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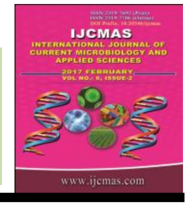

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Multiplication of Phalsa (*Grewia asetica* L.) Cv. Dwarf Type through Hardwood Stem Cutting Under Srinagar Garhwal Himalayas

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A B S T R A C T

An experiment was conducted to study the Multiplication of Phalsa (*Grewia asetica* L.) Cv. Dwarf Type Through Hardwood Stem Cutting Under Srinagar Garhwal Himalayas during the rainy season 2012–13 at Horticultural Research Centre, Chauras Campus, H.N.B. Garhwal University, Srinagar, Garhwal, Uttarakhand, India. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three main factors (1000ppm IBA, 1000ppm NAA and Control) and four sub factors (June, July, August and September). Results of the investigation showed that the maximum number of sprouted cutting (5.083), survival percentage of cutting (50.833), length of longest sprout (7.794cm), diameter of thickest sprout (1.848mm), number of leaves (4.917), number of sprout per cutting (2.333), percentage of rooted cutting (48.333%), number of primary roots (7.158), diameter of thickest root (1.681mm), length of longest root (7.158), fresh weight of root (1.033g) and dry weight of root (0.649g) was recorded under 1000ppm concentration of IBA with mid August planting time.

Introduction

Phalsa (*Grewia asiatica* L.) belongs to genus *Grewia* and family Tiliaceae, is a native to south Asia from India. Phalsa is a small bushy in nature and preferred as an ideal crop for growing in arid and hot regions. It can be grown successfully on the slop of hills. Phalsa is a very popular fruit in our country and is commercially grown particularly in states of Uttar Pradesh, Bihar, Madhya Pradesh and Maharastra. The genus *Grewia* comprises approximately 150 species of shrubs and small trees, and is the only genus in the family that yields edible fruits. The phalsa fruits are good source of vitamin 'C' and 'A'. Ripe fruits of phalsa are consumed fresh, as desserts, or processed into refreshing fruit enjoyed in India during hot summer months. The leaves are believed to have antibiotic properties hence, applied on skin eruptions and they are known to have antibiotic action.

The phalsa plant is propagated by rooting of hardwood cuttings. Hardwood cutting and date of planting influence rooting of phalsa. The time of preparation of cuttings in phalsa greatly affected the extent and success of root formation, the optimal time of cuttings preparation and planting is related to the physiological condition and environmental conditions of the plant (Jadhav, 2007). This may be affected by season and several factors such as nutrient availability, temperature, and light to the rooting percentage of cuttings. The low rooting percentage during winter may be attributed to temperature level at the time of planting. Application of auxin has been found to increase the histological features like formation of callus tissue and differentiation of vascular tissues. Devi *et al.*, (2016) showed that the maximum shoot and rooting performance was observed under 300ppm concentration of IBA with planted on 30th July. Singh *et al.,* (2015) was observed that the phalsa cuttings treated with IBA 2000ppm performed best in all aspects, as length of shoot, length of root rooting and percentage root. Intermittent mist is often used on cuttings because it shortens the temperature of the leaves, increases relative humidity and lowers respiration around the leaf surface. For that, the present investigate was undertaken with the following objectives: (a)To find out the effects of various planting time on response and performance of rooting in stem cuttings of phalsa. (b)To determine the effect of various rooting media on response and performance of rooting in stem cuttings of phalsa.

Materials and Methods

The experiment site was conducted under mist chamber at Horticulture Research Center, Chauras Campus. Geographically Srinagar valley is spread between latitude 30^0, 12' 0" to 30^0 13' 4" North and longitude 78^0 0' 45" to 78^0 0' 50" East. The valley is about 6 km long and 1 to 1.2 km wide located on both side of famous Alaknanda River at an elevation 540 m above MSL and about 132 km from Haridwar in Himalayan region. The valley shows a semi-arid and sub-tropical climate. Except during rainy season rest of months are usually dry with exception occasional showers during winter or early spring. The average minimum and maximum temperature, relative humidity and rainfall vary from 7.44^0C to 34.3^0C, 62.24% and 2.60 to 235.45 mm respectively.

An experiment was conducted to study the influence of four collecting times (June, July, August and September) and two bio regulators (1000ppm NAA, 1000ppm IBA and Control) on rooting characteristics of phalsa (*Grewia asiatica*) in 2012-2013 under mist chamber growing condition. Hardwood cuttings of *Grewia asiatica* were collected from 5 to 7 year old plants and 20 cm long cuttings with basal portion. For preparing the rooting media, farm yard manure and sandy soil in ratio of 1:1 by v/v were mixed thoroughly, cleaned for grasses and stones, then the mixture was filled in root trainers (Singh *et al.*, 2016).

The cuttings basal ends were dipped in dilute solutions, 1000 ppm IBA, 1000 ppm NAA and control by quick dip method for 10 seconds before planting in the rooting medium (Oni, 1987 and Singh *et al.*, 2011). The experiment was laid out in FRBD and replicated thrice with 10 cuttings in each treatment. The cuttings (nine numbers per treatment per replication) were carefully removed from the pots and dipped in water to remove the soil particles adhering to roots to record the observations pertaining to roots viz., percentage of cutting rooted, length of longest root and diameter of root except for the observations on various stem leaf characters and all other were recorded after planting. The recorded data were analysed through statistical software for observation the parameter were statically significant (0.05%) statically difference (FRBD) as described by Cochran and Cox (1992).

Results and Discussion

The results of the survival parameters of *Grewia asiatica* cuttings are showed in the tables 1 and 2. Significantly the maximum number of sprouted cutting (5.083), survival percentage of cutting (50.833), length of longest sprout (7.794cm), diameter of thickest sprout (1.848mm), number of leaves (4.917), number of sprout per cutting (2.333), percentage of rooted cutting (48.333%), number of primary roots (7.158), diameter of thickest root (1.681mm), length of longest root (7.158), fresh weight of root (1.033g) and dry weight of root (0.649g) was recorded under C_1 (1000ppm concentration of IBA), while the minimum number of sprouted cutting (2.750), survival percentage of cutting (27.500%), length of longest sprout (6.751cm), length of longest root (6.860cm), fresh weight of root (0.842g), diameter of thickest sprout (1.653mm), number of leaves (3.861), number of sprout per cutting (1.806), percentage of rooted cutting (24.167%), number of primary roots (6.788), diameter of thickest root (1.248mm), and dry weight of root (0.447g) was recorded under C_0 (control) treatments. The positive relationship has been observed between rooting and IBA treatment by Goutam and Chauhan (1990). Singh *et al.*, (2015) showed that phalsa rooting percentage, survival percentage, length of shoot, length of root and thickening of root was recorded under IBA 2000ppm with mist chamber growing condition.

The effectiveness of auxin to rooting percentage of the cuttings could be through enhancing cambial activity and differentiation of root primordia. Davies and Joiner (1980) observed that the stimulating redistribution and mobilization of some auxin cofactors towards base of the cuttings. Maximum percentage of rooting in cuttings treated with IBA may be ascribed to the maximum partitioning of photosynthesis towards root development. It is also well known that success of vegetative propagation through cuttings of woody plants depends on physiological capacity and genetic for adventitious root formation (Hartman *et al.*, 2002). The findings of present study are similar to the results of in Gupta *et al.*, (2002) in bougainvillea and Luqman *et al.*, (2004) in guava (*Psidium guajava* L.).

In case of time of planting, significantly the maximum number of sprouted cutting (5.666), survival percentage of cutting (56.667%), length of longest sprout (9.218cm), diameter of thickest sprout (2.370mm), number of leaves (5.814), percentage of rooted cutting (54.444%), number of primary roots (8.607), diameter of thickest root (1.774mm), length of longest root (8.607), fresh weight of root (0.996g) and dry weight of root (0.628g) was observed under T_3 (Mid August) planting time and the number of sprout per cutting (2.370) was recorded under T_2 (Mid July) planting time while the minimum number of sprouted cutting (1.556), survival percentage of cutting (15.556%), length of longest sprout (5.242cm), diameter of thickest sprout (1.278mm), number of primary roots (1.778), number of leaves (2.667), number of sprout per cutting (1.778), percentage of rooted cutting (14.444%), number of primary roots (5.444), diameter of thickest root (1.092mm), length of longest root (5.444cm), fresh weight of root (0.826g) and dry weight of root (0.444g) was recorded under T_4 (Mid September) planting time. July and August months have been found to induce better root system in phalsa cuttings.

This is due to enhanced activity of hydrolyzing enzymes and adequate mobilization of reserve food material. The enhanced hydrolysis activity in the presence of optimum production of endogenous hormones was responsible for the increased rooting in cuttings (Nanda and Anand, 1970). Yadav *et al.*, (1978) have shown that the highest percentage of rooting in hardwood cuttings of bougainvillea planted was in August. The rooting behaviour of cuttings may have varied with the seasons and low temperature adversely affecting rooting.

Table.1 Effect of bio regulator and planting time on the shooting performance of phalsa (*Grewia asetica* L.)

Rooting Media	Number of sprouted cutting					Survival percentage of cutting					Length of longest sprout (cm)				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
C_0 (Control)	2.333	3.000	4.000	1.667	2.750	23.333	30.000	40.000	16.667	27.500	7.400	6.407	8.133	5.063	6.751
C_1 (1000ppm IBA)	5.333	5.667	7.667	1.667	5.083	53.333	56.667	76.667	16.667	50.833	6.823	7.177	11.577	5.600	7.794
C_2 (1000ppm NAA)	4.000	4.333	5.333	1.333	3.750	40.000	43.333	53.333	13.333	37.500	7.587	7.520	8.133	5.063	7.076
Mean	3.889	4.333	5.667	1.556		38.889	43.333	56.667	15.556		7.270	7.034	9.281	5.242	
C D 0.5 %															
Planting Time (T)	0.639					6.390					0.690				
Growth Regulator (C)	0.553					5.534					0.598				
T x C	1.107					11.067					1.195				

Table.2 Effect of bio regulator and planting time on the shooting performance of phalsa (*Grewia asetica* L.)

Rooting Media	Diameter of thickest sprout					Number of leaves					Number of sprout per cutting				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
C_0 (Control)	1.500	1.667	2.110	1.333	1.653	3.833	4.333	4.943	2.333	3.861	2.333	2.000	1.557	1.333	1.806
C_1 (1000ppm IBA)	1.667	2.000	2.557	1.167	1.848	4.000	5.333	7.333	3.000	4.917	1.777	2.110	3.110	2.333	2.333
C_2 (1000ppm NAA)	1.500	1.833	2.443	1.333	1.778	4.000	4.167	5.167	2.667	4.000	2.000	3.000	1.333	1.667	2.000
Mean	1.556	1.833	2.370	1.278		3.944	4.611	5.814	2.667		2.037	2.370	2.000	1.778	
C D 0.5 %															
Planting Time (T)	0.359					0.412					NS				
Growth Regulator (C)	NS					0.357					NS				
T x C	NS					0.714					1.122				

T_1 = June, T_2 = July, T_3 = August and T_4 = September, C_1 = 1000ppm IBA, C_2 = 1000ppm NAA and C_0 = Control (distilled water)

Table.3 Effect of bio regulator and planting time on the rooting performance of phalsa (*Grewia asetica* L.)

Rooting Media	Percentage of rooted cutting					Number of primary roots					Diameter of thickest root (mm)				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
C_0 (Control)	20.000	26.667	36.667	13.333	24.167	6.800	7.377	7.227	5.750	6.788	1.330	1.220	1.440	1.000	1.248
C_1 (1000ppm IBA)	50.000	53.333	73.333	16.667	48.333	7.070	6.277	10.380	4.907	7.158	1.557	1.667	2.333	1.167	1.681
C_2 (1000ppm NAA)	36.667	40.000	53.333	13.333	35.833	6.473	7.077	8.213	5.677	6.860	1.220	1.330	1.550	1.110	1.303
Mean	35.556	40.000	54.444	14.444		6.781	6.910	8.607	5.444		1.369	1.406	1.774	1.092	
C D 0.5 %															
Planting Time (T)	2.660					0.974					0.248				
Growth Regulator (C)	2.304					NS					0.215				
T x C	NS					1.687					NS				

Table.4 Effect of bio regulator and planting time on the rooting performance of phalsa (*Grewia asetica* L.)

Rooting Media	Length of longest root (cm)					Fresh weight of root (g)					Dry weight of root (g)				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
C_0 (Control)	6.473	7.077	8.213	5.677	6.860	0.860	0.880	0.870	0.757	0.842	0.450	0.413	0.563	0.360	0.447
C_2 (1000ppm IBA)	7.070	6.277	10.380	4.907	7.158	0.967	1.030	1.147	0.987	1.033	0.627	0.687	0.733	0.550	0.649
C_1 (1000ppm NAA)	6.800	7.377	7.227	5.750	6.788	0.877	0.867	0.970	0.733	0.862	0.477	0.443	0.587	0.423	0.483
Mean	6.781	6.910	8.607	5.444		0.901	0.926	0.996	0.826		0.518	0.514	0.628	0.444	
C D 0.5 %															
Planting Time (T)	0.974					0.116					0.093				
Growth Regulator (C)	NS					0.100					0.081				
T x C	1.687					NS					NS				

T_1 = June, T_2 = July, T_3 = August and T_4 = September, C_1 = 1000ppm IBA, C_2 = 1000ppm NAA and C_0 = Control (distilled water)
IBA = Indole butyric acid, NAA = Naphthalene acetic acid

The low rooting percentage during winter may be attributed to temperature level at the time of planting. The increased hydrolytic activity in presence of applied IBA coupled with appropriate time of planting might be responsible for the enhanced percentage of rooted cuttings. Low nitrogen and High carbohydrate have been observed to favour root formation (Singh 2016). The present findings are similar to the findings of Kumar *et al.*, (2007) in phalsa (Table 3 and 4).

In conclusion, it is suggested that 1000ppm concentration of IBA with August planting time gives the overall best performance under mist condition to produce tallest plant of phalsa (*Grewia asiatica*) cv. dwarf type within a short time and recommend for commercial vegetative multiplication until additional discoveries are made.

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