Correlation study on morphological and biomass traits in half-sib progenies of *Neolamarckia cadamba*

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ABSTRACT

The present correlation study on *Neolamarckia cadamba* was carried out at the research farm of College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. Twenty candidate plus trees (CPTs) of *N cadamba* were selected as seed source from twenty different locations of Bihar, Rajasthan and Uttar Pradesh for the purpose of correlation study of morphological and biomass traits. The study revealed that NPT_1 exhibited outstanding performance for morphological and biomass traits in comparison to all other superior tree progenies under greenhouse conditions. The phenotypic and genotypic variance and their coefficient of variability also showed a sizeable variability. This offers a breeder ample scope to undertake screening and selection of seed sources for the desired traits. Phenotypic correlation coefficients among the seedling traits ranged from non-significant –0.234 (P = 0.01) between shoot-root ratio and root dry weight to highly significant 0.963 (P = 0.01) between seedling biomass and shoot dry weight under greenhouse conditions. Therefore, these characteristics could be harnessed in future improvement programme of *N cadamba*.

Keywords: *Neolamarckia cadamba*; phenotypic; genotypic; correlation; plus trees

INTRODUCTION

Neolamarckia cadamba is also known as the burflower tree. Kadamb (*N cadamba*) is a valuable and rapidly growing tree in south Asia. Kadamb is a medium to big deciduous tree that may grow to 45 m in height. Its bole is straight and cylindrical, frequently branchless for more than 25 m, up to 100 (-160) cm in diameter but usually less, occasionally with tiny buttresses up to 2 m height and reaching up to 60 cm from the stem (Luna 2005).

It grows quickly and is ideal for regeneration in watersheds and degraded regions as well as windbreaks in agroforestry systems. Ceiling boards, light construction work, packing boxes, planking, carving and turnery are all common uses of the wood. The wood produces good veneers and plywood that may be used to construct commercial grade plywood and tea chest plywood. The bark is used to treat fevers, while the leaf extract is used to gargle (Kapil et al 1995).

A breeder determines the breeding methods to be used based on the evaluation of genotypic and phenotypic correlations, so that the helpful correlations may be utilized and the unfavourable ones avoided by producing new variability to create new recombinants (Sahoo and Wani 2020). When selection is based on two or more features, estimation of phenotypic and genotypic correlation between distinct variables gives useful information in breeding programmes.

MATERIAL and METHODS

The investigations were carried out at the research farm of College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh in greenhouse conditions. More than fifty mature fruits were collected from different parts of the crown of all plus trees selected from twenty different regions of Bihar, Rajasthan and Uttar Pradesh ranging from latitude 25.60°N – 26.15°N and longitude 77.98°E – 87.46°E (Table 1). The morphological and biomass data were recorded for five seedlings per replication ie fifteen seedlings of each plus tree progeny were selected randomly and tagged, excluding border ones. Phenotypic and genotypic variance was calculated according to Burton (1952). Phenotypic and genotypic correlation coefficients were estimated as given by Searle (1961).

RESULTS and DISCUSSION

Different accessions of *N cadamba* exhibited considerable amount of variation in growth and yield traits. Analysis of variance showed highly significant variations among the experimental accessions for plant height, collar diameter and seedling biomass parameters. It suggested the presence of considerable amount of variability in material, which can be used for improvement of traits including seed yield.

One of the prerequisites for every genetic improvement programme is the type and extent of variation, as well as correlation studies in a selected parent group. Correlation analysis is required to determine the reaction of numerous qualities to the characters of interest for selection. Breeders often make breeding plans based on genotypic and phenotypic correlation estimations.

As a result, genotypic and phenotypic correlations were calculated using trait mean values to determine the amount of relationship between the characteristics. In greenhouse condition, out of 28 correlation coefficients of phenotypic correlation coefficient among morphological and biomass traits, 21 were found positive and highly significant (1% LoS) and the remaining negative and non-significant. In genotypic correlation coefficient, 21 were found positive and highly significant (1% LoS) and the remaining negative and significant (Table 2).

Estimation of genotypic and phenotypic correlation between various traits provides necessary information in a breeding programme when selection is based on two or more characters. The intensity and direction of association among characters may be measured by genetic coefficients of correlation

Table 1. Details of plus trees of *Neolamarckia cadamba* collected from twenty different locations

Seed source	Locality	State	Latitude	Longitude	Tree height (m)	Tree girth DBH (m)	Fruit size (mm)	100-seed weight (mg)
NPT_1	Chajjubagh, Patna	Bihar	25.60°N	85.71°E	17.38	1.02	38.72	17
NPT_2	Sohsarai, Bihar Sharif	Bihar	25.71°N	85.61°E	10.50	0.40	38.27	15
NPT_3	Kalyanbigah	Bihar	25.31°N	85.70°E	6.70	0.50	38.61	11
NPT_4	Bedhna Road, Barh	Bihar	25.19°N	85.97°E	12.92	0.31	37.56	12
NPT_5	Near nursery, Chandi	Bihar	25.92°N	85.70°E	18.28	1.19	42.71	23
NPT_6	Narauli, Karauta	Bihar	25.51°N	85.10°E	11.86	0.63	39.16	17
NPT_7	Mohmadpur, Samastipur	Bihar	25.39°N	85.56°E	6.09	0.76	39.67	20
NPT_8	Dumri, Begusarai	Bihar	25.57°N	86.02°E	17.00	0.83	38.34	18
NPT_9	Patna (Fatuhamarg)	Bihar	25.12°N	85.51°E	12.00	0.64	38.27	17
NPT_{10}	Sharifganj, Katihar	Bihar	25.24°N	87.46°E	5.53	0.584	37.07	11
NPT_{11}	Sudari	Bihar	25.20°N	85.19°E	14.32	0.45	38.72	22
NPT_{12}	Nayatola Madhopur, Bakhtiarpur	Bihar	25.59°N	85.61°E	18.00	0.82	34.12	16
NPT_{13}	Rahui, Nalanda	Bihar	25.04°N	85.75°E	15.24	0.14	40.28	10
NPT_{14}	Chandi Mod, Harnaut	Bihar	25.53°N	85.94°E	16.55	0.74	43.88	21
NPT_{15}	Hanuman temple, Sangam	Prayagraj	25.13°N	81.13°E	16.76	0.14	41.52	19
NPT_{16}	Khan Chauraha, Naini	Prayagraj	25.87°N	81.05°E	18.93	0.12	36.52	13
NPT_{17}	GTB Nagar, Kareli	Prayagraj	25.55°N	81.86°E	19.00	1.20	42.55	16
NPT_{18}	Subhash Chauraha, Civil Lines	Prayagraj	25.00°N	81.45°E	20.11	0.424	32.19	23
NPT_{19}	Chadi, Jodhpur	Rajasthan	25.26°N	75.06°E	5.79	0.58	30.90	21
NPT_{20}	Saipau road, Dholpur	Rajasthan	26.15°N	77.98°E	13.65	0.96	28.01	19

Table 2. Phenotypic and genotypic correlation coefficient of morphological and biomass traits of plus tree progenies of *Neolamarckia cadamba* (greenhouse condition)

Trait		Seedling height (cm)	Collar diameter (mm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	Shoot -root ratio	Seedling biomass (g)
Seedling height (cm)	Vp	1.000	0.827**	0.608**	0.701**	0.615**	0.608**	–0.094	0.647**
	Vg	1.000	0.899**	0.704**	0.852**	0.732**	0.749**	–0.564**	0.760**
Collar diameter (mm)	Vp		1.000	0.568**	0.654**	0.582**	0.619**	–0.113	0.632**
	Vg		1.000	0.569**	0.730**	0.593**	0.689**	–0.758**	0.650**
Shoot fresh weight (g)	Vp			1.000	0.813**	0.890**	0.804**	0.042	0.902**
	Vg			1.000	0.880**	0.926**	0.932**	–0.477**	0.953**
Root fresh weight (g)	Vp				1.000	0.737**	0.887**	–0.207	0.844**
	Vg				1.000	0.766**	0.932**	–0.954**	0.858**
Shoot dry weight (g)	Vp					1.000	0.787**	0.190	0.963**
	Vg					1.000	0.894**	–0.060	0.981**
Root dry weight (g)	Vp						1.000	–0.234	0.924**
	Vg						1.000	–0.633**	0.963**
Shoot-root ratio	Vp							1.000	0.016
	Vg							1.000	–0.309**
Seedling biomass (g)	Vp								1.000
	Vg								1.000

Vp: Phenotypic variance; Vg: Genotypic variance; **Correlation significant at 1% LoS

depending on the type of material studied. The knowledge of genotypic interrelationship between characters is also of theoretical interest because genotypic correlation may drive genetic linkage, pleiotropy or from developmentally induced relationships between components that are only indirectly the consequences of gene action.

CONCLUSION

The current study found that there was a strong positive and highly significant phenotypic association between shoot fresh weight, shoot dry weight, root fresh weight, root dry weight and total biomass of *N cadamba* seedlings. These experimental investigations also suggest that several significant qualities for choosing desirable genotypes, such as shoot fresh weight, shoot dry weight, root fresh weight, root dry weight and seedling biomass, may be relevant attributes for genetic improvement of *N cadamba.*

Choosing the finest genotypes with the aforementioned characteristics would enhance the agroforestry system and energy planting in wastelands as well as the economic condition of agricultural communities with marginal holdings. As a result, these characteristics should be prioritized during the selection and breeding of Kadamb tree species in order to achieve the desired results.

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