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EFFECT OF PLANTING TIME AND INDOLE BUTYRIC ACID LEVELS ON ROOTING OF WOODY CUTTINGS OF PHALSA (*Grewia asiatica* L.)

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ABSTRACT : The study on effect of planting time and IBA levels on rooting of phalsa (*Grewia asiatica* L.) woody cuttings under mist house condition was undertaken in Horticulture Research Centre, Chauras Campus. HNBGU, Srinagar, Garhwal during 2013. The experiment was laid out in Factorial RBD with three replications. Cuttings were collected during winter season (mid January, February, March) and rainy season (mid June, July and August). The 20 cm long cuttings were prepared from 4 to 5 year old plants and treated with 1000, 1500, 2000 ppm IBA solutions by quick dip method. The cuttings treated with IBA 2000 ppm performed best in all aspects, as rooting percentage, length of shoot, length of root, thickening of root and leaf sprouting in shoot. Overall, M_4C_3 (mid June planting with 2000 ppm IBA) treatment combination was found best for all parameters studied.

Keywords : *Phalsa, planting time, IBA, rooting, survival.*

Phalsa (*Grewia asiatica* L.), belonging to family Tiliaceae, is an important minor fruit crop of India. It is native to the Indian sub-continent and South-East Asia. The genus *Grewia* has 140 species, of which only *Grewia asiatica* is of commercial importance. Phalsa cultivation is the most suitable for marginal lands, particularly for the utilization of the wastelands in arid and semi-arid regions of the world. Phalsa plant is a small bush and hardy in nature and preferred as an ideal crop for growing in hot and arid regions. It can be grown successfully on the slope of hills. It is also preferred for dry land horticulture and silvi-horticulture.

Ripe fruits are sub acidic and good source of vitamin A and vitamin-C. Fruits contain 50-60% juice, 10 to 11% sugar and 2-2.5% acids (Aykroyd, 3). The fruits are used for making excellent juice and squash. It is also used as table fruit by children. The fruits possess high medicinal properties. Its ripe fruit exert cooling effects, cure inflammation, heart and blood diseases, fever and constipation (Salunkhe and Desai, 13). The bark is used as a soap substitute in Burma. The leaves are believed to have antibiotic properties hence, applied on skin eruptions and they are known to have antibiotic action.

Phalsa is usually propagated by seeds which germinate in 15-20 days. Ground-layers, treated with hormones, may have 50% and air-layers may have 85% success. Cuttings are difficult to root. Only 20% of semi-hardwood cuttings from spring flush, treated with 1,000 ppm NAA, and planted in July rooted and grew normally (Morton, 9). The phalsa plant is readily propagated by hardwood cuttings as well as layering (Samson, 14). Rooting of phalsa cuttings depends upon various factors such as pretreatment of cutting, growing condition, environmental factors, etc. which influence the regeneration ability of cuttings (Jadhav, 7). Although phalsa can strike roots but rooting is not appreciable. So, growth regulators are to be used to improve its high rooting ability (Yadav and Rajput, 21). Type of cutting and planting date also influence the rooting of phalsa (Singh *et al.,* 16). The stimulation of adventitious root formation in stem cuttings treated with auxin is well known. Hence, use of growth regulators and suitable planting season and condition would help for rapid multiplication in propagating phalsa cuttings.

MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Centre, Chauras Campus, HNB Garhwal University, Srinagar (Garhwal) during 2013. The Srinagar valley shows a semi-arid and sub-tropical climate. Except during rainy season rest of months are usually dry with exception of occasional showers during winter or early spring. Hardwood stem cuttings of phalsa (*Grewia asiatica* L.) were collected from 4 to 5 year old plants and 20 cm long stem cuttings with basal portion were prepared. For rooting media, sandy soil and farm yard manure (FYM) in ratio of 2:1 by v/v were mixed thoroughly, cleaned for stones and grasses, then the mixture was filled in root trainers. The cuttings were collected from winter season (mid January, February, March) and rainy season (mid June, July and August).The basal end of the cuttings was

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dipped in dilute solutions of 1000 ppm, 1500 ppm and 2000 ppm IBA by quick dip method for 10 seconds before planting in the rooting medium. Cuttings used for control (check) were dipped in tap water only. After the treatment, the cuttings was immediately planted in root trainers and inserted 7.5 cm deep in the rooting media. The experiment was replicated thrice with 10 cuttings in each treatment and a total of 120 cuttings were planted in mist chamber. The mist chamber has the arrangement for intermittent misting to 60 seconds at every 30 minutes interval between 8 am and 8 pm. The number of sprouted cuttings, number of sprouts, length of sprout, percentage of rooting, number of primary roots percentage of secondary rooting, length of root, diameter of root, and fresh weight and dry weight of roots were measured after three months. The data recorded were subjected to statistical analysis by using Factorial Randomized Block Design (FRBD) as described by Cochran and Cox (5).

RESULTS AND DISCUSSION

A perusal of Table 1 indicated that the rooting percentage was influenced significantly by time of planting and IBA treatment. The highest rooting percentage (54.16 %) was recorded when cuttings were planted on mid June (M_4) followed by mid March (M_3), while the lowest rooting percentage (39.16 %) was recorded when cuttings were planted on mid January. The maximum rooting percentage of 62.23 % was recorded in cuttings treated with 2000 ppm IBA (C_3) and the minimum rooting percentage (31.66 %) was recorded under control. Treatment combination of M_6C_3 (mid August planting with 2000 ppm IBA) was found to be the best by producing 73.34 % of rooting. The enhanced hydrolytic activity in presence of applied IBA coupled with appropriate planting time might be responsible for the increased percentage of rooted cuttings. High carbohydrate and low nitrogen have been reported to favour root formation. The findings of Subbaraj *et al.* (20) in Gymnema slyvestre are in agreement to present results. Mid August planting time (M_6) resulted in significantly higher number of primary roots per cutting (17.83). Among various concentrations of IBA, 2000 ppm IBA resulted in the higher number of primary roots per cutting (16.08). The interaction of planting time and IBA concentration (mid August planting with 2000 ppm IBA) was found to be best by producing maximum number of primary roots/cutting (21.44). This may be due to enhanced hydrolysis of carbohydrates caused by auxin treatment (Rajarama, 12; Singh *et al.,* 16).

Significantly the longest average length of roots/cutting (8.56 cm) was found by mid June planting. The appropriate planting time, application of IBA as well as genetic makeup of genotype used might have played vital role in augmenting the growth of roots (Singh and Singh, 15). Amongst IBA levels, the maximum average length of roots/cutting (8.60 cm) was recorded under 2000 ppm which might be due to enhanced histological features like formation of callus and tissues and differentiation of vascular tissues due to auxin (Mitra and Bose, 8). The longest root/cutting (11.38 cm) was produced by interaction of M_4C_3 (mid June planting with 2000 ppm IBA). The findings with respect to average length of root are agreed with the reports of Singh *et al.* (17) in *Thuja compecta* and Singh *et al.* (18) in *Duranta.* Mid June planting time exhibited the maximum diameter of roots (1.90 mm). The maximum average diameter of root (1.82 mm) was recorded with 2000 ppm IBA. The highest diameter of roots/cutting (2.44 mm) was observed under M_4C_3 (mid June planting with 2000 ppm IBA). The invigorated growth of shoot with IBA 2000 ppm at June planting synchronized due to more diameter of roots in these treatments (Table 2) which might have produced

Table 1: Rooting percentage and number of primary roots of phalsa cuttings as influenced by time of planting and IBA concentrations.

IBA Concentrations	Rooting percentage							Number of primary roots/plant						
	M_1	M_2	M_3	M_4	M_5	M_6	Mean	M_1	M_2	M_3	M_4	M_5	M_6	Mean
C_1 (1000 ppm)	43.34	50.00	50.00	53.34	46.66	53.34	49.45	8.34	6.78	8.22	12.61	13.78	17.44	11.19
C_2 (1500 ppm)	46.67	46.67	56.66	56.67	63.33	53.34	53.89	8.11	8.34	8.89	14.34	15.78	17.99	12.24
C_3 (2000 ppm)	50.00	60.00	63.34	66.66	60.00	73.34	62.23	10.33	14.11	11.50	18.55	20.55	21.44	16.08
C_0 (Control)	16.66	40.00	43.34	40.00	36.67	13.34	31.66	1.66	5.67	4.84	9.00	5.50	14.44	6.85
Mean	39.16	49.16	53.34	54.16	51.67	48.34		7.11	8.72	8.36	13.62	13.90	17.83	
C D (P=0.05)														
Time of planting (M)	4.76							1.57						
IBA Conc. (C)	3.89							1.28						
M × C	9.56							3.14						

Table 2: Length of longest roots and diameter of thickest roots of phalsa cuttings as influenced by time of planting and IBA concentrations.

IBA Concentrations	Length of longest root (cm)							Diameter of thickest roots (cm)						
	M_1	M_2	M_3	M_4	M_5	M_6	Mean	M_1	M_2	M_3	M_4	M_5	M_6	Mean
C_1 (1000 ppm)	5.51	5.92	6.04	8.59	6.82	7.07	6.66	1.00	1.00	1.34	1.83	1.11	1.55	1.30
C_2 (1500 ppm)	5.62	6.27	7.19	9.50	6.36	6.27	6.87	1.11	1.34	1.11	2.00	1.11	1.55	1.37
C_3 (2000 ppm)	6.47	7.65	9.16	11.38	8.61	8.34	8.60	1.22	1.44	1.61	2.44	2.11	2.11	1.82
C_0 (Control)	1.21	3.84	4.03	4.83	4.35	5.00	3.87	0.33	1.00	1.00	1.34	1.00	1.67	0.97
Mean	4.70	5.92	6.61	8.56	6.53	6.67		0.91	1.19	1.26	1.90	1.33	1.59	
C D (P=0.05)														
Time of planting (M)	0.59							0.27						
IBA Conc. (C)	0.48							0.22						
M × C	1.19							0.54						

more assimilates and resulted in thickest root growth. These findings are also agree with the results of Awad *et al.* (2).

The maximum average fresh weight of roots per cutting (1.00 g) was recorded under mid June planting time (M_4). Imtiyaz and Sofi (6) also observed the significant variation for these parameters in the two rootstocks with significant increased per cent survival, callusing, bud sprouting and rhizogenesis in M-26 with the application of 2000 ppm IBA than M-9. Among IBA concentrations, C_3 (2000 ppm IBA) revealed the maximum average fresh weight of roots/cutting (1.04 g). The maximum average fresh weight of roots/cutting (1.21 g) was recorded due to interaction M_4C_2 (mid June planting with 1500 ppm IBA). These finding also agreed with the Bhusal *et al.* (4) as reported in *Citrus*. The greater average dry weight of roots/cutting (0.50 g) was recorded with M_5 (mid July planting time). Among IBA concentrations, 2000 ppm IBA produced the maximum average dry weight of roots/cutting (0.56 g).

Average length of sprout per cutting was recorded maximum (7.81 cm) under mid June planting (M_4).The maximum length of sprout per cutting (9.46 cm) was found under 2000 ppm IBA followed by 1500 ppm IBA, while the minimum length of sprout (4.35 cm) was observed under control (Table 4). Auxin concentration has a positive impact in stimulation of growth of pre-formed buds. Due to interaction of planting time and IBA concentration, the maximum length of sprout per cutting (10.46 cm) was produced under M_4C_3 (mid June planting with 2000 ppm IBA treatment). Mid June planting time (M_6) exhibited the maximum diameter of sprout/cutting (1.88 mm). The maximum average diameter of sprout (2.59 mm) was recorded under C_3 (2000 ppm IBA) and the minimum average diameter of sprout (1.39 mm) was under C_1 (1000 ppm IBA). Treatment combination of M_4C_3 resulted in the highest average diameter of sprout per cutting (2.67 mm). The present findings are similar to the reports of Panwar *et al.* (11) in *Bougainvillea* var. Alok.

The maximum average number of leaves/cutting (8.56) was recorded by mid June planting, while the minimum number of leaves per cutting (3.62) was under M_3 (mid March planting). Suitable environmental and climatic conditions for growth of shoots (more light and high photoperiod) might be the cause for the increase in length of shoots and the number of leaves in cuttings of late June (Abdou *et al.,* 1). Significantly the maximum average number of leaves/cutting (Table 5) was obtained by 2000 ppm IBA treatment. The highest average number of leaves per cutting was produced by the interaction of M_4C_3 (mid June planting with 2000 ppm IBA). Srivastava *et al.* (19) had also observed the best results in terms of growth and survival of phalsa cuttings treated with 2000 ppm IBA as compared to 100 and 300 ppm IBA concentrations. Planting time and IBA concentrations affected the number of sprouts per cutting significantly. Among various planting times, M_3 (mid March planting) produced the maximum number of sprouts/cutting (2.50). The highest average number of sprouts/cutting (3.05) was observed with 2000 ppm IBA, while the lowest average number of sprouts per cutting (1.45) was recorded under control. The highest average number of sprouts/cutting (3.34) was recorded under the interaction of mid March planting with 2000 ppm IBA treatment. Environmental conditions in the greenhouse may also be effective for rooting of cuttings (Nair *et al.,* 10).

From the above discussion, it may be concluded that time of planting and various levels of IBA had a large impact on the success, survival and rooting in cuttings of phalsa (*Grewia asiatica* L.) cv. Dwarf type. Time of planting in mid June (M_4) and IBA @ 2000 ppm were found to be the best treatments may be

Table 3: Fresh and dry weight of roots/ cutting (g) of phalsa cuttings as influenced by time of planting and IBA concentrations.

IBA Concentrations	Fresh weight of roots per cutting (g)							Dry weight of roots per cutting (g)						
	M_1	M_2	M_3	M_4	M_5	M_6	Mean	M_1	M_2	M_3	M_4	M_5	M_6	Mean
C_1 (1000 ppm)	0.92	0.82	0.87	1.06	0.93	0.91	0.92	0.43	0.34	0.44	0.51	0.57	0.45	0.45
C_2 (1500 ppm)	0.92	0.85	0.86	1.21	0.97	0.94	0.96	0.43	0.37	0.41	0.46	0.52	0.47	0.44
C_3 (2000 ppm)	1.04	0.86	1.05	1.13	1.16	1.02	1.04	0.57	0.37	0.63	0.59	0.62	0.56	0.56
C_0 (Control)	0.22	0.57	0.57	0.60	0.59	0.74	0.55	0.09	0.22	0.25	0.24	0.28	0.33	0.23
Mean	0.77	0.77	0.84	1.00	0.91	0.90		0.38	0.32	0.43	0.45	0.50	0.45	
C D (P=0.05)														
Time of planting (M)	0.06							0.04						
IBA Conc. (C)	0.05							0.03						
M × C	0.13							0.08						

Table 4: Length of longest sprout and diameter of thickest sprout of phalsa cuttings as influenced by time of planting and IBA concentrations

IBA Concentrations	Length of longest sprouts (cm)							Diameter of thickest sprout (mm)						
	M_1	M_2	M_3	M_4	M_5	M_6	Mean	M_1	M_2	M_3	M_4	M_5	M_6	Mean
C_1 (1000 ppm)	5.51	6.37	6.74	7.46	7.93	6.82	6.80	1.11	1.34	1.34	1.50	1.44	1.67	1.39
C_2 (1500 ppm)	6.39	6.50	7.74	8.08	7.59	7.17	7.24	1.22	1.67	1.84	1.67	1.89	2.00	1.71
C_3 (2000 ppm)	8.11	8.52	9.59	10.46	9.91	10.19	9.46	3.11	2.33	2.34	2.67	2.55	2.55	2.59
C_0 (Control)	1.50	4.27	4.50	5.26	5.35	5.25	4.35	1.00	1.00	1.00	1.00	1.34	1.34	2.12
Mean	5.37	6.41	7.14	7.81	7.69	7.36		1.61	1.58	1.62	1.70	1.80	1.88	
C D (P=0.05)														
Time of planting (M)	0.53							0.19						
IBA Conc. (C)	0.43							0.15						
M × C	1.06							0.38						

Table 5: Number of leaves and sprouts per cutting of phalsa as influenced by time of planting and IBA concentrations.

IBA Concentrations	Number of new leaves							Number of sprout per cutting						
	M_1	M_2	M_3	M_4	M_5	M_6	Mean	M_1	M_2	M_3	M_4	M_5	M_6	Mean
C_1 (1000 ppm)	4.11	4.78	3.34	4.67	4.67	4.00	4.26	1.89	2.11	2.34	1.34	2.00	1.77	1.90
C_2 (1500 ppm)	4.88	4.77	3.61	4.16	4.44	5.34	4.53	2.34	2.44	2.67	1.16	2.11	2.11	2.13
C_3 (2000 ppm)	6.09	5.77	4.89	5.44	5.22	5.11	5.42	3.00	3.11	3.34	2.77	3.00	3.11	3.05
C_0 (Control)	1.93	2.34	2.67	3.34	2.67	2.67	2.60	1.00	1.00	1.67	2.00	1.34	1.67	1.45
Mean	4.25	4.41	3.62	4.40	4.25	4.27		2.05	2.16	2.50	1.81	2.11	2.16	
C D (P=0.05)														
Time of planting (M)	0.48							0.31						
IBA Conc. (C)	0.39							0.26						
M × C	0.96							0.63						

M_1= Mid January, M_2= Mid February, M_3= Mid March, M_4= Mid June, M_5 = Mid July, M_6= Mid August , C_1= 1000 ppm IBA , C_2= 1500 ppm IBA, C_3 = 2000 ppm IBA and C_0 = Control.

recommended for the propagation of phalsa by stem cuttings.

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