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Evaluation of Kenaf (*Hibiscus cannabinus*) genotypes suitable for Paper Industry

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A B S T R A C T

Kenaf is 3-5 times more productive per unit area than pulpwood trees producing pulp with quality equal to or superior to that of many woody species. In this study 77 *Hibiscus cannabinus* germplasm including two checks was evaluate to identify the genotype suitable for paper pulp. The experimental materials were grown in a randomized block design with three replications at the Tamil Nadu Rice Research Institute, Aduthurai for All India Jute & Allied Fibres during 2016. The analysis of variance revealed significant difference among the genotypes for all the three characters. A narrow range of difference between phenotypic coefficient of variation PCV and genotypic coefficient of variation. GCV has recorded for Plant height (9.78 to 7.11), Basal Diameter (22.41 to 19.66) and fibre yield (26.70 to 25.14) indicating less environmental influence on the phenotypic experiment of these characters and they are mostly governed by genetic factors. Hence selection of derived character simply on the phenotypic value may be effective. High h^2 with high GA for basal diameter and fibre yield indicating the predominance of additive gene effects on such traits. This study indicates that basal diameter and fibre yield with high GA should be taken in consideration during selection of higher yield.

Introduction

Hibiscus cannabinus is largely cultivated for its fibre which is extensively employed by the natives in the manufacture of rope, coarse sacking and other articles required for agricultural purposes. It has long been used in trade of cordage products in making twines, ropes, sacs, and fishing nets. World production of Kenaf fibres is estimated at 400000 tons per year, Whereas India being the largest producer. Kenaf is used as a part of interior material of car such as head liners and automobile dash boards. It would be a natural substitute for fibre glass in future. It serves as material for carpet padding and corrugated medium and fire resistant differential density. It is also used in synthetic fibres molded plastics. PLA-based (Polylactic acid) materials are a new class of materials that in recent years have aroused an ever growing interest due to the continuously increasing environmental awareness throughout the world.

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 resist yellowing (Banuelos, 2000). Kenaf is attracting a considerable interest of the paper industry as a source of good quality cellulose fibres. Being an annual herbaceous plant, it is fast growing and high yielding and pulp is easily obtained. Kenaf can be used as an alternative raw material for pulp due to its excellent advantages of being renewable, inexpensive and growing ability under severe conditions such as low water supply and little fertilizer. Kenaf is 3-5 times more productive per unit area than pulpwood trees producing pulp with quality equal to or superior to that of many woody species. Several studies have identified Kenaf to be an interesting substitute for woody species utilized for paper pulp production have tried to improve the surface property of hand sheets prepared from the Kenaf material, and noticed that a bio-polymer of chitosan has ability to form films that improve the surface properties of paper when it is applied to the surface of the sheet and for preparation of net to trap the animals.

India is using mesta for paper pulp. The cultivation of mesta crop for paper pulp is done almost in the same manner as it is done for fibre purpose. However, the main emphasis is given on the thick and tall plants. The thick plants produce more pulp. In this study kenaf germplasm is evaluate to identify the genotype suitable for paper pulp.

Materials and Methods

The material for the present study comprised of 77 *Hibiscus cannabinus* genotypes including two check varieties. The experimental materials were grown in a randomized block design with three replications at the Tamil Nadu Rice Research Institute, Aduthurai for All India Jute &Allied Fibres during 2016. Row to row and plant to plant distances were 40 cm and 7 cm, respectively. Standard package of practices were followed to raise the crop. Net plots were harvested at 120 days after sowing. Data were recorded for three characters viz. plant height, Basal diameter (mm), fibre yield. Plant height was recorded as total plant height from base to top including all flowering nodes at harvesting stage. The stem diameter was measured at mid point between base to top at harvesting stage. Fibre yield was observed after harvesting, retting and drying of fibre. Observations were recorded on 10 randomly selected plants in each of three replications at specified stages of crop growth period when the characters under study had full expression.

Results and Discussion

The analysis of variance revealed significant difference among the genotypes for all the three characters studied (Table 1) suggesting presence of wide variability in the studied germplasm which was also depicted by the range values of all the three traits (Table 2). The plant height ranged from 211.25to 311.25cm; Average basal diameter of the accessions ranged from 0.93 to 2.28 cm and fibre yield per plant ranged from 4.6 to 14.75 g. These concurrent results have depicted that large amount of variability are present in the germplasm under study.

Genetic Variability Analysis

In general, phenotypic variances were higher than the corresponding genotypic variances for all the characters under study (Table 3). The phenotypic variance was the highest for plant height (9.78) followed by total biomass (41.72) and leaf yield (12.85).

A narrow range of difference between

phenotypic coefficient of variation PCV and genotypic coefficient of variation GCV has recorded for Plant height(9.78 to 7.11), Basal Diameter (22.41 to 19.66) and fibre yield (26.70 to 25.14) indicating less environmental influence on the phenotypic experiment of these characters and they are mostly governed by genetic factors. Hence selection of derived character simply on the phenotypic value may be effective.

Further, the estimates of PCV were generally higher than their corresponding GCV for plant height and basal diameter suggesting thereby the important role of environment in the expression of these traits. Hence, phenotypic selection may not hold good for genetic improvement in these traits. These findings are in agreement with Dastidar *et al.*, (1993), Islam *et al.*, (2002), Palve *et al.*, (2003), Echekwu and Showemino (2004), Ibrahim and Hussein (2006), Ghodke and Wadikar (2011); Nwangburuka *et al.*, (2012) and Ibrahim *et al.*, (2013).

High h^2 with high GA for basal diameter and fibre yield indicating the predominance of additive gene effects on such traits. This study indicates that basal diameter and fibre yield with high GA should be taken in consideration during selection of higher yield. These findings were correlated with the results of Nwangburuka *et al.*, (2012) and Ibrahim *et al.*, (2013). High heritability coupled with high genetic advance as percent of mean for plant height, pods plant-1 and seed yield plant-1 indicates the operation of additive genes and offer the best possibility for improvement of this trait through mass selection, progeny selection, family selection to any other suitable modified selection procedure aiming to exploit the additive gene effects (Bhakuni Vandana *et al.*, 2017).

Table.1 Analysis of variance for three characters in kenaf (*Hibiscus cannabinus) germplasm*

Source of variation	df	Plant height (cm)	Basal diameter (mm)	Fibre yield (g/plot)
		Mean sum of square		
Replication	1	1131.858	0.264	3.897
Genotype	76	1076.881**	0.193**	9.848**
Error	76	331.842	0.025	0.590

Table.2 Mean performance of kenaf (*Hibiscus cannabinus)* germplasm

Sl.no	Accession no.	Plant height (cm)	Basal Diameter (cm)	Fibre weight g/plt
1	KIN-036	275.00	2.05	14.75
2	KIN-037	288.75	1.95	13.65
3	KIN-038	275.00	1.64	9.00
4	KIN-039	273.75	1.61	9.25
5	KIN-040	278.75	1.36	6.75
6	KIN-041	281.25	1.86	8.25
7	KIN-042	265.00	1.64	8.05
8	KIN-043	298.75	1.56	8.55
9	KIN-044	291.25	0.93	6.45

10	KIN-045	278.75	0.98	6.00
11	KIN-046	290.00	1.00	6.70
12	KIN-047	311.25	1.16	6.75
13	KIN-048	296.25	0.96	6.45
14	KIN-049	283.75	1.05	9.75
15	KIN-050	294.25	1.57	12.65
16	KIN-052	263.75	1.05	10.80
17	KIN-056	248.75	0.98	12.10
18	KIN-058	285.00	1.39	9.75
19	KIN-060	277.50	0.94	10.55
20	KIN-061	287.50	1.55	13.70
21	KIN-064	273.75	1.25	9.55
22	KIN-065	298.75	0.99	7.25
23	KIN-066	287.50	1.08	13.35
24	KIN-067	303.75	1.34	7.10
25	KIN-068	238.75	1.25	8.70
26	KIN-069	273.75	1.15	9.65
27	KIN-070	247.50	1.20	6.60
28	KIN-072	302.50	1.32	6.70
29	KIN-073	276.25	1.46	7.75
30	KIN-075	285.00	1.15	7.40
31	KIN-076	261.25	1.10	8.90
32	KIN-077	280.00	1.16	10.85
33	KIN-079	217.50	1.00	7.05
34	KIN-080	230.25	1.15	6.95
35	KIN-081	283.75	1.69	9.65
36	KIN-082	291.25	1.49	9.45
37	KIN-083	280.00	1.57	11.95
38	KIN-084	248.00	1.63	7.20
39	KIN-085	246.75	1.60	8.35
40	KIN-086	242.50	1.68	7.65
41	KIN-089	231.25	1.38	7.20
42	KIN-091	261.25	1.39	8.40
43	KIN-095	257.50	1.23	7.05
44	KIN-099	221.25	1.40	7.70
45	KIN-123	285.00	1.50	5.25
46	KIN-124	266.25	1.59	8.25
47	KIN-125	275.00	1.35	8.05
48	KIN-146	288.75	1.68	8.65
49	KIN-127	264.25	1.49	9.20

50	KIN-141	304.00	1.92	6.70
51	KIN-143	264.75	1.71	9.05
52	KIN-144	253.75	1.68	9.15
53	KIN-145	283.75	1.60	6.70
54	KIN-146	238.25	1.68	7.00
55	KIN-147	211.25	1.86	12.70
56	KIN-148	246.50	1.78	5.30
57	KIN-149	217.50	1.80	6.60
58	KIN-151	267.50	1.79	7.55
59	KIN-154	237.50	1.50	5.20
60	KIN-156	271.25	1.38	7.60
61	KIN-158	265.00	1.46	9.10
62	KIN-168	240.50	1.38	10.60
63	KIN-159	257.50	1.51	10.05
64	KIN-170	257.50	1.76	7.60
65	KIN-171	283.75	2.01	7.25
65	KIN-175	249.75	1.32	6.80
67	KIN-176	265.25	1.80	9.75
68	KIN-177	285.00	1.47	5.70
69	KIN-178	296.25	1.96	7.10
70	KIN-179	268.75	1.67	6.10
71	KIN-207	284.00	1.68	9.15
72	KIN-214	296.25	1.50	7.40
73	KIN-220	303.75	2.05	7.60
74	KIN-221	292.50	1.43	9.10
75	KIN-231	277.50	1.31	4.60
76	HC 583+	297.50	1.90	11.55
77	AMC 108+	300.50	2.28	13.15
	Mean	**271.18**	**1.47**	**8.54**
	C.V.	6.72	10.76	9.00
	F ratio	3.25	7.68	16.62
	F Prob.	0.00	0.00	0.00
	S.E.	12.88	0.11	0.54
	C.D. 5%	36.28	0.32	1.53

Table.3 Genetic variability parameters in roselle (*Hibiscus cannabinus* L.) for seed yield and its contributing characters

Character	Mean	Range	GCV (%)	PCV (%)	h(%)	GA	GAM
Plant height (cm)	271.17	211.25-311.25	7.11	9.78	52.9	10.66	13.66
Basal diameter (mm)	1.474	0.93-2.28	19.66	22.41	77.0	35.54	45.54
Fiber yiels (g/plot)	8.543	4.6-14.75	25.14	26.70	88.6	45.54	62.49

PCV=Phenotypic Coefficient of Variation, GCV= Genotypic Coefficient of Variation, GA= Genetic advance and GAM=Genetic advance as per cent mean

In conclusion, the analysis of variance showed significant differences among seventy seven germplasm of Kenaf for all characters studied indicating wider variability and high diversity among genotypes. The genotypic coefficient of variation for all characters studied was higher than the phenotypic coefficient of variation indicating less environmental influence on the phenotypic experiment of these characters and they are mostly governed by genetic factors. High h^2 with high GA for basal diameter and fibre yield indicating the predominance of additive gene effects on such traits indicates the operation of additive gene action in the inheritance of these traits and improvement in these characters is possible through simple selection

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