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PATH ANALYSIS OF METRIC TRAITS IN *Acacia catechu* Willd.

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Correlation and path-coefficient analysis was conducted on eight characters of *Acacia catechu* Willd. seedlings for higher shoot dry weight. Phenotypic correlation of shoot dry weight was positive and significant with all other component characters. The genotypic correlation coefficients were positive, significant and greater in magnitude than the phenotypic correlations. Path-coefficient analysis revealed that shoot fresh weight, root dry weight, number of leaves and leaf area comprehend direct effect on shoot dry weight. Therefore, these traits should be given greater importance while formulating selection indices for better establishment of seedling growth in the plantation areas.

Key words: *Acacia catechu*, correlation, path analysis and shoot dry weight

Biomass yield of a tree species is a complex and composite biological function, the expression of which is associated with a number of component characters. The component characters are quite often inter-related which affects their direct relationship with biomass yield, thereby, making the correlation coefficients less effective for selection. So much so. when more variables are included in the correlation studies, the indirect association becomes more complex and it becomes imperative to separate them out. In such a situation, path coefficient analysis helps to determine the direct and indirect contribution of various associated traits towards the trait of interest.

Correlation and path analysis have been used in forest tree species by workers like Rathinam *et al.* (1982) in *Eucalytptus tereticornis*; Chandrasekharan *et al.* (1985) in *Leucaena lecocephala*; Kumar and Gurumurthy (1996) in *Casuarina equisetifolia* and Khosla *et al.* (1985) in *Pinus roxburghaii.* In order to initiate any selection programme, the present studv was undertaken to study the relationship among shoot dry weight and its component traits through path-coefficient analysis.

MATERIALS AND METHODS

The experimental material consisted of seedlings raised from 40 different locations representing diverse geographic regions in a Randomised Complete Block Design with three replication (Table. 1). Five seedlings per replication were selected at random after one and a half year growth in the nursery. The data were recorded on nine quantitative characters viz; seedling height, collar diameter, inter nodal length, number of leaves, leaf area, shoot fresh and dry weight, root fresh and dry weight. The genotypic and phenotypic correlation coefficients between all pairs of characters were calculated as per the procedure suggested by Searle (1969). Path-coefficient analysis was carried out as per Dewey and Lu (1959).

RESULTS AND DISCUSSION

The estimates of genotypic and phenotypic correlation coefficients between all pairs of eight characters are presented in Table 2. The genotypic correlations were in general higher than the phenotypic correlations. All pair of character combinations were significantly correlated with each other at genotypic as well as phenotypic level. This showed that increase in seedling height resulted in considerable increase in the collar diameter, inter nodal length, number of leaves, leaf area, shoot fresh, root fresh and root dry weight, thus, leading to strong inherent association with higher shoot dry weight. Therefore, special emphasis needs to be given to these traits at the time of selection in the nursery. There was no negative association observed among these traits which may lead to the genetic slippage. These findings are in line with that of Srivastava (1995) among morphological and biomass traits of *Bauhinia variegata* seedlings and Chauhan and Verma (1993) in *Acacia catechu*.

The path-coefficient analysis in Table 3 depicts the direct and indirect effects of seedling height, collar diameter, inter nodal length, number of leaves, leaf area, shoot fresh weight, root fresh and dry weight. From the perusal of Table 3, it is apparent that seedling height which gave significant and positive correlation with shoot dry weight which was primarily due to the positive indirect effects via number of leaves, leaf area, shoot fresh weight and root dry weight. The indirect effects via collar diameter, inter nodal length and root fresh weight were negative.

Collar diameter revealed negligible direct effect on dry shoot weight (–0.0192). The indirect effects through seedling height, inter nodal length and root fresh weight were negative and non-significant to counter balance the high positive effects via shoot fresh weight, root dry weight, number of leaves and leaf area, thereby, resulting in a strong genotypic correlation coefficient. Inter nodal length exhibited small negative direct effect (–0.0362) but the cumulative effect obtained from the indirect positive effect through number of leaves, leaf area, shoot fresh weight and root dry weight compensated the indirect negative effects through seedling height, collar diameter and root fresh weight resulting a highly significant positive correlation.

Number of leaves showed significantly positive association with shoot dry weight (0.1689) which resulted from the direct positive correlation of this trait and indirect positive contribution through leaf area, shoot fresh weight and root dry weight. Association of leaf area and shoot dry weight was positive and highly significant (0.1294). Path analysis revealed that leaf area gave direct positive effect on the resultant trait. The indirect effects via number of leaves, shoot fresh weight and root dry weights were positive and other effects were negative.

The direct effect of shoot fresh weight was maximum and positive (0.9519). The indirect effect via seedling height, collar diameter, inter nodal length and root fresh weight was very small but negative, while number of leaves, leaf area and root dry weight depicted positive indirect effect. The highest positive and significant genotypic correlation was mainly due to the direct positive effect of shoot fresh weight.

The genotypic correlation of root fresh weight with shoot dry weight was positive and highly significant. However, the direct effect was negative (-0.4270) but it was contributed by the positive indirect effects via number of leaves, leaf area, shoot fresh weight and root dry weight. The association of root dry weight with shoot dry weight was positive and highly significant due to its direct effects (0.4477) and indirect positive effects through number of leaves, leaf area, and shoot fresh weight. These positive effects counter balanced the indirect negative effects resulting highly significant correlation coefficients. The residual effect was found very low which indicated that majority of the traits contributing to shoot dry weight were included in the present study.

The above observation clearly depicted that seedling height, collar diameter, and inter nodal length contributed very less but with negative direct effect on shoot dry weight which may be attributed to the very young age of the seedlings

Table 1. Geographical locationa nd habitat data of various seed sources under study

Source No.	Name of seed source	District	State/ Country	Latitude	Longitude	Altitude (cm)	Rainfall (cm)
1	Arki	Solan	HP	31° 09' N	76° 57' E	1260	120.1
2	Awadevi	Hamirpur	HP	31° 40' N	76° 39' E	996	131.0
3	Badrama	Sambalpur	Orissa	21° 09' N	83° 10' E	300	160.1
4	Badsar	Hamirpur	HP	31° 32' N	76° 28' E	717	145.3
5	Bagar	Solan	HP	30° 51' N	76° 15' E	1190	139.6
6	Balera	Solan	HP	31° 08' N	76° 54' E	1100	141.3
7	Bhanjal	Una	HP	31° 46' N	76° 07' E	730	100.8
8	Bharighat	Solan	HP	31° 15' M	76° 50' E	1150	124.4
9.	Bharmour	Chamba	HP	31° 54' N	76° 39' E	1100	110.6
10	Bhota	Hamirpur	HP	31° 37' N	76° 33' E	900	144.8
11	Bilaspur Sadar	Bilaspur	HP	31° 19' N	76° 48' E	825	131.5
12	Dalautpur chowk	Una	HP	31° 49' N	75° 57' E	650	108.6
13	Dharja	Solan	HP	30° 48' N	76° 13' E	1124	142.1
14	Dhameta	Kangra	HP	31° 50' N	75° 55' E	700	121.3
15	Kothi	Solan	HP	30° 58' N	77° 03' E	1100	139.2
16	Gagret	Una	HP	31° 40'N	76° 05' E	500	110.4
17	Gandhal	Sirmour	HP	30° 48' N	70° 15' E	1009	121.4
18	Ghumarwin	Bilaspur	HP	31° 25' N	76° 45' E	1050	122.9
19	Gadchiroli	Gadchiroli	Maharashtra	20° 03' N	80° 01' E	250	160.0
20	Jabalpur	Jabalpur	MP	23° 05' N	79° 58 ' E	400	140.5
21	Kalah	Jammu	J & K	32° 35' N	74° 40' E	621	92.3
22.	Khadpanjawar	Una	HP	31° 32' N	76° 09' E	512	112.8
23	Kharah	Jammu	J & K	33° 10' N	74° 12' E	950	89.5
24	Kheri	Sirmour	HP	30° 50' N	77° 08' E	1106	121.6
25	Kothipura	Bilaspur	HP	31° 17' N	76° 47' E	1076	107.2
26	Kotlabarog	Sirmour	HP	30° 50' N	77° 14' E	1101	122.7
27	Kwangdhar	Sirmour	HP	30° 51' N	76° 19' E	1253	132.5
28	Manlogkala	Solan	HP	30° 56' N	77° 04' E	1200	138.1
29	Naglahar	Kangra	HP	31° 37' N	76° 41' E	750	121.2
30	Nainatikkar	Sirmour	HP	30° 48' N	77° 07' E	1100	124.7
31	Nakroh	Una	HP	31° 46' N	76° 02' E	702	112.2
32	Narag	Sirmour	HP	30° 49' N	77° 11' E	1150	121.9
33	Oel	Una	HP	31° 38' N	76° 05' E	500	117.6
34	Pasha river	Bara	Nepal	27° 18' N	86° 03' E	280	200.0
35	Rewa	Rewa	MP	24° 32' N	81° 11' E	300	116.8
36	Salohberi	Una	HP	31° 53' N	75° 55' E	600	102.9
37	Sithu	Solan	HP	31° 10' N	76° 54' E	1090	123.5
38	Swarghat	Bilaspur	HP	31° 14' N	76° 42' E	850	121.6
39	Talwara	Una	HP	31° 51' N	75° 49' E	622	109.2
40	Taunidevi	Hamirpur	HP	31° 42' N	76° 36' E	1024	131.5

Table 2. Phenotypic and genotypic correlation coefficients among different morphological and biomass traits of *Acacia catechu* under nursery condition

Traits		Seedling height	Collar diameter	Inter-nodal length	No. of leaves	Leaf area	Fresh shoot weight	Fresh root weight	Dry shoot weight
Collar diameter	P	0.8873							
	G	0.8997							
Intenodal length	P	0.8163	0.8148						
	G	0.8083	0.8158						
No. of leaves	P	0.8596	0.8901	0.8001					
	G	0.8901	0.9184	0.8253					
Leaf area	P	0.7702	0.6942	0.6419	0.6130				
	G	0.8406	0.7368	0.6771	0.6357				
Fresh shoot weight	P	0.7955	0.6745	0.8775	0.5269				
	G	0.8456	0.8884	0.9149	0.5778				
Fresh root weight	P	0.7624	0.7839	0.6680	0.7914	0.5746	0.8674		
	G	0.7978	0.8056	0.6901	0.8152	0.6249	0.8675		
Dry shoot weight	P	0.8005	0.8739	0.7191	0.9091	0.5593	0.9754	0.8403	
	G	0.8437	0.9060	0.7500	0.9381	0.6056	0.9781	0.8412	
Dry root weight	P	0.7645	0.8163	0.7579	0.8299	0.5919	0.8242	0.9276	0.8651
	G	0.7979	0.8353	0.7824	0.8515	0.6359	0.8287	0.9297	0.8693

All the Phenotypic correlations are significant at 5% level of significance

Table 3. Direct and indirect effects of nursery traits on dry shoot weight of Acacia catechu

Traits	Seedling height	Collar diameter	Inter-nodal length	No. of leaves	Leaf area	Fresh shoot weight	Fresh root weight	Dry root weight	GC with dry shoot weight
Seedling height	-0.1902	-0.0173	-0.0293	0.1504	0.1085	0.8050	-0.3406	0.3572	0.8437
Collar diameter	-0.1711	-0.0192	-0.0295	0.1551	0.0951	0.8457	-0.3440	0.3739	0.9060
Interiaodal length	-0.1537	-0.0157	-0.0362	0.1394	0.0874	0.6732	-0.2947	0.3503	0.7500
No. of leaves	-0.1693	-0.0176	-0.0299	0.1689	0.0821	0.8708	-0.3481	0.3811	0.9381
Leaf area	-0.1599	-0.0142	-0.0246	0.1074	0.1294	0.5501	-0.2668	0.2847	0.6058
Fresh shoot weight	-0.1608	-0.0171	-0.0256	0.1545	0.0746	0.9519	-0.3704	0.3710	0.9781
Fresh root weight	-0.1517	-0.0155	-0.0250	0.1377	0.0807	0.8258	-0.4270	0.4162	0.8412
Dry root weight	-0.1518	-0.0160	-0.0283	0.1438	0.0821	0.7888	-0.3970	0.4477	0.8693

Residual effect = 0.0073; Bold faces values are direct effects

and may change with their establishment in the plantation area. These results are in conformity with Khosla *et al.*, (1985) in *Pinus roxburghii* seedlings and with Kumar and Gurumurthy (1996) in *Casuarina equisetifolia.*

The present study suggested that traits viz; number of leaves, leaf area, shoot fresh weight and root dry weight not only depicted high and positive direct effects but also revealed positive indirect effects with other associated traits. Therefore, these traits may be given greater emphasis while designing selection indices for biomass improvement programme in this forest tree species.

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