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Correlation and path value analysis of *Rauvolfia serpentina* cuttings for higher survival percentage under the influence of PGRs

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Abstract
Keeping in view the importance of selection of traits for higher survival of Sarpagandha cuttings in nursery by using PGRs, a systematic research trial was undertaken to study trait association pattern and path analysis in stem cuttings of Sarpagandha at AICRP (M&APs) farm, BAU. Research was laid out in Factorial Completely Randomized Design with 13 treatments replicated thrice. Parameters studied were days for initiation of shoot emergence, days for completion of shoot emergence, rooting percentage, number of primary roots/cutting, number of secondary roots/cutting, length of primary roots, length of secondary roots, sprouting percentage, length of shoots, area of leaves, basal diameter of shoot, number of leaves/cutting, number of sprouts/cutting and survival percentage of cuttings. Correlation matrix among traits of stem cuttings of Sarpagandha indicated that survival percentage is highly significantly positively correlated with 11 traits and among them maximum value is shown by sprouting percentage (0.962). Path analysis of traits affecting survival percentage of Sarpagandha cuttings indicated that six traits had direct positive effect, out of which maximum direct positive effect was shown by number of primary roots/cutting (2.120) and maximum direct negative effect (-1.878) was shown by number of secondary roots/cutting.

Keywords: Sarpagandha, *Rauvolfia serpentina*, correlation, path value analysis

Introduction

Survival of seedlings is a complex trait and more prone to environmental fluctuations, so understanding the association between survival and its components is of paramount importance for making the best use of these relationships in selection. The path coefficient analysis helps to explain direct and indirect effects and hence, has extensively been used in various experiments. The estimates of correlation coefficients 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.

Rauvolfia serpentina Benth ex. Kurtz, an endangered medicinal plant, of family Apocynaceae is a woody evergreen perennial shrub, grows up to 60 cm of height [5]. It is native to India and several species of *Rauvolfia* found in different edaphoclimatic conditions in humid tropics of Nepal, Sri Lanka, Burma, Cambodia etc [3]. It is an erect, evergreen perennial shrub with a long, irregular, nodular, yellowish root stock, growing to a height of 60-90cm. Its leaves are simple, 7.5-10 cm long and 3.5-5 cm broad, elliptic or lanceolate, glabrous, bright green above and pale green beneath and occurring in whorls of 3-5. The fruit is drupe, 0.5cm in diameter and shiny black when fully ripe [1]. The root system consists of prominent, tuberous, soft tap root reaching a length of 30-50 cm in 2 year old plant with diameter 1.2-2.5cm.

It grows well in frost free tropical to sub-tropical situations under irrigation. Sarpagandha grows in wide range of climate conditions but flourishes well under hot, humid tropical climate open or partial shade. Elevation of 1300 m having a temperature range of 10-38°C and annual rainfall of 2500 mm are suitable for this species. Good yield is obtained in areas less prone to frost and having less severe water [9]. The propagation of *Rauvolfia serpentina* by seeds is poor because the seed of the plant has a cinnamic acid derivative which affects the germination percentages [5]. *Rauvolfia* is propagated by seeds and also by vegetative means like root-cuttings, root-stumps, stem-cuttings and leaf-cuttings. Stem cutting planted in the nursery during the early monsoon or June and kept moist until they give about 40-65% success rate [6].

Material and Methods

The experimental site was located at AICRP (MAPs) Research Farm, Birsa Agricultural University, Kanke, Ranchi, located in the plateau region of Jharkhand. Geographically, it is located at $23^0$26'30" N latitude and $85^0$18'20" E longitude in Chhota nagpur plateau, situated in north eastern part of India and at an altitude of between 646 m above the mean sea level. The soil of the site is lateritic, developed from granite-gneiss, sandy loam in texture, sedentary in nature and well drained with low water holding capacity and poor consistency. The general climate of the region is classified as 'sub humid megathermal' with mean daily temperature of about 24.2 ºC. The mean relative humidity is about 70.88% with its range from 57.0 to 92.0% in the area. The average annual rainfall of this area is approximately 1400mm which is mostly erratic, punctuated with occasional dry spells.

The experimental materials comprised of uniform, healthy, disease and pest free cuttings of pencil size thickness collected from median portion of *Rauvolfia serpentina* of mother plants from AICRP (MAPs) Research Farm, BAU. Stem cuttings of length 15 cm, thickness 6-7 mm, having 4-5 bud was selected. The basal portion of the cutting was given a slant cut and lower bud of the cutting was planted in the medium. Cuttings were treated with carbendazim (0.2%) before planting to check the incidence of the fungal diseases including rot. Transplanted cuttings were raised in polytubes and maintained under identical growing conditions in experimental area and used to study rooting and sprouting pattern. Data on various parameters was taken after 75 days of transplantation of cuttings in poly tubes. Experiment was laid out in Factorial Completely Randomized Design with 13 treatments replicated thrice by following the procedure outlined by [8]. Data was collected on days for initiation of shoot emergence, days for completion of shoot emergence, rooting percentage, number of primary roots/cutting, number of secondary roots/cutting, length of primary roots, length of secondary roots, sprouting percentage, length of shoots, area of leaves, basal diameter of shoot, number of leaves/cutting, number of sprouts/cutting and survival percentage of cuttings. Mean values of data recorded was subjected to correlation and path value analysis to screen out superior traits having significant impact on survival of Sarpagandha seedlings raised by stem cuttings under the influence of different concentrations of PGRs.

The correlation coefficient between characters was calculated by using the formula suggested by [7]. The significance of the correlation coefficient was determined from the t-statistic. Path coefficient 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. Path value analysis was calculated by the formula suggested by [4].

Results and Discussion

Correlation matrix among traits of stem cuttings of *Rauvolfia serpentina*: Table 1 represents the correlation matrix among traits of stem cuttings of *Rauvolfia serpentina* under nursery condition. Survival percentage of cutting after 75 days of transplantation in polytubes was highly positively significantly correlated with 11 traits namely; days for completion of shoot emergence (0.699), rooting percentage (0.960), number of primary roots per cuttings (0.893), number of secondary root per cuttings (0.831), length of primary root (0.878), sprouting percentage (0.962), length of shoots (0.846), area of leaves (0.912), basal diameter of shoots (0.824), number of leaves/cutting (0.883) and number of sprouts/cutting (0.763). Days for initiation of shoot emergence were highly negatively correlated with survival percentage (-0.850). However survival percentage of cuttings was not significantly correlated with length of secondary roots.

Table 1: Correlation matrix among traits of stem cuttings of *Rauvolfia serpentina under nursery conditions*

	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	-0.597*	1.000												
V_3	-0.864**	0.784**	1.000											
V_4	-0.822**	0.769**	0.914**	1.000										
V_5	-0.813**	0.712**	0.873**	0.974**	1.000									
V_6	-0.778**	0.716**	0.884**	0.981**	0.972**	1.000								
V_7	-0.525NS	0.428NS	0.622*	0.658*	0.649*	0.564*	1.000							
V_8	-0.859**	0.774**	0.996**	0.920**	0.880**	0.887**	0.660*	1.000						
V_9	-0.798**	0.781**	0.925**	0.916**	0.929**	0.925**	0.507NS	0.910**	1.000					
V_{10}	-0.909**	0.666*	0.903**	0.901**	0.885**	0.866**	0.697**	0.914**	0.820**	1.000				
V_{11}	-0.781**	0.354NS	0.768**	0.797**	0.770**	0.759**	0.732**	0.783**	0.654*	0.877**	1.000			
V_{12}	-0.827**	0.649*	0.902**	0.940**	0.957**	0.931**	0.661*	0.899**	0.919**	0.909**	0.866**	1.000		
V_{13}	-0.661*	0.640*	0.775**	0.941**	0.949**	0.962**	0.574*	0.777**	0.853**	0.779**	0.720**	0.904**	1.000	
V_{14}	-0.850**	0.699**	0.960**	0.893**	0.831**	0.878**	0.544NS	0.962**	0.846**	0.912**	0.824**	0.883**	0.763**	1.000

Where V_1-Days for initiation of shoot emergence, V_2-Days for completion of shoot emergence, V_3-Rooting percentage, V_4-Number of primary roots/cutting, V_5-Number of secondary roots/cutting, V_6-Length of primary roots, V_7-Length of secondary roots, V_8-Sprouting percentage, V_9-Length of shoots, V_{10}-Area of leaves, V_{11}-Basal diameter of shoot, V_{12}-Number of leaves/cutting, V_{13}-Number of sprouts/cutting, V_{14}-Survival percentage of cuttings

High C/N ratio and carbohydrate reserves were responsible for the high success of the basal cuttings of Pomegranate [10]. Positive correlation of rooting behavior with total carbohydrates, phenols as well as C/N ratio was observed by [11], whereas nitrogen contents had slightly negative relationship with rooting.

Path analysis of traits affecting survival percentage of *Rauvolfia serpentina* cuttings: Table 2 represents the path analysis of traits affecting survival percentage of *Rauvolfia serpentina* cuttings after 75 days of transplantation in polytubes. Six traits had direct positive effect on survival percentage of cuttings like days for initiation of shoot emergence (0.017), number of primary roots/cuttings (2.120), length of primary roots (0.481), sprouting percentage (1.461), area of leaves (0.376), number of leaves/cutting (1.998), while seven traits having direct negative effect were days for completion of shoot emergence (-0.522), rooting percentage (-0.748), number of secondary roots/cutting (-1.878), length of secondary roots (-0.164), length of shoots (-0.783), basal diameter of shoots (-1.107) and number of sprouts/cuttings (-0.661).

Table 2: Path analysis of traits affecting survival percentage of *Rauvolfia serpentina* cuttings 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	0.017	0.311	0.646	-1.742	1.526	-0.374	0.086	-1.255	0.625	-0.341	0.864	-1.651	0.432
V_2	-0.0104	-0.522	-0.586	1.630	-1.337	0.344	-0.070	1.131	-0.611	0.250	-0.391	1.296	-0.422
V_3	-0.015	-0.409	-0.748	1.939	-1.639	0.425	-0.102	1.455	-0.724	0.339	-0.850	1.802	-0.512
V_4	-0.014	-0.401	-0.684	2.120	-1.829	0.472	-0.108	1.344	-0.717	0.338	-0.882	1.877	-0.622
V_5	-0.014	-0.372	-0.653	2.066	-1.878	0.467	-0.106	1.285	-0.727	0.332	-0.853	1.912	-0.627
V_6	-0.013	-0.373	-0.661	2.081	-1.825	0.481	-0.092	1.296	-0.724	0.325	-0.840	1.860	-0.635
V_7	-0.009	-0.223	-0.465	1.395	-1.219	0.271	-0.164	0.964	-0.396	0.262	-0.811	1.321	-0.379
V_8	-0.015	-0.404	-0.745	1.951	-1.652	0.426	-0.108	1.461	-0.712	0.343	-0.867	1.796	-0.513
V_9	-0.013	-0.408	-0.692	1.942	-1.744	0.444	-0.083	1.329	-0.783	0.308	-0.724	1.836	-0.564
V_{10}	-0.015	-0.347	-0.675	1.911	-1.662	0.416	-0.114	1.336	-0.642	0.376	-0.971	1.816	-0.514
V_{11}	-0.013	-0.184	-0.574	1.690	-1.446	0.365	-0.120	1.143	-0.512	0.329	-1.107	1.730	-0.475
V_{12}	-0.014	-0.339	-0.675	1.993	-1.797	0.448	-0.108	1.314	-0.720	0.341	-0.959	1.998	-0.597
V_{13}	-0.011	-0.334	-0.579	1.996	-1.782	0.462	-0.094	1.134	-0.668	0.292	-0.797	1.806	-0.661

Residual are 0.00000

Where V_1-Days for initiation of shoot emergence, V_2-Days for completion of shoot emergence, V_3-Rooting percentage, V_4-Number of primary roots/cutting, V_5-Number of secondary roots/cutting, V_6-Length of primary roots, V_7-Length of secondary roots, V_8-Sprouting percentage, V_9-Length of shoots, V_{10}-Area of leaves, V_{11}-Basal diameter of shoot, V_{12}-Number of leaves/cutting, V_{13}-Number of sprouts/cutting

Maximum positive direct effect was calculated for number of primary roots/cuttings (2.120) and minimum positive direct effect (0.017) was calculated for days for initiation of shoot emergence. Minimum direct negative effect (-0.164) was calculated for length of secondary roots and maximum direct negative effect (-1.878) was calculated for number of secondary roots/cutting. A positive effect of glucose on cutting rhizogenesis was found if hexose was supplied during the root induction phase, followed by sucrose in the root formation step, especially for *Eucalyptus globulus*. The beneficial effect of glucose in the induction phase on root number was also evident under suboptimal auxin concentrations [2].

Conclusion

Survival percentage of cuttings is highly significantly positively correlated with 11 traits. Maximum value of it is shown by sprouting percentage (0.962). Highly significantly negatively correlated (-0.850) was observed with days for initiation of shoot emergence.

Six traits had direct positive effect, out of which maximum direct positive effect was observed for number of primary roots/cutting (2.120) and minimum by days for initiation of shoot emergence (0.017). Maximum direct negative effect (-1.878) was shown by number of secondary roots/cutting.

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