cuttings treated with IBA.

It is evident from Table 1 that except the treatment T_5 (2500 ppm), the number of dead cuttings were not found significant in respect of IBA concentrations. T_5 (2500 ppm) treatment with an average of (1.66) dead cuttings showed the best survival percentage of cuttings. While, the maximum number of dead cuttings (3.34) were recorded under T_2 (1000 ppm) treatment. The present findings are similar to the findings of Tahir *et al.,* (1998) in guava cuttings and Panwar *et al.,* (2001) in pomegranate. Patil *et al.,* (2000) also recorded 80% survival of hard wood cuttings of grape treated with IBA.

A perusal of Table 1 shows that the numbers of sprouts per cutting were found significant in respect of IBA concentrations. Except T_1 (500 ppm) treatment almost all the treatments increased number of sprouts per cutting against the T_0 (control) treatment. The maximum number of sprouts per cutting (10.53) were recorded under the treatment T_5 (2500 ppm), while, the minimum number of sprouts per cutting (5.76) were recorded under the treatment T_1 (500 ppm). Similar results have been obtained by Singh *et al*., (2014) in hard wood cutting of pomegranate**.**

The data presented in Table1 indicated that the average length of sprouts per cutting was found to increase significantly. The maximum average length of sprouts per cutting (20.66cm) was recorded under T_5 (2500 ppm) treatment, while the minimum average length of sprout per cutting (15.83 cm) was recorded under the T_0 (control) treatment. These finding are very much on the line with the results of Panwar *et al.,* (2001) and Singh *et al*., (2014*).*

Treatment T_5 (2500 ppm) obtained first rank in diameter of sprouts/cutting with an average (0.41). The minimum average diameter of sprout per cutting (0.20cm) was recorded under the treatment of T_0 (control) treatment during investigations. Finding of Singh *et al.,* (2014) and Panwar *et al.,* (2001) in pomegranate, Patil *et al.,* (2000) in grape and Tahir *et al.,* (1998) in guava justified the result of present investigation.

All the IBA concentrations affect the number of leaves per cutting significantly (Table 1). It is evident from the data the maximum number of leaves per cutting (81.90) was recorded under the treatment T_5 (2500 ppm). While the minimum average number of leaves per cutting (22.23) was recorded under the treatment T_0 (control), during the present investigations. Similar results of Singh *et al.,* (2014) in pomegranate and Jan *et al.,* (2014) in olive cuttings.

Root Observations

A perusal of Table 2 indicates that the percentage of rooting was found to increase significantly in respect of IBA concentrations. Among all the treatments, T_5 (2500 ppm) treatment showed the highest percentage of rooted cutting (73.33). The minimum percentage of rooted cutting (23.33) was recorded under the T_0 (control) treatment. Singh *et al.,* (2014), Panwar *et al.,* (2001) *and* Bose and Mandal (1972) reported that the hard wood cuttings of pomegranate rooted well when treated with the IBA. Findings of these scientists very much match with the result of present investigation.

It is evident from the data the number of primary roots were found significant in respect of IBA concentrations. The highest number of primary roots per cutting (42.80) was recorded under the treatment T_5 (2500 ppm). While, the minimum number of primary roots per cutting (28.76) were recorded under the treatment T_1 (500 ppm). The present findings are similar to the findings of Singh *et al.,* (2014) reported maximum number of primary roots in the cuttings of pomegranate treated with IBA.

During the present investigation it was observed that all the treatment of IBA were found to increase number of secondary roots in the cuttings significantly (Table 2).The maximum number of secondary roots per cutting (91.40) were recorded under T_5 (2500 ppm) treatment, while the minimum number of secondary roots per cutting (74.18) were recorded under the treatment T_2 (1000 ppm). The present findings are similar to the findings of Singh *et al.,* (2014) in pomegranate.

The data on average length of roots per cutting have been presented in Table 2, revealed that length of the longest root was not found significant in respect of IBA concentration. The T_5 (2500 ppm) treatment was found to give longest root with an average length of 28.12 cm. The minimum length of roots per cutting 22.16cm was recorded under the treatment T_0 (control) during the present investigations. This is similar to the findings by Jan *et al.,* (2014) which was observed while working in olive cuttings.

The data presented in Table 2 indicated that all the treatments of IBA were found significant to increase the diameter of roots. With an average diameter of root (0.21cm) to obtained highest rank the treatment T_5 (2500 ppm), while, the minimum value (0.17) was obtained under the treatment T_0 (control). Rahman *et al.,* (2002) in olive observed highest root length thickness in the cuttings treated with IBA. The result of present study in respect to length and thickness of roots are more or less match with finding of above

scientist with a little variation due to the in concentration and species.

Among all the treatments fresh weight of root per cutting was recorded maximum (1.88g) under the treatment T_5 (2500 ppm). The minimum fresh weight of roots per cutting (0.71g) was recorded under the treatment T_2 (1000 ppm). Similar and Satisfactory result were also found by Ahmed *et al*., (2010) in mulberry cuttings.

The data (Table 2) obtained during the course of present study showed that all the treatments of IBA gave significantly higher dry weight against the T_0 (control) treatment. Average dry weight of roots per cutting (1.02g) was recorded maximum under treatment T_5 (2500 ppm. The minimum average dry weight of roots per cutting (0.36g) was observed under the treatment T_2 (1000 ppm) and T_0 (control). Which is also resemble with the findings of Ahmed *et al.,* (2010) in mulberry cuttings.

CONCLUSION

Among various concentrations of IBA, treatment T_5 (2500 ppm) showed the best performance in terms of number of sprouted cuttings, minimum number of dead cuttings, un-sprouted cuttings, number of sprouts/cutting, length and diameter of sprouts, percentage of rooted cuttings, number of primary roots, secondary roots, fresh weight and dry weight of roots under Valley condition of Garhwal Himalayas.

Table 1. Effect of Different Concentration of IBA on the Shoot Parameters of Plum (*Prunas domestica* L.*)* Cuttings cv. Santa Rosa

Treatments	Number of sprouted cuttings	Number of un-sprouted cutting	Number of dead cutting	Number of sprouts/cutting	Length of sprouts /cutting (cm)	Diameter of sprouts/cutting (cm)	Average number of leaves on new sprout
T_1	5.34	1.67	2.99	5.76	15.95	0.21	33.06
T_2	5.00	1.67	3.33	6.40	16.84	0.22	36.26
T_3	5.66	2.34	2.00	6.83	17.66	0.25	59.33
T_4	6.00	2.00	2.00	9.03	19.70	0.27	66.10
T_5	6.67	1.67	1.66	10.53	20.66	0.41	81.90
T_0	4.33	3.00	2.67	6.30	15.83	0.20	22.23
S.Em±	0.38	0.44	0.53	0.73	0.78	0.13	2.20
C.D.at 5%	1.19	1.39	1.68	2.30	2.47	0.41	6.95

Table 2. Effect of Different Concentration of IBA on the Root Parameters of Plum (*Prunas domestica* L.*)* Cuttings cv. Santa Rosa

Treatments	% of rooted cuttings	Number of Primary roots/cutting	Number of Secondary roots/cutting	Length of longest root/cutting (cm.)	Diameter of thickest root/cutting (cm.)	Fresh weight of root/cutting (g)	Dry weight of root/cutting (g)
T_1	36.66	28.76	76.21	24.54	0.17	0.88	0.46
T_2	40.00	37.02	74.18	24.67	0.18	0.71	0.36
T_3	50.00	37.63	76.35	25.47	0.19	1.22	0.68
T_4	56.66	38.15	76.24	26.28	0.20	086	0.55
T_5	73.33	42.80	91.40	28.12	0.21	1.88	1.02
T_0	23.33	29.62	79.00	22.16	0.17	0.74	0.36
S.Em±	3.80	1.60	3.96	1.48	0.73	0.31	0.16
C.D.at 5%	11.97	5.05	12.48	4.68	0.23	0.99	0.50

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