The Andhra Agric. J 63 (3): 660-666, 2016

Effect of Auxins and Type of Cutting on Propagation of Phalsa (*Grewia subinaequalis* DC.) Under Local Agro-Climatic Conditions

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ABSTRACT

The investigation was carried out to study the effect of auxins and type of cutting on propagation of phalsa at Horticultural College and Research Institute, Dr.Y.S.R. Horticultural University, Venkataramannagudem. The experiment consists of fourteen treatment combinations *i.e.,* hardwood and semi hardwood cuttings treated with IBA and NAA each at the rate of 100 ppm, 200 ppm and 300 ppm along with control (water) and replicated thrice in factorial randomized block design. The cuttings were dipped for 24 hours in solutions of IBA and NAA. The hardwood cuttings treated with IBA at 200 ppm concentration recorded the highest for root and shoot parameters, viz., minimum number of days taken for sprouting (12.48), maximum number of sprouts per cutting (5.70), number of leaves per cutting (6.13), leaf area per cutting (15.61cm^2), leaf chlorophyll content per cutting (44.96 mg), fresh and dry weight of the shoot (22.07 g and 11.24 g), percentage of rooted cuttings (45.68), number of roots per rooted cutting (38.00), length of the longest root per rooted cutting (20.89 cm), survival percentage of rooted cuttings (28.21), fresh and dry weight of the root (3.10 g and 0.94 g) and percentage of establishment of rooted cuttings in the main field (25.21). The result revealed that hardwood cuttings treated with IBA at 200 ppm concentration followed by NAA at 100 ppm concentration were most effective for obtaining maximum shoot growth, root growth, survival percentage and for its large scale multiplication.

Key words : Hardwood, IBA, NAA, Phalsa, and Semi hardwood cuttings.

Phalsa (*Grewia subinaequalis* DC.) is an exotic bush plant considered horticulturally as a small fruit crop indigenous to the Indian sub-continent and South-East Asia. In India, it is commercially cultivated in Punjab, Haryana, Uttar Pradesh and Andhra Pradesh. The fruits are excellent for making juice and squash. The phalsa plant is small bushy and hardy in nature and preferred as an ideal crop for growing in hot and arid regions. It is also preferred as dry land horticulture crop and in silvi-horticulture system. Despite of its nutrirional importance of the crop, phalsa is cultivated only in a limited area as the availability of suitable planting material is meagre and scanty.

As phalsa is a cross pollinated crop commercially propagated by seed, a wide variability exists in its population and it is not possible to retain true to type characters. Vegetative propagation ensures multiplication of selected elite clones for commercial cultivation. Therefore, it is necessary to standardize the fast, convenient, economic, propagation technique to get superior planting material. Eventhough, multiplication of phalsa is possible through stem cuttings, the rooting reactions and growth characters of the cuttings are greatly influenced by the growing environmental conditions. Eventually, reports on systematic investigation on the propagation of phalsa from stem cuttings and use of growth regulators under various growing conditions for better growth and multiplication are scanty. Therefore, the present study is carried out on the propagation of phalsa by using different concentrations of auxins and type of stem cuttings for rapid multiplication.

MATERIAL AND METHODS

The study was carried out at college farm, Horticultural College and Research Institute, DrYSR Horticultural University, Venkataramannagudem during 2012. Hardwood cuttings from one year old shoots and semi hardwood cuttings from current season's growth having length of 20-22 cm with 4-5 nodes were taken. The leaves were removed from the cuttings and were trimmed to the required length by removing the terminal portions just above a bud. The basal end of each cutting was given a slant cut, to expose máximum absorbing surface area for effective rooting. The cuttings were treated with IBA and NAA concentrations at the rate of 100 ppm, 200 ppm and 300 ppm each for 24 hours, along with distilled wáter (control). Twenty cuttings per treatment were planted in the polybags containing the rooting media. The experiment was laid out in a Mixed Factorial Randomized Block Design with three replications. The leaf chlorophyll content per cutting was estimated by using digital leaf chlorophyll meter (SPAD-502).The data on root and shoot growth were recorded at 60 days after planting was recorded. The cuttings survived were planted in the main field and survival percentage was recorded. The data on various parameters were statistically analysed as per the procedure laid out by Panse and Sukhatme (1978) and presented in the table-1 and 2.

RESULTS AND DISCUSSION

The type of auxin at different concentrations and type of cuttings treated for their effect on phalsa had shown significant difference on various shoot growth and root growth characters which are discussed here under.

Shoot growth parameters

Number of days taken for sprouting

The hardwood cuttings treated with IBA at 200 ppm recorded significant lowest number of days taken for sprouting (12.48) followed by IBA 300 ppm (15.16) whereas the number of days (16.33) but significantly higher than the hard wood cuttings was recorded in semi hardwood cuttings treated with IBA 200 ppm (Table-1). This might be due to enhanced auxin concentration in the cell increased the cell division which results on quick callus formation resulting in early sprouting in the hard wood cutting as reported by Chauhan and Reddy (1971) in plum.

Number of sprouts per cutting

The hardwood cuttings treated with IBA at 200 ppm recorded significant maximum number of sprouts per cutting (5.70) followed by NAA at 100 ppm (5.02) whereas the maximum number of sprouts per cutting (4.30)) but significantly lower than the hard wood cuttings were recorded in semi hardwood cuttings treated with NAA at 100 ppm over control (Table-1). This might be due to better utilization of stored carbohydrates and nitrogen in the hardwood along with the auxin application promotes growth and produced more number of sprouts per cutting as stated by Chandramouli (2001) in Bursera.

Number of leaves per cutting

The hardwood cuttings treated with IBA at 200 ppm recorded maximum number of leaves per cutting (6.13) followed by NAA at 100 ppm concentration (5.93) over control whereas the maximum number of leaves per cutting (4.43) was recorded in semi hardwood cuttings treated with IBA at 200 ppm) but significantly lower than the hard wood cuttings was recorded in phalsa (Table-1). Auxins induced vigorous rooting system as it produced more number of sprouts thus enabling the cuttings to absorb more nutrients and produced more number of leaves as stated by Stancato *et al* (2003) in *Rhipsalis*.

Leaf area per cutting (cm^2)

The hardwood cuttings having reserved food material when treated with IBA at 200 ppm concentration recorded significant maximum leaf area per cutting (15.61 cm^2) followed by NAA at 100 ppm concentration (13.77 cm^2) whereas the maximum leaf area per cutting (11.44 cm^2)) but significantly lower than the hard wood cuttings was recorded in semi hardwood cuttings treated with IBA at 200 ppm over control (Table-1). This might be due to enhanced cell division and cell elongation in the leaf tissue by the auxins in the hardwood cuttings that resulted in more leaf area per cutting in phalsa which was also reported by Baghel and Saraswat (1989) in pomegranate.

Leaf chlorophyll content (mg)

The hardwood cuttings treated with IBA at 200 ppm concentration recorded significant

Table 1. Effect of auxins and type of cutting on shoot growth of phalsa (*Grewia subinaequalis* DC.) cuttings under local agro climatic condition.

	Number of days to sprouting	Number of sprouts per cutting	Number of leaves per cutting	Leaf area (cm^2) per cutting	Leaf chlorophyll content (mg) per cutting	Fresh weight of the shoot (g) per cutting	Dry weight of the shoot (g) per cutting
Type of cutting (C)							
Hardwood cutting (C_1)	16.44	4.11	4.84	11.44	30.63	15.47	8.04
Semi hardwood cutting (C_2)	17.84	3.30	3.96	8.76	23.32	8.57	3.42
Concentration of Auxins (P)							
IBA 100 ppm (P_1)	17.77	3.83	4.30	10.22	28.59	13.89	6.49
IBA 200 ppm (P_2)	14.40	4.90	5.28	13.58	37.52	18.45	8.49
IBA 300 ppm (P_3)	16.01	4.08	4.50	10.76	30.03	12.55	5.34
NAA100 ppm (P_4)	16.38	4.66	5.09	12.44	31.12	15.50	7.33
NAA 200 ppm (P_5)	17.43	3.88	4.19	9.35	24.22	11.17	5.27
NAA 300 ppm (P_6)	18.60	3.63	4.13	8.60	22.32	9.86	4.96
Control (P_7)	19.38	0.98	3.15	5.74	15.04	2.69	2.26
Interactions:							
C_1P_1	17.41	4.40	4.44	11.11	31.53	17.98	9.05
C_1P_2	12.48	5.70	6.13	15.61	44.96	22.07	11.24
C_1P_3	15.16	4.50	5.00	12.61	31.46	14.58	6.93
C_1P_4	15.32	5.02	5.93	13.77	33.58	19.00	9.98
C_1P_5	17.20	4.06	4.26	10.58	29.11	15.81	8.00
C_1P_6	18.21	3.92	4.30	10.46	25.97	14.75	7.58
C_1P_7	19.33	1.16	3.83	5.84	17.82	4.09	3.53
C_2P_1	18.13	3.26	4.16	9.32	25.66	9.80	3.93
C_2P_2	16.33	4.10	4.43	11.44	30.08	14.84	5.74
C_2P_3	16.86	3.66	4.00	8.91	28.60	10.53	3.75
C_2P_4	17.45	4.30	4.25	11.12	28.66	12.00	4.67
C_2P_5	17.66	3.70	4.12	8.25	19.33	6.54	2.55
C_2P_6	18.99	3.33	3.97	6.63	18.66	4.97	2.34
C_2P_7	19.43	0.80	2.46	5.65	12.27	1.30	0.99

	S.E(m)±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D
Type of cutting (C)	0.20	0.59	0.06	0.19	0.06	0.19	0.23	0.68	0.56	1.64	0.35	1.01	0.15	0.45
Concentration of auxins (P)	0.38	1.11	0.12	0.37	0.12	0.36	0.44	1.28	1.05	3.07	0.65	1.90	0.29	0.85
Interaction (CXP)	0.54	1.57	0.17	0.52	0.17	0.52	0.62	1.82	1.49	4.34	0.92	2.69	0.41	1.21

maximum leaf chlorophyll content per cutting (44.96 mg) followed by NAA at 100 ppm concentration (33.58 mg) whereas the maximum leaf chlorophyll content per cutting (30.08 mg)) but significantly lower than the hard wood cuttings was recorded in semi hardwood cuttings treated with IBA at 200 ppm over control (Table-1). This might be due to increased leaf area by the auxins activated more photosynthates resulted in the increased number of leaves and more leaf chlorophyll content per cutting in phalsa which was also reported by Sukhawant *et al.* (2001) in grape.

Fresh and dry weight of the shoots (g)

The significant maximum fresh weight (22.07 g) and dry weight (11.24 g) of the shoot was recorded in the hardwood cuttings treated with IBA at 200 ppm followed by NAA 100 ppm (19.00 g and 9.98 g respectively). However, the maximum fresh weight (14.84 g) and dry weight (5.74 g) of the shoot but significantly lower than the hard wood cuttings was recorded in semi hardwood cuttings treated with IBA at 200 ppm concentration. This might be due to the fact that hardwood cutting produced more number of sprouts, leaves, increased leaf area, leaf chlorophyll content, which resulted in maximum fresh and dry weights of the shoot as stated by Purohit and Shekarappa (1985) in pomegranate and Shukla and Bist (1994) in pear.

Root growth parameters

Percentage of rooted cuttings

The hardwood cuttings treated with IBA at 200 ppm concentration recorded significant highest percentage of rooting of cuttings (45.68) followed by NAA 100 ppm (41.25) whereas in semi hardwood cuttings the percentage of rooting (20.66) but significantly lower than the hard wood cuttings was recorded with IBA at 200 ppm concentration over control (Table-2). As per Haissing (1974) the auxins, when applied exogenously to the stem cuttings increases the development of pre-existing root primordial and there by increases the more number of roots per cutting which further helps in sprouting and vegetative growth in plant. Similar results on the IBA treatment were also reported by and Reddy *et al.* (2008) in fig.

Number of roots per cutting

The significant maximum number of roots per cutting were observed in hardwood cuttings treated with IBA 200 ppm concentration (38.00) followed by NAA 100 ppm (29.00) whereas the number of roots per cutting (19.00) but significantly lower than the hard wood cuttings was recorded in semi hardwood cuttings treated with IBA at 200 ppm over control (Table-2). The more number of roots per cutting under optimum concentration of IBA may be attributed to the increased rate of respiration, accumulation of higher level of amino acids at their bases in the auxin treated cuttings than untreated cuttings. Simlarly, nitrogenous substances accumulating in the basal part of treated cuttings, apparently which are mobilized in the upper part and translocated the aspargine as stated by Strydom and Hartmann (1960). The hardwood cutting of phalsa gave more number of roots than semi hardwood cutting. This might be due to fact that hardwood cutting contained higher stored carbohydrate than semi hardwood cutting as stated by Hartmann *et al.* (1990). Similar results were also reported by Sandhu *et al.* (1991) in pomegranate and Reddy *et al.* (2008) in fig.

Length of the longest root per rooted cutting (cm)

The significant longest root per rooted cutting was observed in the hardwood cutting treated with IBA 200 ppm (20.89 cm) followed by IBA 300 ppm (17.00 cm) where as in semi hardwood cuttings the longest root per rooted cutting but significantly lower than the hard wood cuttings (11.89 cm) was recorded with IBA at 200 ppm concentrations over control (Table-2). This might be attributed to the action of auxin activity which might caused hydrolysis and translocation of carbohydrates and nitrogenous substances in the cellular level at the base of cuttings and resulted in accelerated cell elongation and cell division as reported by Singh *et al.* (2003) in *Commiphora wightii*.

Survival percentage of rooted cuttings

The treatment of hardwood cuttings with IBA at 200 ppm concentration gave the significant maximum survival percentage (28.21) followed by NAA at 100 ppm concentration (23.59) over other

Table 2. Effect of auxins and type of cutting on root growth of phalsa (*Grewia subinaequalis* DC.) cuttings under local agro climatic condition.

	Percentage of rooted cuttings (%)	Number of roots per cutting	Length of the longest root (cm) per cutting	Survival percentage of rooted cuttings (%)	Fresh weight of the root (g) per cutting	Dry weight of the root (g) per cutting	Percentage of establishment of rooted cuttings
Type of cutting (C)							
Hardwood cutting (C_1)	32.00 (33.48)	20.02	13.74	18.47 (24.06)	1.99	0.58	14.96 (21.22)
Semi hardwood cutting (C_2)	9.71 (16.37)	10.46	7.84	5.76 (11.87)	1.04	0.40	4.05 (9.97)
Concentration of Auxins (P)							
IBA 100 ppm (P_1)	23.30 (28.15)	16.73	12.46	14.22 (21.01)	1.88	0.58	12.01 (19.62)
IBA 200 ppm (P_2)	33.17 (34.74)	28.50	16.39	20.10 (26.11)	2.46	0.78	17.91 (24.48)
IBA 300 ppm (P_3)	21.28 (26.43)	16.09	13.26	15.34 (22.64)	1.88	0.59	11.50 (18.10)
NAA100 ppm (P_4)	27.12 (30.52)	20.53	11.50	15.96 (22.81)	2.11	0.67	12.31 (19.20)
NAA 200 ppm (P_5)	19.33 (24.61)	11.56	9.83	8.83 (15.10)	1.14	0.34	7.09 (13.95)
NAA 300 ppm (P_6)	16.79 (22.54)	10.23	9.75	8.66 (15.03)	0.81	0.42	4.92 (11.68)
Control (P_7)	5.83 (11.19)	3.06	2.33	1.66 (3.07)	0.32	0.05	0.83 (2.15)
Interactions:							
C_1P_1	34.28 (35.78)	20.00	15.98	21.36 (27.51)	2.50	0.68	17.36 (24.56)
C_1P_2	45.68 (42.50)	38.00	20.89	28.21 (32.05)	3.10	0.94	25.21 (30.05)
C_1P_3	32.79 (34.83)	1.32	17.00	23.11 (28.69)	2.39	0.70	19.66 (26.27)
C_1P_4	41.25 (39.94)	29.00	12.18	23.59 (29.03)	2.68	0.83	20.00 (26.55)
C_1P_5	31.66 (34.20)	15.73	14.66	15.00 (22.58)	1.56	0.48	12.60 (20.69)
C_1P_6	28.33 (32.14)	15.40	13.00	14.66 (22.44)	1.18	0.33	8.26 (16.14)
C_1P_7	10.00 (14.99)	3.73	2.46	3.33 (6.14)	0.50	0.09	1.66 (4.30)
C_2P_1	12.33 (20.52)	13.46	8.95	9.33 (17.77)	1.27	0.48	6.66 (14.68)
C_2P_2	20.66 (26.99)	19.00	11.89	12.00 (20.18)	1.82	0.62	10.62 (18.91)
C_2P_3	9.77 (18.04)	13.86	9.52	5.33 (13.33)	1.36	0.51	3.33 (9.93)
C_2P_4	13.00 (21.10)	12.06	10.82	8.33 (16.59)	1.54	0.49	4.62 (11.85)
C_2P_5	7.00 (15.02)	7.40	6.50	2.66 (7.62)	0.72	0.36	1.58 (7.21)
C_2P_6	5.24 (12.94)	5.06	5.00	2.66 (7.62)	0.44	0.35	1.58 (7.21)
C_2P_7	1.66 (7.40)	2.40	2.19	0.00 (0.00)	0.13	0.02	0.00 (0.00)

	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D	S.E(m) ±	C.D
Type of cutting (C)	0.95	2.76	0.48	1.41	0.42	1.22	0.65	1.90	0.05	0.14	0.01	0.01	0.61	1.79
Concentration of auxins (P)	1.78	5.17	0.91	2.65	0.78	2.28	1.22	3.55	0.09	0.27	0.01	0.02	1.15	3.36
Interaction (CXP)	2.51	7.32	1.28	3.74	1.11	3.23	1.73	5.03	0.13	0.39	0.01	0.04	1.63	4.75

(*Figures in parenthesis indicates angular values) treatments whereas in semi hardwood cuttings the maximum survival percentage (12.00) but significantly lower than the hard wood cuttings was recorded with IBA at 200 ppm concentration. This might be due to increased root length, maximum number of primary roots and early sprouting resulted in more thickness of the roots and thereby higher survival percentage in the nursery. The ability of regenerating new fibrous roots from main roots which absorb more nutrients and water from the potting mixture and increased the survival percentage of rooted cuttings as reported by Singh *et al.* (2003) in long pepper.

Fresh and dry weight of the roots (g)

The significant fresh and dry weight of the roots (3.10 g and 0.94 g respectively) were recorded in hardwood cuttings treated with IBA at 200 ppm concentration followed by NAA at 100 ppm (2.68 g and 0.83 g) whereas the maximum fresh and dry weight of the roots (1.82 g and 0.62 g) but significantly lower than the hard wood cuttings were recorded in semi hardwood cuttings treated with IBA at 200 ppm concentrations over control (Table-2). This might be attributed to higher root length and more number of roots which accumulates more stored carbohydrates with increased volume of the roots per cutting in hardwood cuttings than semi hardwood cuttings as stated by Hartman *et al.* (1990).

Percentage of establishment of the rooted cuttings

The percentage of establishment of the rooted cuttings in the main field was significantly highest in hardwood cuttings (25.21) treated with IBA at 200 ppm concentration followed by NAA 100 ppm concentration (20.00) over control. In semi hardwood cuttings the maximum establishment percentage (10.62) but significantly lower than the hard wood cuttings was recorded with IBA at 200 ppm concentrations (Table-2). This might be due to highest length of the roots, more number of roots, more number of leaves and leaf area in the hardwood cuttings with enhanced absorption and utilization of water and nutrients from the soil in the main field and increased the more number of rooted cuttings on establishment at field level than semi hardwood cuttings of phalsa as also reported by Sharma *et al.* (2009) in pomegranate.

The highest rooting and root growth with the auxins might be ascribed to increased metabolic activity and utilization of sugars and starch upon hydrolysis in the stem. The growth regulator IBA was found to be superior to NAA because of its greater chemical stability, slow mobility in plants and slow destruction by auxin-degrading enzyme. The influence of IBA on rooting and root growth has been experimentally sustained earlier by various workers. In the present study among all the treatment combinations, the hardwood cuttings treated with IBA at 200 ppm concentration followed by NAA at 100 ppm concentration over semi hardwood cutting treatments achieved maximum shoot and root growth and establishment percentage than untreated cuttings in phalsa.

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(Received on 26.11.2013 and revised on 04.06.2015)