Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8315

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2020) *8*(4), 669-673

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Estimating the Effect of Morphological Characteristics on Biomass Potential in *Acacia catechu* Using Correlation and Path Coefficient Analysis

Ankita*, P. K. Mahajan and Bharti

Department of Basic Sciences, Dr Y S Parmar University of Horticulture and Forestry, Nauni - Solan Himachal Pradesh 173230 India

*Corresponding Author E-mail: ankitabhadana@gmail.com

Received: 10.07.2020 | Revised: 13.08.2020 | Accepted: 18.08.2020

ABSTRACT

It is of utmost desire for plant breeders to know the extent of relationship between biomass and various morphological characteristics, which will certainly facilitate selection of desirable characteristics. So an attempt was made to measure the correlation coefficients and path coefficients of biomass and its contributing characters in Acacia catechu. Two sites i.e. under plantation (site- I) and natural forest (site-II) ecosystems were randomly selected. Pooled data were used for correlation and path coefficient analyses as all tree characteristics showed non-significant variations between the two sites. Diameter at breast height and tree height were positively and significantly correlated with biomass. Path analysis revealed that diameter at breast height was the most important characteristic of Acacia catechu for biomass improvement which should be exploited through a breeding programme for improving its biomass potential.

Keywords: *Acacia catechu, Correlation, Path coefficient analysis*

INTRODUCTION

Acacia catechu belongs to the family fabaceae. It is found in Australia, Africa and Central Asia in abundance. In India, it distributed in Tropical Moist Deciduous, Tropical Dry Deciduous and Tropical Thorn Forest types. *Acacia catechu* is mainly found in the states of Uttar Pradesh, Bihar, Orissa, Jammu, Punjab, Uttarakhand, Himachal Pradesh, Tamil Nadu, Karnataka, Assam and Madhya Pradesh. In Himachal Pradesh *Acacia catechu* is found in Mandi, Hamirpur, Kangra, Sirmaur, Una, Chamba, Shimla, Solan and Bilaspur districts below 1300 m amsl (Chowdhery & Wadhwa, 1984). *Acacia catechu* is commercially, ecologically and medicinally very important species. Its wood is used for fuel, fodder, timber and shelter etc. Cutch and katha are extracts obtained from heartwood of *Acacia catechu*. Katha is used in pan making and the most common use of katha is in the treatment of sore throat (Hashmat & Hussain, 2013). Cutch is chiefly used in dying and tanning industry.

Cite this article: Ankita, Mahajan, P.K., & Bharti (2020). Estimating the Effect of Morphological Characteristics on Biomass Potential in *Acacia catechu* Using Correlation and Path Coefficient Analysis, *Ind. J. Pure App. Biosci. 8*(4), 669-673. doi: http://dx.doi.org/10.18782/2582-2845.8315

There may be many characteristics which affect the biomass of the tree. The study of inter relationship among various characters in the form of correlation is one of the important aspects in the selection programme for the breeder to make an effective selection based on the correlated and uncorrelated response. The estimation of correlation indicates only the extent and nature of association between biomass and its components, but does not show the direct and indirect effects of different biomass attributes on yield. Biomass is dependent on several characters which are mutually associated; these will in turn impair the true association existing between a component and biomass. A change in any one component is likely to disturb the whole network of cause and effect. The present study is therefore, aimed at determining the inter-relationship between biomass and its contributing characters in *Acacia catechu* in mid hills of Himachal Pradesh using simple correlation and path coefficient analysis.

MATERIALS AND METHODS

Experimental sites i.e. under plantation (site- I) and natural forest (site-II) ecosystems were located in the mid-hill zone of Himachal Pradesh (Dr. YS Parmar University of Horticulture and Forestry, Nauni-Solan) with the elevation of about 900-1300 m amsl. For estimation of different growth characteristics, firstly both the sites were properly inspected and the trees were counted and numbered. The trees selected through random number table were measured for different growth characteristics. Thus a sample of 60 and 45 trees were selected at random from plantation (site- I) and natural forest (site- II) ecosystems, respectively. Different characteristics viz., were diameter at breast height (DBH), tree height (m), bole height (m), crown length (m), crown height (m), crown width (m) and biomass recorded. Karl Pearson's correlation coefficient between biomass and various biomass attributing characteristics of *Acacia catechu* was worked out and tested for its significance. Direct and indirect effect of various morphological characters on biomass production of *Acacia catechu* was also worked out with the help of Path coefficient analysis as described by Wright (1921) and modified by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The data were collected for various growth characteristics from randomly selected 60 and 45 trees from plantation (site-I) and natural forest (site-II), respectively. To test the variation between the two sites for all the studied characteristics variance ratio test (F-test) was applied. Mean and variances have presented in Table 1. F-test suggested that there was no significant variation among the tree characteristics between the two sites.

Table 1: Variability analysis for different growth characteristics

Tree characteristics	Variances			Mean	
	Site − I	Site – II	F−statistic	Site − I	Site − II
DBH (cm)	19.59	19.84	1.01	17.54	16.93
Tree height (m)	3.09	1.94	1.59	6.95	6.66
Crown height (m)	0.720	0.68	1.05	2.49	2.51
Crown length (m)	1.49	1.26	1.18	4.52	4.14
Crown width (m)	1.05	0.66	1.59	4.81	4.86
Bole height (m)	0.59	0.83	1.14	3.49	3.03
Total green biomass (kg)	2064.37	1304.47	1.58	124.25	92.19
Total dry biomass (kg)	710.34	506.04	1.40	74.93	49.66
Proportion of dry biomass	0.0039	0.0056	1.42	0.60	0.53

In order to find out the linear relationship between all possible pairs of directly measured variables, Karl Pearson's coefficient of correlations was worked out for all growth characteristics viz., DBH, tree height, crown height, crown length, crown width, bole height, total green biomass and total dry biomass. Data from both sites were pooled to estimate correlation coefficients as there was no significant variation for the characteristics between the two sites. The results have been presented in Table 2. The significance of correlation coefficient (r) value was tested against (n-2 = 103) degrees of freedom at 1 % and 5 % level of significance. The results revealed that total dry biomass and total green biomass were positively and significantly correlated with all tree growth characteristics. It is also evident from the table that total green biomass showed a highly significant correlation with diameter at breast height (0.906) followed by tree height (0.686). Total dry biomass showed a highly significant correlation with total green biomass (0.953) followed by diameter at breast height (0.839) and tree height (0.614). DBH was also found to be positively and significantly correlated with tree height (0.689).

Table 2: Correlation matrix indicating relationship between different tree growth characteristics

Characters	**Diameter (cm)**	**Height (m)**	**Bole height (m)**	**Crown height (m)**	**Crown Length (m)**	**Crown width (m)**	**Total green biomass (kg)**	**Total dry biomass (kg)**
Diameter (cm)	1.000	0.689**	0.317**	0.429**	0.635**	0.264**	0.906**	0.839**
Height (m)		1.000	0.514**	0.692**	0.870**	0.340**	0.686**	0.614**
Bole height (m)			1.000	0.703**	0.190	0.122	0.415**	0.343**
Crown height (m)				1.000	0.292**	0.262**	0.417**	0.305**
Crown Length (m)					1.000	0.251*	0.646**	0.627**
Crown width (m)						1.000	0.201*	0.153
Total green biomass (kg)							1.000	0.953**
Total dry biomass (kg)								1.000

******significant at 1% level of significance, * significant at 5% level of significance

Although correlation studies are helpful in determining the components of biomass, they do not provide a clear picture of nature and extent of contributions made by number of independent variables. Path coefficient analysis devised by Dewey and Lu (1959), provides a realistic basis for allocation of appropriate weightage to various characteristics for the improvement of biomass production. The path co-efficient analysis of all characteristics influencing green and dry biomass has been presented in Table 3 and Table 4, respectively.

Table 3: Path coefficient analysis of characteristics influencing total green biomass in *Acacia catechu*

Character	**Diameter (cm)**	**Tree height (m)**	**Bole height (m)**	**Crown height (m)**	**Crown length (m)**	**Crown width (m)**	**Direct+ Indirect effect**
Diameter (cm)	**0.823**	-0.208	0.076	0.005	0.219	-0.009	**0.906**
Tree height (m)	0.567	**-0.301**	0.123	0.008	0.300	-0.011	**0.686**
Bole height (m)	0.261	-0.155	**0.240**	0.008	0.065	-0.004	**0.415**
Crown height (m)	0.353	-0.208	0.168	**0.012**	0.101	-0.009	**0.417**
Crown length (m)	0.523	-0.262	0.045	0.003	**0.345**	-0.008	**0.646**
Crown width (m)	0.217	-0.102	0.029	0.003	0.087	**-0.033**	**0.201**

Table 4: Path coefficient analysis of characteristics influencing total dry biomass in *Acacia catechu*

Character	Diameter (cm)	Tree height (m)	Bole height (m)	Crown height (m)	Crown length (m)	Crown width (m)	Direct+ Indirect effect
Diameter (cm)	**0.776**	-0.302	0.084	-0.018	0.311	-0.013	**0.839**
Tree height (m)	0.535	**-0.438**	0.137	-0.030	0.426	-0.016	**0.614**
Bole height (m)	0.246	-0.225	**0.266**	-0.030	0.093	-0.006	**0.343**
Crown height (m)	0.333	-0.303	0.187	**-0.043**	0.143	-0.012	**0.305**
Crown length (m)	0.493	-0.381	0.050	-0.012	**0.489**	-0.012	**0.627**
Crown width (m)	0.205	-0.149	0.032	-0.011	0.123	**-0.048**	**0.153**

The perusal of Table 3 indicates that diameter made the highest direct positive contribution of 0.823 to total green biomass followed by crown length (0.345). Most of the characteristics made their highest indirect contribution to total green biomass through diameter at breast height and crown length. The least indirect contribution to total green biomass was via crown height followed by crown width which is negative. Table 4 revealed that most of the characteristics indirectly and significantly contributed towards total dry biomass via diameter at breast height (0.776) and crown length (0.489). The least indirect contribution to total dry biomass was via bole height followed by crown height and crown width which are negative. Krenzel et al. (2003) observed a high positive correlation (R^2=0.978) between biomass and DBH in 20 years old teak plantation. Salunkhe et al. (2014) concluded that the relationship between basal area and above ground biomass was positive in tropical deciduous forests of state Madhya Pradesh, India. Kumari et al. (2016) worked out correlation coefficients between biomass and different biomass affecting components of *Ulmus villosa* in mid-hills of Himachal Pradesh.

Summary: There was a non-significant variation between the two sites for all tree characteristics in *Acacia catechu*. Total green biomass and total dry biomass were positively correlated with all the characteristics. Total green biomass and total dry biomass had highly significant correlation i.e. 0.906 and 0.839, respectively with diameter at breast height (cm) followed by tree height (m) and crown length (m). Path analysis indicated that diameter at breast height made the highest direct positive contribution to both total green and dry biomass. Most of the characteristics made their highest indirect contribution to total green and dry biomass through diameter at breast height and crown length. The least indirect contribution to total green biomass and total dry biomass was via crown height and via bole height respectively.

REFERENCES

Chowdhery, H.J., & Wadhwa, B.M. (1984). *Flora of Himachal Pradesh*: analysis. *1*(3), Botanical survey of India, Dehradun.

Dewey, D.R., & Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal 51*, 515-518.

Hashmat, M.A., & Hussain, R. (2013). A review on *Acacia catechu* wild. *Interdisciplinary Journal of Contemporary Research in Businesss 5*, 593-600.

Krenzel, M., Castillo, A., Moore, T., & Potvin, C. (2003). Carbon storage of harvest –

age teak plantations, Panama. *Forest Ecology and Management 173*, 213-225.

Kumari, K., Chandel, A., Bharti, & Mahajan, P.K. (2016). Biomass production of Ulmus villosa under Mid-hills of Himachal Pradesh – A statistical Approach. *Indian Journal of Ecology*. *43*, 760-764.

Salunkhe, O., Khare, P.K., T.R., Sahu, and Singh, S. (2014). Above ground biomass and carbon stocking in tropical deciduous forests of state of Madhya Pradesh, India. *Taiwania 59*, 353– 359.

Wright, S. (1921). Correlation and causation. *Journal of Agricultural Research. 20*, 557-585.