Eco. Env. & Cons. 28 (May Suppl. Issue) : 2022; pp. (S147-S152)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i03s.020

Propagation of *Prunus salicina* (L.) Santa Rosa: Effect of planting times and auxin levels on success of stem cuttings under mist environment

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(Received 10 September, 2021; Accepted 15 October, 2021)

ABSTRACT

Prunus salicina (L.) Santa Rosa, an important temperate fruit crop having good source of vitamin C, is difficult to propagate commercially either by budding or cuttings. The present study was carried out to regenerate the species through stem cuttings with different doses of auxin in one year old stem cuttings in six different planting times of winter. Indole-3-butyric acid (IBA) was found to be effective auxin in inducing rooting in plum. Exogenous application of IBA significantly improved rooting of cuttings. Among six planting times, 31st December was the best for rooting of stem cuttings which succeeded in 100% rooting with 1500 ppm IBA treatment. 100% sprouting and rooting was observed in stem cuttings planted in the month of January and best acclimatization to field with 100% success in first fortnight of January planted cuttings under mist. However, planting time in relation to season and IBA level had fascinating interaction revealing a residual effect and inherent characteristics of the species for phenophase regulation. It is recommended to treat the cuttings with 1500 ppm IBA and make the cuttings from mature trees in 31st December to 16th January for successful rooting. If these recommendations are followed, it can be achieved 100% success in commercial propagation of *P. salicina*, and thus help in acclimatization of clonal plantations for fruit production in the country.

Key words : *Auxin, Indole 3-butyric acid (IBA), Planting time, Santa Rosa plum, Cuttings*

Introduction

Plums are one of the widely cultivated stone fruits and characterized as a firm flesh when unripe, becoming softer to melting at maturity.They can be consumed fresh but are most often processed, mostly to prunes or distilled drinks (Catherine and Ginies, 2009). Santa Rosa is known as a delicious fruit cultivar of Japanese plum. It is high chilling require cultivar grown in temperate regions. Commercially plum is propagated by patch budding which require high skill man power whereas rate of success is very less. Beyond this the availability and selection of correct scion and rootstock make it bottle neck of propagation. The rootstock is a very vital component of a grafted fruit tree and often determines the success or failure of an orchard enterprise (Dhoot *et al*., 2017). Whereas, cutting is a simplest method of propagation which need very less care and skill, and help for shallow rooted plant which caused dwarfing effect and make it suitable for high density plantation.Still some plant species

fail to root even after giving the treatment of these factors (Chen *et al.,* 2012). For cutting propagation, auxin is often used to facilitate greater and quicker rooting (Mehta *et al*., 2016). Recently, McMahon *et al.* (2015) worked on Chickasaw plum stem cuttings and reported that rooting success was highest when harvested in May (44%) and August (49%). Whereas, Mozumder *et al.* in 2016 observed that IBA treated plum cuttings produce profuse shoot growth but no root was emerged and all cuttings died after a few (25-30) days when planted in the month of June. In contrast with the success and failure of plum cuttings, there may be several factors that can be responsible for it. In temperate region where Santa Rosa plants grow very well seems less success due to frost injury in juvenile stage. So, the plants grown under mist in subtropical condition may help to acclimatization of plants for subtropical as well temperate condition. Therefore, the present investigation was undertaken to evaluate the rooting and growth of Santa Rosa plum cutting under different concentrations of the rooting hormone and planting time under the mist condition.

Materials and Methods

The experiment was carried out in the Horticultural Research Centre, and Department of Horticulture, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand, during the period of December to June of two consecutive years 2016-17 and 2017-18 under Ph.D. discipline. Santa Rosa plum cutting were prepared of 16 cm length and 0.4 to 0.6 mm diameter from more than 10 years old trees of Santa Rosa plum established in Horticultural Research Centre, Chauras Srinagar Garhwal. Prepared cuttings were treated with six IBA concentrations (0, 1000, 1500, 2000, 2500 and 3000 ppm) and planted in six different planting time in 15 days interval (1st December, 16th December, 31st December, 16thJanuary, 31st January and 15th February) under the mist chamber. The cuttings were planted in disposable glass of 200 gm capacity filled with (Cocopeat, Vermicompost, sand and soil @ 2:2:1:1 portion) rooting media. An intermittent mist system was set at 22±2 °C temperature and 79-85 % relative humidity and mist were relayed at 30 minutes interval for 20 second. The experiment was organized according to factorial randomized block design (F-RBD). The days taken to sprouting of cutting was observed on daily basis and sprouting percentage of cutting was taken in 15 days interval upto 90 days of planting under the mist. Rooting of cuttings were observed after 90 days of planting the cuttings under mist of each treatment.

Results and Discussion

In the study where different IBA concentration and planting time were applied, at the level of 0.05 in term of days taken to sprout, sprouting percentage and rooting percentage, hormone doses, planting time and hormone × planting time interactions significant differences ($p \leq 0.05$) were determined.

Days taken to sprout: During the course of investigation regular observation pertaining to days to sprouting were recorded in two consecutive years 2016-17 and 2017-18 and the pooled mean values are presented in Table 1. The analyzed data revealed that days taken to sprout in Santa Rosa plum cutting under mist condition was significantly ($p \leq 0.05$) influenced by planting time.

Amongst the planting times under study, 15th February (T_6) recorded the minimum mean days taken to sprouting (11.23) which is significantly different from other planting times. The data on mean days taken to sprout indicate that cuttings planted on 1st December took maximum days (84.57) followed by 16th December (67.79), 31st December (41.68), 16th January (23.51) and 31st January (15.84) in decreasing order. In hormonal treatments, minimum mean days taken to sprout recorded with 1500 ppm (C_2) IBA treatment (38.65) followed by 2000 ppm (C_3) IBA concentration (39.60), 2500 ppm (40.20), 1000 ppm (41.06) and 3000 ppm (41.42) in comparison to control (43.68) which was maximum. Within interactions, minimum mean days taken to sprouting recorded under 15th February, with 1500 ppm IBA T_6C_2 (9.17) followed by T_6C_3 (9.39), T_6C_4 (9.83), while the maximum of this was in 1st December with control T_1C_0 (86.05) followed by T_1C_5 (85.33).

In a study Sahariya *et al.* (2013) also reported minimum days taken to sprout 14.03 and 9.88 of bougainvillea (var. Thimma) with 1500 ppm IBA treatment in open field and poly house condition, respectively. Dawa *et al*. (2017) concluded that 23.33 days was earliest period taken to sprout in 1000 ppm IBA, followed by 500 ppm and 1500 ppm IBA in rose cutting. In the present study, the earliest sprouting on 15th February planted cuttings might possibly be due to favourable day length which in-

Table 1. Effect of planting time and IBA level on days taken to sproutingof Santa Rosa plum cuttings under mist environment

Planting Time	IBA Concentration						
	C_0 Control	C_1 1000ppm	C_2 1500ppm	C_3 2000ppm	C_4 2500ppm	C_5 3000ppm	Mean (T)
Days taken to sprouting							
T_1(1st Dec)	86.05	84.50	83.61	83.94	84.00	85.33	84.57
T_2(16th Dec)	72.39	67.50	65.61	66.89	67.17	67.17	67.79
T_3(31st Dec)	44.05	42.39	37.72	40.50	41.55	43.83	41.68
T_4(16th Jan)	26.61	25.11	21.50	22.28	22.50	23.05	23.51
T_5(31st Jan)	17.83	15.67	14.28	14.61	16.17	16.50	15.84
T_6(15th Feb)	15.17	11.22	9.17	9.39	9.83	12.61	11.23
Mean (C)	43.68	41.06	38.65	39.60	40.20	41.42	
	Planting Time (T)			IBA Concentration (C)			(T x C)
Sem±	0.21			0.21			0.52
CD (5%)	0.60			0.60			1.48

creases absorption of nutrient and water from roots to shoot, in comparison to other planting times by reduction of growth retardant compound present in cuttings like Abscissin, phenols etc. (De Klerk *et al*., 2011; Vidal, *et al*., 2020). Apart from this IBA increases root formation which ultimately can facilitate early sprouting.

Sprouting percentage (%): The data presented in Table 2 indicate that mean percentage of sprouted cuttings of Santa Rosa plum under mist environment was significantly highest in 31st December (94.72%) followed by 31st January (90%), 16th January (87.50%), 15th February (74.44%), 16th December (72.22%) and minimum in 1st December (58.61%) under the mist environment.IBA treatments also caused significant effect on percentage of sprouted cuttings. The highest mean sprouted cuttings were observed in 1500 ppm (91.39%) followed by 2000 ppm (89.44%), 2500 ppm (85.55%), 1000 ppm (83.89%), 3000 ppm (79.17%) and least in control (48.05%). Effect of planting time and IBA concentration level's interaction on mean sprouted cutting, was maximum 100% in 31st December with 1000 ppm, 1500 ppm, 2000 ppm, and 2500 ppm (T_3C_1, T_3C_2, T_3C_3, T_3C_4), 16th January with 1500 ppm and 2000 ppm (T_4C_2, T_4C_3) and 31st January with 1500 ppm (T_5C_2). The minimum value was recorded in 1st December with control (T_1C_0) as only 30% cuttings sprouted followed by T_6C_0 (40%).

This possibly reflects a precision level interaction between environmental stimulus and cellular mechanism regulating growth and differentiation.

Table 2. Effect of planting time and IBA level on sprouted cutting percentage of Santa Rosa plum under mist environment

Planting Time	IBA Concentration						
	C_0 Control	C_1 1000ppm	C_2 1500ppm	C_3 2000ppm	C_4 2500ppm	C_5 3000ppm	Mean (T)
Per cent (%) of sprouted cuttings							
T_1(1st Dec)	30.00	61.67	71.67	68.33	65.00	55.00	58.61
T_2(16th Dec)	41.67	75.00	85.00	83.33	76.67	71.67	72.22
T_3(31st Dec)	73.33	100.00	100.00	100.00	100.00	95.00	94.72
T_4(16th Jan)	38.33	95.00	100.00	100.00	98.33	93.33	87.50
T_5(31st Jan)	65.00	95.00	100.00	98.33	93.33	88.33	90.00
T_6(15th Feb)	40.00	76.67	91.67	86.67	80.00	71.67	74.44
Mean (C)	48.05	83.89	91.39	89.44	85.55	79.17	
	Planting Time (T)			IBA Concentration (C)			(T x C)
Sem±	1.40			1.40			3.43
CD (5%)	3.95			3.95			9.67

Singh and Singh (2011) reported in their study that among various concentrations of IBA, 1000 ppm resulted in maximum 85.39% sprouting followed by 1500 ppm in Louise Wathen cultivar of bougainvillea cuttings.

In another study highest 6.29% sprouting were recorded with 2000 ppm IBA in Pant Lemon cuttings (Singh *et al*., 2013). Dormant hardwood cuttings of peach sprouted in highest percentage (97.47%) when treated with 3000 ppm IBA and declined further with increase or decrease in IBA concentrations (Kaur, 2015).

An attempt has been made to express the trend of days taken to sprout in plum cuttings planted at different planting times representing a transition in environmental conditions from winter to spring, important for a rosaceous tree with winter dormant period. The curves in Fig 1 clearly show that irrespective of the planting time the sprouting of cuttings occur in the month of February to first week of March that coincides with the normal sprouting period of the test plant. This confirmed that it was inherently the active growth period for Santa Rosa plum cuttings.

Rooting percentage (%): The data presented in Table 3 indicates that planting time greatly influenced the rooting percentage of Santa Rosa plum cutting under the mist environment. Planting time 31st December was highest in mean rooting percent (91.67%) followed by 16th January (80.83%), 31st January (78.89%), 16th December (70%) and 15th February (67.50%) while the least rooting percentage of Santa Rosa plum cuttings was found in 1st December planting (57.78%).

Among IBA concentrations, 1500 ppm had highest mean rooting percentage of Santa Rosa cuttings (91.39%) followed by 2000 ppm (87.78%), 2500 ppm (83.33%), 1000 ppm (80%) and minimum (27.50%) was in control treatment. Combination of planting time 31st December and 1000 to 2500 ppm IBA as T_3C_1, T_3C_2, T_3C_3, T_3C_4; and 16th January with 1500 ppm (T_4C_2),31st January with 1500 ppm (T_5C_2) all resulted in 100% of rooting under the mist condition while lowest rooting percentage (6.67%) was in 15th February planting time and control treatment interaction (T_6C_0) of Santa Rosa plum cuttings.Similar to the present findings, Jana *et al.* (2015) and Ibrahim *et al.* (2015) also found that among different IBA concentrations, 1500 ppm was highest in rooting percentage followed by 2000 ppm and 2500 ppm while the minimum was in control of lemon verbena cuttings.

Field establishment of cuttings: Among all planting times,31st December planted cuttings recorded highest mean field establishment (83.33%) followed by 16th January (69.44%), 1st December (48.15%), 31st January (41.67%), 16th December (35.18%) and minimum mean field establishment was observed in 15th February (30.55%) as figured in Table 4.Cuttings treated with differed concentrations of IBA and planted in field after rooting considerably different in their field establishment percentage. IBA concen-

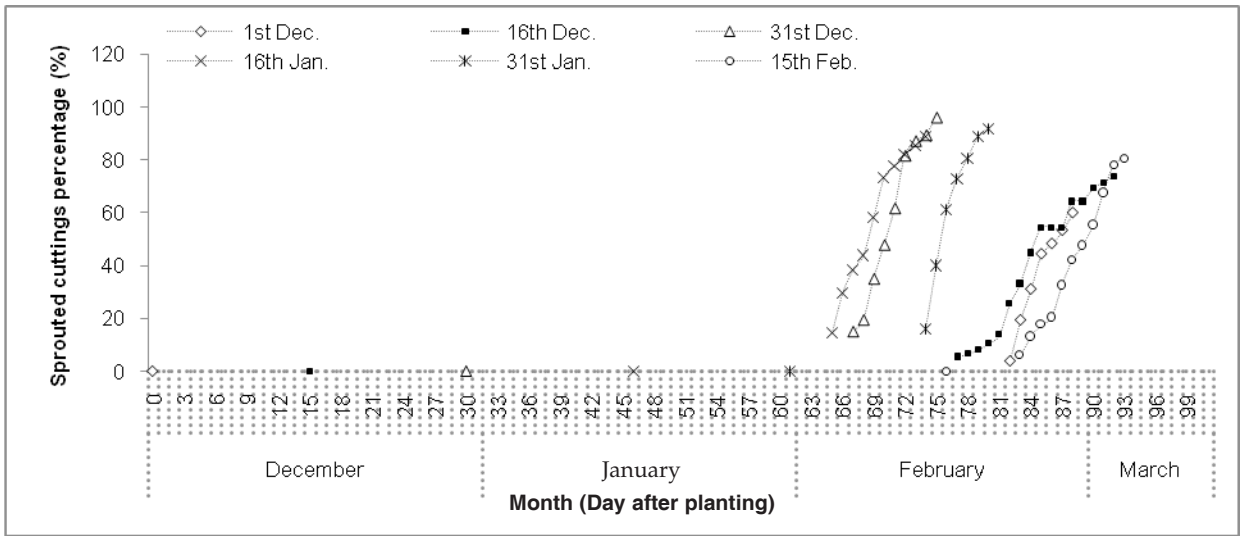

Fig. 1. Effect of planting time on number of first sprouted cuttings of Santa Rosa plum cutting under the mist environment on monthly basis

Table 3. Effect of planting time and IBA level on rooted cutting percentage of Santa Rosa plum cuttings under mist environment

Planting Time	IBA Concentration						
	C_0 Control	C_1 1000ppm	C_2 1500ppm	C_3 2000ppm	C_4 2500ppm	C_5 3000ppm	Mean (T)
Rooting percentage (%)							
T_1(1st Dec)	28.33	60.00	71.67	68.33	63.33	55.00	57.78
T_2(16th Dec)	35.00	73.33	85.00	81.67	76.67	68.33	70.00
T_3(31st Dec)	55.00	100.00	100.00	100.00	100.00	95.00	91.67
T_4(16th Jan)	21.67	91.67	100.00	95.00	90.00	86.67	80.83
T_5(31st Jan)	18.33	81.67	100.00	96.67	91.67	85.00	78.89
T_6(15th Feb)	6.67	73.33	91.67	85.00	78.33	70.00	67.50
Mean (C)	27.50	80.00	91.39	87.78	83.33		76.67
	Planting Time (T)			IBA Concentration (C)			(T x C)
Sem±	1.55			1.55			3.79
CD (5%)	4.37			4.37			10.70

Table 4. Effect of planting time and IBA level on field establishment percentage of Santa Rosa plum cuttings under mist environment

Planting Time	IBA Concentration						
	C_0 Control	C_1 1000ppm	C_2 1500ppm	C_3 2000ppm	C_4 2500ppm	C_5 3000ppm	Mean (T)
Field establishment percentage (%)							
T_1(1st Dec)	11.11	50.00	77.78	61.11	55.56	33.33	48.15
T_2(16th Dec)	11.11	33.33	55.56	44.44	33.33	33.33	35.18
T_3(31st Dec)	11.11	100.00	100.00	100.00	100.00	88.89	83.33
T_4(16th Jan)	11.11	77.78	100.00	94.44	77.78	55.56	69.44
T_5(31st Jan)	0.00	44.44	66.67	66.67	44.44	27.77	41.67
T_6(15th Feb)	0.00	33.33	55.56	44.44	33.33	16.66	30.55
Mean (C)	7.41	56.48	75.93	68.52	57.41	42.59	
	Planting Time (T)			IBA Concentration (C)			(T x C)
Sem±	3.03			3.03			7.43
CD (5%)	8.56			8.56			20.97

Fig. 2. Rooting in cuttings of Santa Rosa plum under different IBA Concentration

tration effect on mean field establishment was maximum with 1500 ppm (75.93%) IBA concentration followed by 2000 ppm (68.52%), 2500 ppm (57.41%), 1000 ppm (56.48%), 3000 ppm (42.59%) and minimum with control (7.41%). Data obtained on interaction of planting time and IBA concentration levels indicated that 100% field establish was recorded in T_3C_1, T_3C_2, T_3C_3, T_3C_4, and T_4C_2. Plants obtained under treatment combination T_5C_0 and T_6C_0 failed to establish in field while 11.11% field establishment was recorded with T_1C_0, T_2C_0, T_3C_0, T_4C_0.

Conclusion

On the basis of overall study it may be concluded that among differed planting time and percentage IBA levels the 31st December planting time is suitable for getting maximum success whereas IBA concentration 1500 ppm best treatment in respect to rooting, vegetative growth and multiplication rate. Therefore, keeping in view the various advantages

of planting time and IBA concentration responses in regeneration potential of cuttings, 31st December planting time along with application of IBA @1500 ppm have been recommended for multiplication of Santa Rosa plum.

Acknowledgements

The authors wish to thank department of Horticulture and HAPPRC, Hemwati Nandan Bahuguna Garhwal University for technical support in performing this research.

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