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Traits association and path value analysis of *Gymnema sylvestre* cuttings for higher survival percentage under the influence of PGRs

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Abstract
Keeping the importance of traits having significant impact of survival percentage of cuttings grown through vegetative propagation and their respective direct and indirect effect on it, a systematic research trial was conducted to know the trait association and path value analysis of independent characters on survival percentage of Gudmar cuttings under the influence of different concentrations of PGRs at AICRP (M&APs) farm, BAU, Ranchi. Research was laid out in Factorial Completely Randomized Design with 13 PGRs treatments replicated thrice. Survival percentage of cutting after 75 days of transplantation in polytubes is highly positively significantly correlated with 8 traits namely: Rooting percentage, number of primary roots, number of secondary roots, length of secondary roots, sprouting percentage, length of shoots, number of leaves per cuttings, number of sprouts per cutting and significantly correlated with days for completion of shoot emergence and area of leaves. Nine traits having direct positive effect are days for initiation of shoot emergence, days for completion of shoot emergence, rooting percentage, number of primary roots per cutting, number of secondary roots per cutting, length of primary roots, length of shoots, area of leaves, number of leaves per cuttings while four traits having direct negative effect are length of secondary roots, sprouting percentage, basal diameter of shoots, number of sprouts per cutting. Maximum positive direct effect was calculated for number of leaves per cutting (0.810) and minimum positive direct effect (0.060) was calculated for days for completion of shoot emergence followed by maximum direct negative effect (-0.087) calculated for number of sprouts per cutting and minimum direct negative effect (-0.942) was calculated for length of secondary roots.

Keywords: Gudmar, Gymnema *sylvestre*, Correlation, Path value analysis

Introduction
Poor seed viability and low seed germination rate has hampered large scale commercial cultivation of plant species (Goel *et al.,* 2009). To overcome this problem, plant growth regulators are extensively used for mass multiplication of Gudmar and for fine tuning of various physiological processes. It has been widely demonstrated that extremely minute concentrations of PGRs have the potential to regulate several phases of plant growth and for initiation of rooting in cuttings of various medicinal crops (Chaperon *et al.,*1983). Among them, the most widely used are Indole butyric acid, Indole acetic acid, naphthalene acetic acid and some other ready-to-use commercial formulations available either in liquid or in powder form. However it is essential to screen out important factors contributing significantly to high higher survival percentage and their respective direct and indirect effects.

In this regard, probing the components of survival percentage of seedlings grown through cuttings/seeds involves assessment of mutual relationship among various characters contributing to it. The estimate of correlation coefficient mostly indicate interrelationship of different characters but it does not furnish information on cause and effect. Under such situation, path analysis helps to identify the index of selection, which needs due importance while practicing selection with aimed to improve high survival parentage. Further, path coefficient analysis helps in partitioning of correlation coefficients into direct and indirect effects and in the assessment of relative contribution of each component character and extensively been used (Nagvanshi *et al.,* 2015).

Gymnema sylvestre R. Br. is popularly known as Gudmar or Madhunashini of Asclepiadaceae family 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. 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 of different concentrations of IBA, IAA, NAA and control replicated thrice. 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. 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 analyzed to draw meaning inferences. Correlation coefficient was calculated by using the formula suggested by Miller *et al.,* (1958). Path value analysis is a standardized partial regression coefficient and measures the direct influence of one variable upon another and permits the separation of correlation coefficient into components of direct and indirect effects. It was calculated by the formula suggested by Dewey and Lu (1959).

Results and Discussion:

Data related to trait and path value analysis of Gudmar cuttings under the influence of different concentrations of PGRs is presented below. Table 1 represents the correlation matrix among traits of stem cuttings of *Gymnema sylvestre* under nursery condition.

Survival percentage of cutting after 75 days of transplantation in polytubes is highly positively significantly correlated with 8 traits namely: Rooting percentage, number of primary roots, number of secondary roots, length of secondary roots, sprouting percentage, length of shoots, number of leaves per cuttings, number of sprouts per cutting. Correlation matrix among traits of stem cuttings of *Gymnema sylvestre indicated that s*urvival percentage of cuttings is highly significantly positively correlated with 8 traits and among them maximum value of it is shown by number of leaves/cutting (0.949), but highly significantly negatively correlated (-0.867) with days for initiation of shoot emergence. Survival percentage is significantly correlated with days for completion of shoot emergence and area of leaves Days for initiation of shoot emergence were highly negatively correlated with survival percentage (-0.867). However survival percentage of cutting is not significantly correlated with basal diameter of shoots. Talei *et al.,* (2012) also observed significant correlation between germination traits of Kalmegh seeds.

Table 2 represents the path analysis of traits affecting survival percentage *Gymnema sylvestre* cutting after 75 days of transplantation in polytubes. Path analysis of traits affecting survival percentage *Gymnema sylvestre* cutting indicated nine traits having direct positive effect are days for initiation of shoot emergence, days for completion of shoot emergence, rooting percentage, number of primary roots per cutting, number of secondary roots per cutting, length of primary roots, length of shoots, area of leaves, number of leaves per cuttings while four traits having direct negative effect are length of secondary roots, sprouting percentage, basal diameter of shoots, number of sprouts per cutting. Maximum positive direct effect was calculated for number of leaves per cutting (0.810) and minimum positive direct effect (0.060) was calculated for days for completion of shoot emergence followed by maximum direct negative effect (-0.087) calculated for number of sprouts per cutting and minimum direct negative effect (-0.942) was calculated for length of secondary roots. Talei *et al.,* (2012) also observed that four parameters namely seed weight, germination period, rate of germination and germination energy have direct positive effect on germination percentage of Kalmegh seeds, while three parameters namely days taken for initiation of seed germination, days taken for 50% of final seed germination and days taken for completion of seed germination has direct negative effect. Singh and Ahmad (1997) observed genotypic effects in the differences in germination percentage of Kalmegh seeds.

Table 1: Correlation matrix among traits of stem cuttings of Gymnema sylvestre under nursery condition

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}
V_1	1.000													
V_2	-0.579*	1.000												
V_3	-0.867**	0.596*	1.000											
V_4	-0.779**	0.708**	0.876**	1.000										
V_5	-0.685**	0.487^{NS}	0.869**	0.783**	1.000									
V_6	-0.439^{NS}	0.439^{NS}	0.683*	0.692**	0.596*	1.000								
V_7	-0.693**	0.571*	0.877**	0.928**	0.829**	0.812**	1.000							
V_8	-0.785**	0.752**	0.919**	0.903**	0.747**	0.791**	0.847**	1.000						
V_9	-0.797**	0.794**	0.915**	0.918**	0.727**	0.749**	0.851**	0.986**	1.000					
V_{10}	-0.618*	0.484^{NS}	0.722**	0.785**	0.643*	0.592*	0.681*	0.778**	0.739**	1.000				
V_{11}	-0.494^{NS}	0.637*	0.658*	0.764**	0.699**	0.817**	0.735**	0.825**	0.784**	0.784**	1.000			
V_{12}	-0.874**	0.572*	0.972**	0.792**	0.837**	0.591*	0.790**	0.881**	0.878**	0.642*	0.602*	1.000		
V_{13}	-0.710**	0.654*	0.874**	0.881**	0.712**	0.781**	0.859**	0.940**	0.901**	0.804**	0.762**	0.809**	1.000	
V_{14}	-0.867**	0.626*	0.939**	0.795**	0.721**	0.487^{NS}	0.705**	0.872**	0.893**	0.644*	0.512^{NS}	0.949**	0.783**	1.000

Table 2: Path analysis of traits affecting survival percentage *Gymnema sylvestre* cutting after 75 days of transplantation in polytubes

	V_1	**V_2**	**V_3**	**V_4**	**V_5**	**V_6**	**V_7**	**V_8**	**V_9**	**V_{10}**	**V_{11}**	**V_{12}**	**V_{13}**
V_1	0.161	-0.035	-0.080	-0.598	-0.109	-0.163	0.653	0.253	-0.481	-0.107	0.287	-0.708	0.062
V_2	-0.093	0.060	0.055	0.544	0.078	0.163	-0.538	-0.243	0.480	0.083	-0.370	0.463	-0.057
V_3	-0.139	0.036	0.092	0.673	0.139	0.253	-0.826	-0.297	0.553	0.124	-0.382	0.788	-0.076
V_4	-0.125	0.042	0.081	0.768	0.125	0.256	-0.874	-0.291	0.555	0.135	-0.444	0.642	-0.077
V_5	-0.110	0.029	0.080	0.601	0.160	0.221	-0.781	-0.241	0.439	0.111	-0.406	0.678	-0.062
V_6	-0.070	0.026	0.063	0.531	0.095	0.371	-0.765	-0.255	0.452	0.102	-0.475	0.479	-0.068
V_7	-0.111	0.034	0.081	0.713	0.132	0.301	-0.942	-0.273	0.514	0.117	-0.427	0.640	-0.075
V_8	-0.126	0.045	0.085	0.693	0.119	0.293	-0.798	-0.323	0.596	0.134	-0.480	0.713	-0.082
V_9	-0.128	0.048	0.084	0.706	0.116	0.277	-0.802	-0.318	0.604	0.127	-0.456	0.711	-0.079
V_{10}	-0.099	0.029	0.066	0.603	0.103	0.219	-0.641	-0.251	0.446	0.173	-0.456	0.520	-0.070
V_{11}	-0.079	0.038	0.060	0.587	0.112	0.303	-0.692	-0.266	0.473	0.135	-0.582	0.488	-0.066
V_{12}	-0.140	0.034	0.089	0.609	0.134	0.219	-0.744	-0.284	0.530	0.111	-0.350	0.810	-0.070
V_{13}	-0.114	0.039	0.080	0.677	0.114	0.289	-0.809	-0.303	0.544	0.139	-0.443	0.655	-0.087

Conclusion

From the above data, it can be concluded that rooting percentage, sprouting percentage, length of primary roots, number of sprouts/cutting, length of shoots, basal diameter of shoots and leaf area are the important parameters for higher survival percentage of Gudmar cuttings. Nine traits having direct positive effect are days for initiation of shoot emergence among them maximum positive direct effect was shown by number of leaves per cutting (0.810) and maximum direct negative effect (-0.087) by number of sprouts per cutting.

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