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Effect of plant growth regulators on sprouting and rooting of *Gymnema sylvestre* cuttings

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Abstract
Keeping the importance of vegetative propagation in ensuring mass multiplication of seedlings particularly of those species, which are difficult to germinate through seeds and to multiply the seedlings of uniform genetic composition, identical to parental type transmission, a systematic research trial was conducted to know the effect of PGRs on growth, rooting and survival of stem cuttings of Gudmar at AICRP (M&APs) farm, BAU, Ranchi. Research was laid out in Factorial Completely Randomized Design with 13 treatments replicated thrice. Minimum number of days taken for initiation (3.00 days) of shoot emergence was observed in 7 PGRs treatments. Maximum number of days taken for completion of shoot emergence was 16.00 days in 250 ppm IAA. Maximum rooting percentage (45.00%) was observed in 750 ppm IBA, while maximum sprouting percentage was observed in 750 ppm IBA (61.67%). Maximum number of primary roots (3.43) cuttings was observed in 750 ppm IAA, while maximum number of secondary roots (76.40) cuttings was observed in 750 ppm IAA. Maximum length of primary roots (10.31 cm) cuttings was observed in 750 ppm IBA, while maximum length of secondary roots (2.23 cm) cuttings was observed in 750 ppm IBA. Maximum number of sprouts (2.35) was observed in 750 ppm IBA, while maximum length of shoots (3.05 cm) cuttings was observed in 750 ppm IBA. Maximum number of leaves (17.52) was observed in 750 ppm NAA and maximum basal diameter of shoots (1.97 mm) was observed in 1000 ppm IBA. Maximum area of leaves (4.82 $cm^{2)}$ was observed in 750 ppm IBA and maximum survival percentage (45.00%) was observed in 750 ppm NAA. Sprouting trend in *Gymnema sylvestre* cuttings indicates that maximum sprouting was occurred between 19-20 days. Average sprouting percentage under PGR treatment varied from 40-45%.

Keywords: Gudmar, Gymnema *sylvestre*, sprouting, rooting, survival percentage

Introduction
Poor seed viability and low seed germination rate has hampered large scale commercial cultivation of Gudmar. In recent years, many such difficult to root species are made to root easily by use of root inducing chemicals and modifying the surrounding environment (Thomas, 1985). To overcome this problem, vegetative propagation has the potential to produce seedlings of high uniformity and plays a vital role in selection and improvement of medicinal plants, which is not possible through seed regeneration. Among several methods of vegetative propagation, stem cuttings is the quickest and easiest technique to obtain good stock material round the year (Hartmann *et al.*,1993). In recent years, many species difficult to germinate through seeds, successful attempts has been taken to induce early and higher rooting by using root inducing chemicals (PGRs). Therefore along with seed propagation technique one has to think about their vegetative method of multiplication from which the plants can be available throughout the year (Sharma, 2009). Vegetative propagation, a well established technique for medicinal plants, plays a vital role in selection and improvement of medicinal plants (Gurumurti *et al*., 1984). It helps to achieve genetic gain with in short period of time by mass multiplication of selected genotypes (Wright, 1976). It is a method of rapidly multiplying desire genetic material and capturing most of the genetic potential (Kerketta, 2000). Keeping the importance of vegetative propagation in ensuring seedlings of uniform genetic composition, identical to parental type transmission, a systematic research trial was conducted to know the effect of PGRs on growth, rooting and survival of stem cuttings of Gudmar at AICRP (M&APs) farm, Birsa Agricultural University, Ranchi with the objectives of to standardize the dozes of PGRs needed to obtain seedlings from stem cuttings of *Gymnema sylvestre*; to study the effect of different PGRs on rooting and shooting behavior of *Gymnema sylvestre* stem cuttings and to study the effect of PGRs on the survival of *Gymnema sylvestre* stem cuttings.
Gymnema sylvestre R. Br. is popularly known as Gudmar or Madhunashini of Asclepiadaceae

family and is widely distributed in the tropical forests of central, western and southern India and in the tropical areas of Africa, Australia and China. Its habit is perennial, woody climber and generally requires support for growth. It is a slow growing herb, found in tropical and subtropical humid climate. Propagation through seed germination is difficult due to low viability of the seeds. Leaves are opposite, usually elliptic or ovate, inflorescence is lateral umbel in cymes. The important active ingredient of *Gymnema sylvestre* is an organic acid called "Gymnemic acid". The leaves of this plant are used for inhibiting the taste of sweetness and are used in the control of diabetes, as a stomachic, diuretic and cough suppressant activity. The leaf extract is also used for the treatment of various physiological effects such as rheumatism, ulcer, jaundice, dyspepsia, constipation, eyes pain, dental caries. It also possesses antimicrobial, antiviral, hepatoprotective, anti-allergic, anti inflammatory and free radical scavenging activities.

Materials and Methods

The experimental material was stem cuttings of Gudmar. Research was laid out in Factorial Completely Randomized Design with thirteen treatments (T_0 : Control, T_1 : IBA 250 ppm, T_2 : IBA 500 ppm, T_3 : IBA 750 ppm, T_4 : IBA 1000 ppm, T_5 : IAA 250 ppm, T_6 : IAA 500 ppm, T_7 : IAA 750 ppm, T_8 : IAA 1000 ppm, T_9 : NAA 250 ppm, T_{10} : NAA 500 ppm, T_{11} : NAA 750 ppm and T_{12} : NAA 1000 ppm) and three replications. Number of stem cuttings per treatment was kept 20. Cuttings of each species of length 15 cm having 4-5 bud of uniform thickness (4-5 mm of Gudmar) were selected. Finely powdered sieved farm yard manure, sand and peat in the ratio of 1:2:1 was taken and filled into perforated polythene bag. Before planting the cuttings, medium was treated with carbendazim (0.2%) as a preventive measure against fungal diseases. The basal portion of the cutting was given a slant cut and lower bud of the cutting was planted in the medium. Required concentration of the PGRs solution was prepared. PGR was dissolved in little quantity of ethyl alcohol and stock solutions were prepared with distilled water. Cuttings were treated with carbendazim (0.2%) before planting to check the incidence of the fungal diseases including rot. Watering was done regularly as and when medium gets dried.

Cuttings was dipped up to 5 cm in the prepared PGRs solution for two minutes and transplanted in the polythene bags filled with rooting medium. Parameters studied were rooting percentage, number of roots/cutting (primary & secondary), length of the root (primary & secondary), sprouting percentage, number of sprouts/cutting, length of shoot, number of leaves/cutting, number of days taken for initiation of shoot emergence, number of days taken for completion of shoot emergence, basal diameter of shoot, area of leaves and survival percentage of cuttings. After two and half months from transplanting the cuttings into polythene tubes, data was collected for different root and shoot parameters and statistically analyzed to draw meaning inferences.

Rooting percentage was calculated by taking the ratio of the number of rooted cuttings to total number of cuttings transplanted and multiplied by 100. Number of roots per cutting (Primary & secondary) was calculated by the number of adventitious roots and their mean was expressed as the number of roots per cutting. Length of the root (Primary & secondary) was measured as the length of the longest root and their mean was calculated to express the length of the longest root. Sprouting percentage was calculated by taking the ratio of the number of sprouted cuttings to total number of cuttings planted and multiplied by 100. Number of sprouts per cutting was counted and their mean was used to express the number of sprouts per cutting. Length of shoot was measured in cm and the mean value was expressed as the length of shoot. The length was measured from point of initiation of the shoot to the growing tip. Number of leaves per cutting was calculated as number of fully opened leaves and their mean was used to express the number of leaves. Basal diameter of shoot was measured at point of initiation of the shoot and expressed in mm. Survival percentage of cuttings was calculated by taking the ratio of the number of survived cuttings to total number of cuttings planted and multiplied by 100.

Results and Discussion

Data related to rooting and sprouting behavior of Gudmar cuttings under the influence of different concentrations of PGRs is presented below. Maximum number of days taken for initiation of shoot emergence was observed in control (5.33 days) and minimum (3.00 days) in 7 PGRs treatments, however all PGRs treatments were *at par* to each other. Maximum number of days (25.66 days) taken for completion of shoot emergence was observed in 250 PPM IAA and minimum (16.00 days) in control, which is *at par* with 1000 ppm IAA and 250 ppm NAA, but significantly inferior with rest of the 10 PGR treatments. Husen (2003) reported that treating *Rauvolfia* cuttings with IBA 2000 ppm significantly increased rooting and sprouting percentage against the control. Shwetha (2005) reported better induction of rooting (66.6%) in Indian lavender cuttings treated with IBA at 2000 ppm, as compared to control (15.3%). Milind (2008) observed better rooting (92%) in *Stevia* cuttings treated with 500 ppm IBA as against 78 per cent in the control and also significantly higher values for different root parameters were recorded with this treatment.

Table 1: Days taken for initiation and completion of shoot emergence, rooting and sprouting percentage in *Gymnema sylvestre* cuttings after 75 days of transplantation in polytubes

Sl. No.	Treatments details	Initiation of shoot emergence (days)	Completion of shoot emergence (days)	Rooting percentage	Sprouting percentage
1.	T_0 (Control)	5.33	16.00	16.67	26.67
2.	T_1 (250 PPM IBA)	3.33	22.00	36.67	51.67
3.	T_2 (500 PPM IBA)	3.66	22.33	38.33	56.67
4.	T_3 (750 PPM IBA)	3.33	23.00	45.00	61.67
5.	T_4 (1000 PPM IBA)	3.33	23.33	43.33	60.00
6.	T_5 (250 PPM IAA)	3.00	25.66	35.00	51.67
7.	T_6 (500 PPM IAA)	3.66	24.66	41.67	55.00
8.	T_7 (750 PPM IAA)	3.00	22.00	45.00	55.00
9.	T_8 (1000 PPM IAA)	3.00	20.00	41.67	50.00
10.	T_9 (250 PPM NAA)	3.00	19.33	40.00	51.67
11.	T_{10} (500 PPM NAA)	3.00	22.66	43.33	55.00

12.	T_{11} (750 PPM NAA)	3.00	22.00	45.00	58.33
13.	T_{12} (1000 PPM NAA)	3.00	22.00	45.00	53.33
Grand mean		3.35	21.92	39.74	52.82
S.E. (m)±		0.28	1.53	2.70	2.22
C.D. 5%		0.81	4.46	7.88	6.48
C.V. (%)		14.30	12.07	11.75	7.27

Maximum rooting percentage (45.00%) of *Gymnema sylvestre* was observed in 750 ppm IBA, 750 ppm IAA, 750 ppm NAA, 1000 ppm NAA, which is significantly superior to control (16.67%), 250 ppm IAA (35.00%) and 250 ppm IBA (36.67%) but *at par* with rest of the 6 PGR treatments. Maximum sprouting percentage (61.67%) of *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which is *at par* with 500 ppm IBA (56.67%), 1000 ppm IBA (60.00%) and 750 ppm NAA (58.33%) but significantly superior with rest of the 9 treatments including control (26.67%). Bhattacharjee and Balakrishna (1993) obtained cent percent rooting in *Ixora singaporensis* with 4000 ppm IBA. Farooqi *et al.*, (1994) conducted an experiment to know the effect of IBA on *Rosa damascena* cuttings. They found the increasing trend of rooting percentage, number of roots per cutting, length of the longest root (cm), thickness of root (cm), fresh and dry weight of root with increasing concentration of IBA from 100 ppm to 300 ppm. Singh (1979) reported highest rooting (97.36%) in *Jasminum sambac* cuttings when treated with IBA at 4000 ppm against control (30%). Gupta and Kher (1986) got highest rooting percentage in *Tabernaemontana coronaria* when treated with IBA at 2000 ppm.

Maximum number of primary roots (3.43) in *Gymnema sylvestre* cuttings was observed in 750 ppm IAA, which is *at par* with 750 ppm IBA (3.37) and 750 ppm NAA (3.23) but varied significantly superior with rest of the 10 treatments including control (1.72). Maximum number of secondary roots (76.40) in *Gymnema sylvestre* cuttings was observed in 750 ppm IAA, which is *at par* with 7 PGR treatments but varied significantly superior with rest of the 5 treatments including control (60.05). Somappa (1979) observed that Indian lavender (*Bursera delpechiana*) cuttings treated with IBA 1500 ppm obtained maximum rooting percentage. Number of primary roots per cutting (4.33) and length of longest root (7.7 cm) were also higher in the same treatment.

Table 2: Number of primary & secondary roots, length of primary & secondary roots in *Gymnema sylvestre* cuttings after 75 days of transplantation in polytubes

Sl. No.	Treatments details	Number of primary roots	Number of secondary roots	Length of primary roots (cm)	Length of secondary roots (cm)
1.	T_0 (Control)	1.72	60.05	6.32	1.63
2.	T_1 (250 PPM IBA)	2.87	67.33	8.13	1.92
3.	T_2 (500 PPM IBA)	2.93	69.07	8.28	1.96
4.	T_3 (750 PPM IBA)	3.37	70.40	10.31	2.23
5.	T_4 (1000 PPM IBA)	2.87	72.00	9.95	2.06
6.	T_5 (250 PPM IAA)	2.93	66.27	7.41	1.93
7.	T_6 (500 PPM IAA)	3.00	71.71	7.67	1.97
8.	T_7 (750 PPM IAA)	3.43	74.60	8.67	2.22
9.	T_8 (1000 PPM IAA)	2.80	73.87	7.84	1.99
10.	T_9 (250 PPM NAA)	2.73	66.53	7.76	1.88
11.	T_{10} (500 PPM NAA)	2.93	69.40	7.92	2.04
12.	T_{11} (750 PPM NAA)	3.23	70.87	8.46	2.09
13.	T_{12} (1000 PPM NAA)	2.80	70.40	8.05	2.02
Grand mean		3.35	69.42	8.21	2.00
S.E. (m)±		0.28	2.14	0.48	0.08
C.D. 5%		0.81	6.26	1.41	0.22
C.V. (%)		14.30	5.35	10.14	6.53

Maximum length of primary roots (10.31 cm) in *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which is *at par* with 1000 ppm IBA (9.95 cm) but varied significantly superior with rest of the 11 treatments including control (6.32 cm). Maximum length of secondary roots (2.23 cm) in *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which is *at par* with 5 PGR treatments but varied significantly superior with rest of the 7 treatments including control (1.63 cm).

Maximum number of sprouts (2.35) in *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which varied significantly superior to all of the treatments including control (1.31). Maximum length of shoots (3.05 cm) in *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which is *at par* with 9 treatments but varied significantly superior to rest of the 3 treatments including control (1.94 cm).

Table 3: Number of sprouts, length of shoots, number of leaves, basal diameter of shoots in *Gymnema sylvestre* cuttings after 75 days of transplantation in polytubes

Sl. No.	Treatments details	Number of sprouts	Length of shoots (cm)	Number of leaves	Basal diameter of shoots (mm)
1.	T_0 (Control)	1.31	1.94	7.23	1.60
2.	T_1 (250 PPM IBA)	1.86	2.82	13.80	1.87
3.	T_2 (500 PPM IBA)	2.12	2.86	14.64	1.90
4.	T_3 (750 PPM IBA)	2.35	3.05	15.65	1.93
5.	T_4 (1000 PPM IBA)	1.99	3.00	16.63	1.97

6.	T_5 (250 PPM IAA)	1.89	2.80	13.56	1.80
7.	T_6 (500 PPM IAA)	1.98	2.89	15.50	1.85
8.	T_7 (750 PPM IAA)	1.99	2.91	15.84	1.89
9.	T_8 (1000 PPM IAA)	1.96	2.63	16.30	1.84
10.	T_9 (250 PPM NAA)	1.90	2.71	15.00	1.75
11.	T_{10} (500 PPM NAA)	2.01	2.90	17.34	1.82
12.	T_{11} (750 PPM NAA)	2.03	3.03	17.52	1.83
13.	T_{12} (1000 PPM NAA)	1.99	2.86	16.85	1.71
Grand mean		1.95	2.80	15.07	1.83
S.E. (m)±		0.07	0.09	0.82	0.06
C.D. 5%		0.20	0.28	2.40	0.18
C.V. (%)		5.97	5.89	9.42	5.75

Maximum number of leaves (17.52) in *Gymnema sylvestre* cuttings was observed in 750 ppm NAA, which is *at par* with 7 treatments but varied significantly superior to rest of the 5 treatments including control (7.23). Maximum basal diameter of shoots (1.97 mm) in *Gymnema sylvestre* cuttings was observed in 1000 ppm IBA, which is *at par* with 9 treatments but varied significantly superior to rest of the 3 treatments including control (1.60 mm).

Maximum area of leaves (4.82 cm^2) in *Gymnema sylvestre* cuttings was observed in 750 ppm IBA, which is *at par* with 9 treatments but varied significantly superior to rest of the 3 treatments including control (3.98 cm^2).

Table 4: Area of leaves, survival percentage in *Gymnema sylvestre* cuttings after 75 days of transplantation in polytubes

Sl. No.	Treatments details	Area of leaves (cm^2)	Survival percentage
1.	T_0 (Control)	3.98	16.67
2.	T_1 (250 PPM IBA)	4.75	36.67
3.	T_2 (500 PPM IBA)	4.78	36.67
4.	T_3 (750 PPM IBA)	4.82	38.33
5.	T_4 (1000 PPM IBA)	4.55	38.33
6.	T_5 (250 PPM IAA)	4.40	35.00
7.	T_6 (500 PPM IAA)	4.68	41.67
8.	T_7 (750 PPM IAA)	4.77	38.33
9.	T_8 (1000 PPM IAA)	4.62	36.67
10.	T_9 (250 PPM NAA)	4.67	40.00
11.	T_{10} (500 PPM NAA)	4.70	41.67
12.	T_{11} (750 PPM NAA)	4.48	45.00
13.	T_{12} (1000 PPM NAA)	4.40	43.33
Grand mean		4.58	37.56
S.E. (m)±		0.12	2.17
C.D. 5%		0.35	6.34
C.V. (%)		4.57	9.99

Maximum survival percentage (45.00%) in *Gymnema sylvestre* cuttings was observed in 750 ppm NAA, which is *at par* with 4 treatments but varied significantly superior to rest of the 8 treatments including control (16.67%). Srivastava *et al.,* (2009) reported maximum rooting and establishment percentage (87.66%) in Kiwi plant (*Actinidia chinensis*) cuttings treated with IBA at 5000 ppm against control (12%). They also got maximum number of roots per cutting (52.5) and length of the longest root (21.53 cm) compared to control (15 and 6.5 cm, respectively). Field establishment was also higher (98%) in case of IBA compared to control (42.5%).

Conclusion

Most of the traits having highly significant positive relation with survival percentage of Gudmar cuttings like rooting percentage, sprouting percentage, length of primary roots, number of sprouts/cutting, length of shoots, basal diameter of shoots and leaf area having maximum significant value under 750 ppm IBA. Other traits also have significant value in 750 ppm IBA. So, 750 ppm IBA is the standardized doze of PGR to obtain maximum seedlings from stem cuttings of *Gymnema sylvestre*. Maximum rooting (45.00%) and sprouting percentage (61.67%) of *Gymnema sylvestre* cuttings was observed under 750 ppm IBA treatments, which was significantly superior to many PGR treatments. Maximum sprouting in *Gymnema sylvestre* cuttings occurred between 19-20 days. Average sprouting percentage under PGR treatment varied from 40-45% but in case of control it was less than 15%. In case of *Gymnema sylvestre* cuttings, maximum survival percentage (45.00%) was observed in 750 ppm NAA, which was significantly superior to 8 treatments including control (16.67%). So, 750 ppm NAA is best for Gudmar cuttings for its maximum survival.

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