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Genetic Variability, Heritability and Correlation Studies in Kenaf (*Hibiscus cannabinus* L.)

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Abstract: A study was carried out with 33 Kenaf (*Hibiscus cannabinus* L.) genotypes of diverse origin to obtain information on genetic variability, heritability and correlation between fibre yield and various yield attributes. A substantial variability was observed among the genotypes for all 8 characters studied. The character dry stick weight per plant exhibited the highest phenotypic and genotypic coefficients of variation (20.30, 14.11) followed by dry fibre yield per plant (18.06, 12.05) and green weight per plant (17.25, 11.41). Heritability ranged from 98.36 for days to 50% flowering to 15.97% for node number per plant. High heritability coupled with high genetic advance was observed for days to 50% flowering and green weight per plant suggesting the dominant role of additive gene effects in the expression of these two characters. Correlation studies revealed that fibre yield was positively and significantly correlated with all the characters studied except node number per plant and days to 50% flowering. The character node number per plant was negatively associated with fibre yield. To enhance yield status of kenaf, the characters plant height, base diameter, green weight and stick weight could be used as selection criteria.

Key words: Genetic variability, kenaf, roselle

Introduction

Kenaf, a fast growing, deep rooted, relative to okra and cotton, is one of the important bast fibre crops of the world and is mostly grown over a wide latitudinal range like 16° S to 41° N (Kumar, 1999). It is an environment-friendly natural fibre like jute and has all the potential to be converted into a number of eco-friendly products that the whole world is looking for. Compared to jute, it has some advantages in cultivation. The crop can be grown in the marginal land where jute cannot grow. Moreover, it needs less weeding and less care. Kenaf plants rapidly produce a tremendous amount of biomass, meaning that it has a great potentiality as an alternative source of raw material for making paper. In assessing kenaf as an alternative raw material for pulping, it shows a promising prospect. It makes a bright, high-quality paper that resists yellowing (Banuelos, 2000). Possible new economic uses for kenaf includes feed for livestock, paper-pulp and bean poles. Kenaf twigs and seeds are good feed for milch cattle and its dried stem is used as fuel, fencing, match sticks and climbing sticks of betel leaves and kakrol vegetable field (BJRI, 1993). This has created interest in cultivating kenaf at farmer level and as such the genetic improvement of the crop is needed. But, the genetic improvement of any crop is dependent upon the existence of initial genetic variability among populations. Therefore, knowledge of the initial variability and the degree and direction of correlation amongst yield attributes is necessary while aiming at a rational genetic improvement in economic yield through selection approaches in a population of diverse genotypes. Keeping an eye on such requirements this study was undertaken to measure the genetic variability, heritability and correlation between fibre yield and other yield components in kenaf for some possible information about the effective selection criteria in kenaf breeding.

Materials and Methods

The experiment was conducted with 33 exotic genotypes of Kenaf of different accessions at the field laboratory of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh, Bangladesh. Seeds of these genotypes were taken from the 'Gene Bank' of Bangladesh Jute Research Institute (BJRI), Dhaka and were sown on March 22, 2000 in RCBD. The individual plot size was 3 x 1.2m^2 accommodating 5 rows, spaced 30 cm apart with 6 - 7 cm spacing within rows. Standard cultivation practices were followed. Data were recorded on 10 plants (randomly selected) from 3 middle rows of each plot for 8 quantitative traits of which seven were per plant basis and only one (days to 50% flowering) was on plot average basis. Among the characters studied, days to 50% flowering was observed in field; plant height (m), base diameter (mm), node number per plant, internodal length (cm) and green weight per plant (gm) were recorded in field laboratory after harvesting; dry stick weight per plant (gm) and dry fibre yield per plant (gm) were recorded after retting, extraction and drying by following standard procedure (Kundu, 1959). The coefficients of variation, broad sense heritability, genetic advance and genetic advance as percentage of mean were worked out as suggested by Burton (1952), Hanson *et al.* (1956), Allard (1960) and Comstock and Robinson (1952), respectively. The correlation coefficients were estimated by the method quoted Singh and Chaudhary (1985).

Results and Discussion

Among the genotypes significant differences were observed for all the characters under study except node number per plant. This variation reflects the diverse geographic origin and distribution of the genotypes. Observed variability (phenotypic variance) was partitioned into heritable (genotypic variance) and non- heritable (environmental variance) components (Table 1). A narrow range of difference between phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was recorded for days to 50% flowering (6.76 and 6.71), base diameter (7.60 and 5.22), plant height (7.13 and 4.58) and internodal length (10.21 and 6.33) indicating less environmental influence on the phenotypic expression of these characters and they are mostly governed by genetic factors (Table 2). Hence, selection of desired character simply on the phenotypic value may be effective. On the contrary, a wide difference between PCV and GCV was observed for the remaining characters (Table 2) indicating higher influence of environment on these characters and thus, selection on the phenotypic basis would not be effective for the genetic improvement of such traits. Similar finding were reported by Heliyanto *et al.* (1998) in Kenaf. High heritability values were recorded for all the characters studied except node number per plant (showed moderate heritability). High heritability for the characters days to 50% flowering, plant height, green weight and fibre yield was also reported by Sasmal and Chakraborty (1977) and Dutta *et al.* (1973) in *Hibiscus cannabinus*. High heritability coupled with high genetic advance (GA) for days to 50% flowering and green weight per plant indicating the predominance of additive gene effects on such traits. Manjunatha and Sheriff (1991) also recorded similar findings for days 50% flowering in kenaf. High heritability coupled with moderate GA was observed for dry stick

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Table 1: Mean, range and variances for 8 quantitative characters in Kenaf (*Hibiscus cannabinus* L.)

			Variances		
Characters	Mean	Range	Phenotypic(σ^2_p)	Genotypic(σ^2_g)	Environmental (σ^2_e)
Plant height (m)	2.39	2.07-2.63	0.029	0.012	0.017
Base diameter (mm)	18.51	16.33-20.40	1.977	0.932	1.045
Node No./Plant	75.74	69.67-83.67	30.123	4.811	25.312
Internodal length (cm)	3.16	2.72-3.69	0.104	0.040	0.064
Green wt./plant (gm)	226.15	170.67-288.33	1522.191	665.552	856.639
Dry stick wt./plant (gm)	39.47	26.83-51.83	64.217	31.009	33.208
Days to 50% flowering	204.62	148.00-222	191.599	188.452	3.147
Dry fibre yield / plant (gm)	16.73	12.00-21.17	9.125	4.065	5.060

Table 2: Coefficient of variations, Heritability, Genetic advance and Genetic advance as percentage for yield and seven yield attributes in Kenaf (*Hibiscus cannabinus* L.)

	Coefficient of variation				
Characters	Phenotypic (PCV)	Genotypic (GCV)	Heritability(% h^2)	Genetic advance (GA)	Genetic advance as percentage of mean (%GA)
Plant height (m)	7.13	4.58	41.38	0.15	6.28
Base diameter (mm)	7.60	5.22	47.14	1.37	7.40
Node no./plant	7.25	2.90	15.97	1.81	2.39
Internodal length (cm)	10.21	6.33	38.46	0.26	8.23
Green wt./plant (gm)	17.25	11.41	43.72	35.14	15.54
Dry stick wt./plant (gm)	20.30	14.11	48.29	7.97	20.19
Days to 50% flowering	6.76	6.71	98.36	28.05	13.71
Dry fibre yield / plant (gm)	18.06	12.05	44.55	2.77	16.56

Table 3: Correlation coefficients among eight different yield components in Kenaf (*Hibiscus cannabinus*)

Characters		Base diameter	Node no. /plant	Internodal length	Green wt./ plant	Dry stick wt./plant	Days to 50% flowering	Dry fibre yield/ plant
Plant height	G	0.473**	-0.212	0.593**	0.724**	0.841**	-0.241	0.661**
	P	0.564**	0.476**	0.164	0.764**	0.796**	-0.173	0.675**
Base	G		0.110	0.420*	0.828**	0.725**	0.101	0.838**
diameter	P		0.422*	0.126	0.867**	0.779**	0.047	0.837**
Node no.	G			-0.593**	0.315	0.250	-0.399*	-0.273
/ plant	P			-0.319	0.554**	0.537**	-0.157	0.326
Internodal	G				0.209	0.295	0.304	0.506**
length	P				0.038	0.041	0.194	0.182
Green wt.	G					0.946**	-0.135	0.742**
/ plant	P					0.943**	-0.110	0.827**
Dry stick wt.	G						-0.207	0.776**
/ plant	P						-0.159	0.834**
Days to 50%	G							0.138
flowering	P							0.071

*: Significant at 5% level of probability, ** : Significant at 1% level of probability, G=Genotypic, P=Phenotypic

weight per plant. Similar findings for dry stick weight in kenaf was also observed by Sasmal and Chakraborty (1977) which provides support to these findings.

Selection for yield based on variability studies may not always be effective unless the other yield components influencing it directly or indirectly are taken into consideration. Hence, knowledge regarding association of characters with yield and among themselves provides guideline to the plant breeder for making improvement through selection for yield. In this study genotypic correlation coefficients (r_g), in some cases, were higher than their corresponding phenotypic correlation coefficients (r_p) indicating a strong inherent relationship among these characters. On the other hand, r_g in remaining cases were lower than that of r_p (Table 3) suggesting that the expression of these characters were appreciably enhanced by environmental influence. Similar results in relation to this finding were reported by Shreshtha (1991) in jute. Out of seven auxiliary characters of yield, four viz. plant height, base diameter, green weight and dry stick weight per plant showed positive and highly significant correlation both at genotypic and phenotypic levels. Similar findings were reported by Manjunatha and Sheriff (1991) in kenaf and Aruna *et al.* (1988) in roselle (*Hibiscus sabdariffa* L.). Fibre yield showed high genotypic but low phenotypic correlation with internodal length indicating high association of additive genes controlling the pair of characters, but environmental effects together with epistatic and dominant genes may be created low phenotypic association. The character days to 50% flowering had positive and non-significant genotypic and phenotypic correlations with fibre yield and the character node number per plant had non-significant positive correlation at phenotypic level but non-significant negative correlation at genotypic level which is almost similar to the result of Shreshtha (1991) in jute.

Plant height and base diameter showed significant positive correlation both at genotypic and phenotypic levels with green weight and dry stick weight per plant. Green weight per plant and plant height also showed significant positive correlation at both levels with dry stick weight per plant and base diameter, respectively. Node number per plant showed significant and negative association with internodal length and days to 50% flowering at genotypic level but at phenotypic level it showed positive and significant association with green weight and dry stick weight per plant. Days to 50% flowering showed non-significant negative correlation with most of the characters at both levels. Subramayan *et al.* (1995) observed positive genotypic and phenotypic association of internodal length with other characters except days to 50% flowering which showed negative correlation in kenaf and which contradicts to the present findings. This discrepancy between the findings of this study and their findings could be due to differences in genetic materials and the growing environments used.

Thus, the characters base diameter, plant height, green weight and dry stick weight appeared to be predominant consideration for fibre yield as they exhibited highly significant positive correlation with dry fibre yield and among themselves. Therefore, selection based on these characters may bring out desired improvement towards enhancing the dry fibre yield in kenaf.

References

Allard, R.W., 1960. Principles of Plant Breeding. John Willey and Sons. Inc., New York.

Aruna, C., D. Subramanyan, P.V.R. Kumar and G. Satyanarayan, 1988. Correlation and path analysis in roselle (*Hibiscus sabdariffa* L.). The J. Res., APU., 17: 65-67.

Banuelos, G.S., 2000. Kenaf and Canola-Selenium Slurpers. Agril. Res., June, pp: 10-11.

BJRI, 1993. Annual Report. Bangladesh Jute Research Institute, Dhaka-1207, Bangladesh.

Burton, G.W., 1952. Quantitative inheritance in grasses. Proc. Sixth Int. Grassland Cong., 1: 277-283.

Comstock, R.E. and H.F. Robinson, 1952. Genetic parameters, their estimation and significance. Proc. Sixth Int. Grassland Cong., 1: 284-291.

Dutta, A.N., S.K. Srivastava and R.A. Yadav, 1973. Components of variance for fibre yield in jute-cum-mesta varietal tests. Indian Agric., 17: 257-261.

Hanson, C.H., H.F. Robinson and R.E. Comstock, 1956. Biometrical studies of yield in segregating populations of Korean Lespedza. Agron. J., 48: 268-272.

Heliyanto, B., M. Hossain and S.L. Basak, 1998. Genetic evaluation of several kenaf (*Hibiscus cannabinus*) germplasm through diallel crossing. Indonesian J. Crop. Sci., 13: 15-22.

Kumar, D., 1999. Possibility of commercial utilization of residual heterosis in kenaf (*Hibiscus cannabinus* L.). Indian J. Genet., 59: 227-232.

Kundu, B.C., 1959. Jute in India, Sect.1. Agriculture, Indian Central Jute Committee, Calcutta.

Manjunatha, S. and R.A. Sheriff, 1991. Genetic variability studies in kenaf. J. Maharashtra Agril. Univ., 16: 126-127.

Sasmal, B.C. and K. Chakraborty, 1977. Variability in quantitative character of kenaf. Acta Agronomica Academica Hungarica, 26: 278-282.

Shreshtha, V.S., 1991. Genetic variability, correlation and path analysis studies in jute (*C. capsularis* L.). M.Sc. (Ag.) Thesis. Rajendra Agril. Univ., Bihar, Pusa.

Singh, R.K. and B.D. Chaudhary, 1985. Biometrical Methods in Quantitative Genetic Analysis (rev. edition). Kalyani Publishers, New Delhi, India.

Subramayan, D., P.V.R. Kumar, B. Krishnamurthy and S. Islam, 1995. Heritability and correlation studies in kenaf (*Hibiscus cannabinus* L.). Indian J. Genet. Pl. Breed., 55: 279-282.