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STABILITY ANALYSES OF FIBRES YIELD OF KENAF USING MULTIPLE BIOMETRICAL MODELS

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ABSTRACT. Multiple models have been used to examine stability in many crops, but little of such exits for kenaf. Relationship of stability estimates of various models reveals the importance of one or more estimates for reliable predictions of cultivar behaviour and stability. This study evaluated 33 kenaf genotypes across six location for core and bast fibre yield stability using four models. Kenaf were grown in a four row plot, 5 m each, at 0.2 m within row and 0.5 m between rows in the trial laid out in randomized complete block design with three replications. Twenty plants were randomly harvested per plot at 12 weeks after planting and processed to fibres. Dry core fibre weight (CFW) and bast fibre weight (BFW) were taken. Data collected were pooled across locations and subjected to analysis of variance. Genotypes stability were estimated using Finlay-Wilkinson, Wricke's ecovalence (*Wi*), Kang's rank sum and superiority index models. Correlations among the weights and stability models were performed. Significant differences existed in the genotypes (G) ($p < 0.01$), environments (E) and G×E for CFW and BFW. Partitioning the G×E showed that genotypes linear response and deviation from the mean were significant for CFW and BFW. Significant and positive correlation existed between Finlay-Wilkinson and Kang's rank sum (0.570^{***}), *Wi* (0.615^{***}) and superiority index (0.582^{***}) for CFW. Significant correlations also existed between the efficacy of Kang's rank sum and *Wi* (0.569^{***}), and with superiority index (0.779^{***}). Kang's rank sum correlated with Finlay-Wilkinson (0.345^{**}), while *Wi* model had correlation with Finlay-Wilkinson (0.538^{**}) and Kang's rank sum (0.318^{**}) for the BFW. All the models correlated with one another. Any of the models is sufficient to select stable genotypes in kenaf fibre yield breeding programmes.

Keywords: kenaf; bast fibres; core fibres; genotype × environment; parametric stability.

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INTRODUCTION

The effects of genotypes and the locations are non-additive, thus differences in the yield of a genotype will depend on the location (Yue *et al.*, 1997). Then, the choice of genotypes based on the mean yield in one location will be less efficient (Hopkins *et al.*, 1995). Genotype by environment interactions (G×E) report the differential performance of genotypes across environments (Hallauer *et al.*, 1988) and are important to the plant breeder in developing improved varieties. Varietal performances differ when compared over a series of environments due to the G×E interactions effects. The interaction limits efficiency of breeding programmes, thus there is difficulty in demonstrating the superiority of a variety over the remaining. Large G×E effect has been reported to undermine progress in selection of promising varieties in multi environment trials (METs) (Comstock & Moll, 1963), thereby affecting the recommendations of genotypes for specific environments or locations.

Several techniques have been developed to study the G×E with the prime aim of measuring performance of different genotypes across environments or locations in many crops (Wricke, 1962; Finlay & Wilkinson, 1963; Eberhart & Russell 1966; Perkins & Jinks, 1968; Freeman & Perkins, 1971; Shukla, 1972; Francis & Kannenberg, 1978; Lin *et al.*, 1986; Becker & Leon, 1988; Lin & Binns, 1988). Despite this, very little had been done on the analysis of G×E for kenaf. The techniques that concurrently consider yield and stability components are recommended for identifying the high yielding and stable genotypes (Kang, 1993). They are useful in identification of adaptable genotypes, and to achieve steady performance of crop over divergent environments. The models are also useful in developing phenotypically stable varieties and for effective selection for stability of performance, as well as prediction of responses of crop varieties under changing environments.

According to Huehn (1996), G×E interactions examination and determination of the adaptation of genotypes may be accomplished by using the numerous parametric or non-parametric approaches. Despite the large number of statistical models proposed for measuring the performance stability across environments, none of them can adequately capture the performance of a genotype across environments. None of them is superior to another, because each of them has its limitations and principles. Parametric analyses are based on statistical assumptions on the distribution of genotypic, environmental and G×E interactions effects, while non-parametric (analytical clustering) do not involve specific modelling assumptions, when relating environments and phenotypes with respect to biotic and abiotic factors. Though parametric techniques are more commonly used, non-parametric procedures are easier to use and interpret. Besides, no assumptions are needed regarding the distribution of the data. Nonparametric techniques cause little variation in the results due to removal or addition of genotypes and outlier bias is reduced (Huehn, 1990).

Efficiency of each of the models varied with the procedures and are used differently for different conditions or situations. For instance, coefficient of variability (Francis & Kannenburg, 1978) is used for studying each genotype and the genotypic variances across environments, while regression coefficient (Finlay & Wilkinson, 1963) compares genotypes × environments with mean response of all genotypes in a trial. Eberhart & Russell (1966) and Perkins & Jinks (1968) are commonly used to describe stability, considering residual mean square from the regression model on the environmental index. Parametric models based on simple linear regression analysis are widely used to identify superior cultivars, but the mean of all the cultivars in each environment is taken as a measure of the environmental index and is used as an independent variable in the regression (Becker & Léon, 1988; Crossa, 1990). However, stability estimates from nonparametric models based on the relative classification of the cultivars in a set of environments are good alternatives for parametric measurements for their limitations (Nassar & Hühn, 1987).

Wricke's ecovalence (*Wi*) (Wricke, 1962) evaluates stability based on the contribution of each genotype to the total G×E sum of squares. On this assumption, stable genotypes are those that have low *Wi* values, representing smaller deviations from the mean across environments. This indicates a genotype with zero Wricke's ecovalence is regarded as stable (Becker & Léon, 1988). On the other hand, Kang's rank-sum (*rs*) (Kang, 1988) model concurrently considers yield and Shukla's stability variance as the selection criteria, and assigns a weight of one to both yield and stability. It identifies high-yielding and stable genotypes simultaneously. Both the highest yielding genotype and the genotype with the lowest stability variance are ranked one and *vice versa*. The ranks by yield and by stability variance are added for each genotype and the genotype with the lowest rank sum value is considered the most desirable. Superiority index (Lin & Binns, 1988) is used to assess the superiority of a genotype relative to those with maximum performance in each environment. It quantifies the genetic deviation and the G×E interaction. Superior genotype are those with the lowest value. The genotype remains among the most productive in a given multi-environments (Muller, 1976).

Understanding the yield components stability is essential in planning and prediction in crop improvement programmes. Multiple models have been used for examining stability in many crops (Scapim *et al*., 2000; Moremoholo & Shimelis, 2009; Sahin *et al*. 2012; Kaya & Ozer 2014), but not for kenaf. The level of association among the stability estimates of different models has been reported to show whether one or more estimates should be obtained for reliable predictions of cultivar behaviour. It also helps the breeder to choose the best adjusted and most informative stability parameter(s) to fit his concept of stability (Duarte & Zimmermann, 1995). Therefore, this trial was carried out evaluate 33 kenaf genotypes for stability of core and bast fibre yield, using four stability models across six environments representing different agro ecologies in Nigeria.

MATERIALS AND METHODS

A number of 33 genotypes of kenaf were evaluated in a varietal trial in six different locations in Nigeria, in 2016. Amount of rainfall and mean minimum and maximum temperatures of the various locations during the trial were shown in *Fig. 1*. Seeds of each genotype were planted in a four row plot, 5 m each, at a spacing of 20 cm within row and 0.5 m between rows in the field. The trial was laid out in randomized complete block design with three replications. Four seeds were sowed per hill and thinned to two per stand to adjust the population density to 80,000 plants ha^{-1} at three weeks after planting. About 60 kg ha^{-1} NPK fertilizer was applied at four weeks after planting. The plots were kept weed free throughout the trial using hoeing method.

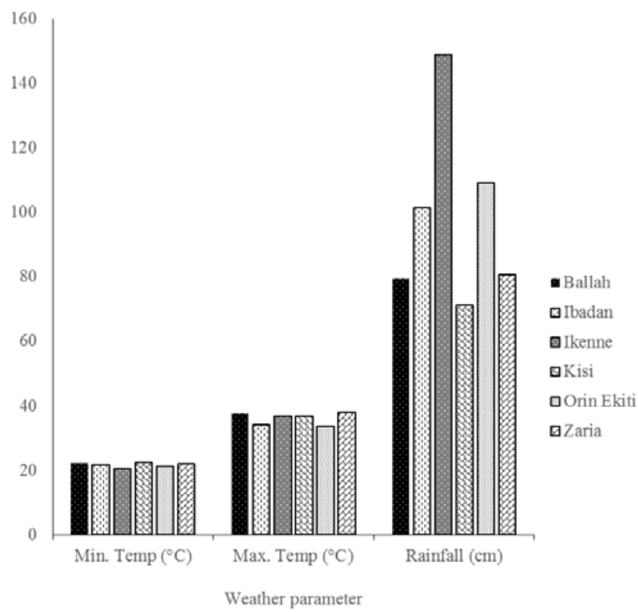

Figure 1 - Mean temperature and amount of rainfall of the location in 2016

A sum of 20 plants were randomly selected from each plot and cut at the base at 12 weeks after planting for retting. The freshly cut kenaf were bundled and tagged by plot before soaking in a running river, where they were allowed to float for two weeks. The soaked kenaf were prevented from being washed away by placing heavy weights on them in the river. Kenaf fibre yields consist of two components, namely core and bast fibres. The core fibre is obtained as the inner stick (pith) of the stem after the bark has been removed. Fibre from the bark that is removed is the bast. The kenaf bundles were removed from the river and bast fibres were stripped from core manually at the end of the soaking period. Both the core and bark of the plants were washed in clean water to ensure good fibre quality. The fibre was dried by direct sunshine for 5 days. Fibre dryness was taken by hand feeling. The dried core and bast fibres were weighed using sensitive scale. Data collected were pooled across locations and subjected to ANOVA using SAS (2009) (SAS Institute, Inc., Cary, NC). Stability of the genotypes were estimated and ranked using Finlay-Wilkinson (Finlay & Wilkinson, 1963), Wricke's ecovalence (*Wi*) (Wricke, 1962), Kang's rank sum (Kang, 1988) and superiority index (Lin & Binns, 1988) models. Spearman's rank correlations among the main yield and stability statistics were also performed.

Wricke's ecovalence (*Wi*) estimates were obtained using:

$$Wi = \sum (Yij - yy. - y.j + \mu)2,$$

where, W_i = ecovalence of the *i*th genotype, Y_{ij} = the observed phenotypic value of the *i*th cultivar in the *j*th environment, *yy.* = mean of *i*th cultivar across the entire environment, *y.j* = mean of *j*th environment and µ = grand mean.

Superiority index (P*i*) of Lin & Binns (1988) was estimated as:

$$P_i = \sum_{j=1}^{n} \frac{(Xij - Mj)^2}{2n},$$

where, P*i* = superiority index of the *i*th cultivar, X*ij* = yield of the *i*th cultivar in the *j*th environment, M*j* = maximum response obtained among all the cultivars in the *j*th environment, and *n* = number of locations.

RESULTS

Combined analysis of variance for core and bast fibre yields across locations

There were significant differences in the genotypes (G) ($p< 0.01$) for both the core fibre weight (CFW) and bast fibre weight (BFW) (*Table 1*).

Significant variations also existed due to environments (E) and G×E for the two fibre components. Partitioning the G×E showed that linear response to the environment was highly significant for both CFW and BFW, while deviation from the mean was significant ($p< 0.05$) for the two yield parameters. Coefficients of variation were about 20.1% for CFW and 18.7% for BFW. Moreover, coefficients of determination was high (about 0.9) and similar for the two yield parameters.

Table 1 - Combined analysis of variance for fibre yield of kenaf genotypes grown in six environments in 2016

Sources of variation	df	Mean square	
		Core fibre weight	Bast fibre weight
Genotypes	32	381.81**	69.62**
Environments	5	33722.27***	4190.87***
Genotype × Environment (G × E)	160	338.05***	49.38***
G × E (linear)	32	530.68**	56.97**
G × E (deviation)	128	289.90**	47.48**
Pooled error	384	44.00	6.00
CV (%)		20.05	18.73
R^2		0.93	0.92

Table 2 - Core fibre mean yield and estimates and rank of stability parameters of kenaf genotypes evaluated across six locations in 2016

Genotype	Mean yield (g/plant)		Finlay-Wilkinson		Kang's rank sum		Wricke's ecovalence (W_i)		Superiority index (P_i)	
	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank
G1	28.01	33	1.04±0.20	19	6	15	60.89	31	411.31	15
G2	31.09	28	1.11±0.23	21	23	29	66.81	33	126.90	6
G3	30.14	31	1.29±0.17	31	4	12	39.17	25	69.18	3
G4	34.84	11	1.24±0.20	28	13	20	6.43	2	196.37	11
G5	38.89	1	1.22±0.35	27	-10	1	26.59	18	124.11	5
G6	34.30	16	0.94±0.27	13	18	24	10.97	6	49.79	2
G7	32.17	24	0.90±0.08	11	-1	8	27.94	20	35.73	1
G8	32.15	25	0.79±0.17	7	-7	3	10.93	5	127.09	7
G9	33.47	20	1.18±0.19	23	1	10	47.71	29	243.97	12
G10	30.71	29	1.10±0.26	20	5	14	16.43	12	182.88	10
G11	33.03	21	1.29±0.10	30	15	22	29.29	21	182.53	9
G12	33.83	19	1.21±0.26	25	2	11	19.68	15	167.07	8
G13	34.70	13	0.45±0.14	3	7	16	65.68	32	361.45	13
G14	35.51	6	1.19±0.09	24	-6	4	36.66	23	457.48	18
G15	38.32	3	1.03±0.07	17	-9	2	44.27	28	104.49	4
G16	33.92	18	0.83±0.23	8	17	23	15.74	10	390.52	14
G17	31.74	26	0.78±0.30	6	20	26	5.17	1	433.99	17
G18	35.22	9	0.98±0.17	16	14	21	25.79	17	654.70	22
G19	30.65	30	0.83±0.35	9	25	31	14.46	9	1164.09	32
G20	29.57	32	0.87±0.31	10	-2	7	18.41	13	736.81	26
G21	31.68	27	0.15±0.43	1	-4	6	7.03	3	412.40	16
G22	35.43	7	0.97±0.15	15	12	19	23.73	16	710.56	24
G23	36.89	5	0.97±0.10	14	19	25	12.52	7	941.93	27
G24	38.45	2	1.81±.018	33	9	18	36.66	24	595.03	20
G25	37.15	4	0.76±0.23	5	21	27	12.77	8	971.39	28
G26	34.39	15	1.53±0.17	32	24	30	7.69	4	1085.50	31
G27	35.33	8	1.22±0.22	26	4	12	19.25	14	731.77	25
G28	32.22	23	0.51±.014	4	22	28	29.75	22	1015.15	29

Genotype	Mean yield (g/plant)		Finlay-Wilkinson		Kang's rank sum		Wricke's ecovalence (W_i)		Superiority index (P_i)	
	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank
G29	32.49	22	1.03±0.19	18	28	33	42.55	27	1197.41	33
G30	34.09	17	0.42±0.24	2	27	32	39.18	26	1024.42	30
G31	35.05	10	1.27±0.15	29	-5	5	26.68	19	517.27	19
G32	34.72	12	1.16±0.37	22	8	17	16.25	11	650.77	21
G33	34.44	14	0.93±0.41	12	0	9	54.11	30	703.91	23

Table 3 - Bast fibre mean yield and estimates and rank of stability parameters of kenaf genotypes evaluated across six locations in 2016

Genotype	Mean yield (g/plant)		Finlay-Wilkinson		Kang's rank sum		Wricke's ecovalence (W_i)		Superiority index (P_i)	
	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank	Estimate	Rank
G1	12.15	32	0.90±0.12	11	4	13	7.03	8	80.13	17
G2	12.29	30	0.88±0.25	10	13	20	13.17	25	14.17	4
G3	13.40	19	1.28±0.09	26	-6	4	11.00	22	1.14	1
G4	14.10	10	1.29±0.28	27	8	17	9.59	16	6.82	2
G5	13.96	13	1.03±0.54	17	-4	6	9.12	13	21.50	6
G6	13.79	16	1.34±0.29	30	17	24	10.97	21	42.23	11
G7	14.04	11	0.86±0.13	9	3	11	5.22	3	25.02	7
G8	13.14	21	0.78±0.16	8	-7	3	6.58	7	17.23	5
G9	12.94	24	1.25±0.27	25	5	14	5.96	5	41.80	10
G10	14.38	7	1.08±0.14	22	3	11	3.64	1	26.61	8
G11	12.21	31	0.91±0.08	12	6	15	5.51	4	34.43	9
G12	12.61	28	1.32±0.16	29	-2	7	8.11	11	12.30	3
G13	11.90	33	0.50±0.26	3	16	23	15.90	31	73.65	16
G14	12.96	23	1.06±0.22	20	-5	5	9.50	15	48.22	12
G15	14.50	6	1.09±0.13	23	-9	1	11.47	23	50.21	13
G16	15.94	3	0.97±0.30	16	7	16	7.62	9	57.72	14
G17	15.26	5	0.67±0.26	4	18	25	9.71	17	128.76	25
G18	16.39	1	0.75±0.16	7	20	26	15.02	29	133.34	26
G19	15.79	4	0.67±0.25	5	26	31	7.73	10	161.71	28
G20	16.02	2	0.94±0.36	14	0	9	10.39	19	70.17	15
G21	14.14	9	0.42±0.52	2	9	18	9.34	14	84.47	18
G22	14.16	8	0.96±0.18	15	23	29	10.23	18	165.15	30
G23	12.83	27	0.93±0.08	13	15	21	8.28	12	124.17	24
G24	13.73	17	1.57±0.17	32	10	19	10.73	20	97.62	21
G25	13.92	14	1.05±0.52	19	21	27	6.29	6	146.55	27
G26	13.50	18	1.59±0.11	33	24	30	4.64	2	173.52	31
G27	13.10	22	1.03±0.22	18	-8	2	14.70	28	84.94	19
G28	12.94	25	0.75±0.32	6	22	28	14.58	27	161.79	29
G29	13.82	15	1.30±0.32	28	27	32	16.30	32	193.96	32
G30	13.97	12	0.32±0.27	1	28	33	15.52	30	219.36	33
G31	13.25	20	1.09±0.25	24	-2	7	13.54	26	85.54	20
G32	12.89	26	1.35±0.33	31	15	21	11.89	24	109.64	22
G33	12.53	29	1.07±0.21	21	2	10	16.96	33	113.15	23

Core fibre yield stability ranks of the kenaf genotypes

Genotypes 5, 24 and 15 were ranked among the highest CF yielding, while G1, G20 and G3 were ranked least yielding (*Table 2*). Each of the highest yielding genotypes had CFW greater than 38 g/plant, while each of the three least yielding had below 30 g/plant CF. The different statistics models ranked the genotypes variously, with respect to stability in CFW. Finlay-Wilkinson model ranked G21, G30 and G13 as the three most stable genotypes, and G3, G26 and G24 as the three most unstable. The G5, G15 and G8 were among the genotypes ranked most stable by Kang's rank sum, which ranked G29, G30 and G19 as the three most unstable, with respect to the trait. Wricke's ecovalence model suggested G17, G4 and G21 as among the most stable and G2, G13 and G1 among the least stable. Superiority index model ranked G7, G6 and G3 as most stable, while G26, G19 and G29 were among the most unstable genotypes according to superiority index model.

For BFW, mean weight of G18, G20, G16, G19 and G17 were among the highest with each of them having greater than 15 g/plant, while G13, G1 and G11 had the least (*Table 3*). Finlay-Wilkinson model selected G30, G21 and G13 as among the most stable genotypes for BFW, while G26, G24 and G32 were detected among the most unstable. According to Kang's rank sum model, G15, G27 and G18 were ranked the best three in stability of the BFW, while G30, G29 and G19 were among the least. Wricke's ecovalence model listed G10, G26 and G7 as top three of the most stable genotypes, while G33, G29 and G13 were three least stable. Genotypes 3, 4 and 12 were prominent among most stable, while G30, G29 and G26 were least stable based on superiority model index.

Positive and significant correlations existed among the usefulness of stability models employed in this study (*Table 4*). There was no significant correlations between the mean yield and any of the stability models for both fibre types. Highly significant and positive correlation existed between Finlay-Wilkinson and Kang's rank sum (0.570^{***}), Wricke's ecovalence (0.615^{***}) and superiority index (0.582^{***}) for CFW. Significant correlations also existed between the efficacy of Kang's rank sum and Wricke's ecovalence (0.569^{***}), as well as with superiority index (0.779^{***}). Wricke's ecovalence model had positive and significant correlation with superiority index model for the CFW. Positive and significant correlations also existed among the models for BFW. Kang's rank sum correlated with Finlay-Wilkinson (0.345^{**}), while Wricke's ecovalence model had correlation with Finlay-Wilkinson (0.538^{**}) and Kang's rank sum (0.318^{**}) for the BFW. Moreover, superiority index model had significant correlations with Finlay-Wilkinson (0.575^{**}), Kang's rank sum (0.665^{**}) and Wricke's ecovalence (0.742^{***}).

Table 4 - Spearman's rank correlation coefficients among the stability statistics used for core (above diagonal) and bast (below diagonal) fibres

	Mean yield (g/plant)	Finlay-Wilkinson	Kang's rank sum	Wricke's ecovalence (W_i)	Superiority index (P_i)
Mean yield		-0.249	0.129	0.009	-0.121
Finlay-Wilkinson	0.124		0.570***	0.615***	0.582***
Kang's rank sum	-0.159	0.345**		0.569***	0.799***
Wricke's ecovalence (W_i)	0.101	0.538***	0.318**		0.578***
Superiority index	-0.174	0.575***	0.665***	0.742***	

** and *** mean significant at 1% and 0.1% probability, respectively.

DISCUSSION

High significant variations observed for environment and G×E for both CFW and BFW indicate large variability in the yield components of the crop among environments and that the genotypes actively interacted with the environments. The weather conditions of each location, especially the amount of rainfall, which varied considerably during the trial, provided an effective model on which the genotypes could be tested. This suggests that environment had significant influence of the yield traits, therefore selection may be difficult unless the G×E is analyzed. Therefore, assessment of response of the cultivars to environmental variation and analysis of stability parameters are imperative. The presence of large significant deviation, representing 68.6% and 76.9% of the G×E sum of squares for CFW and BFW, respectively, shows that yield response of the genotypes to environment is largely unpredictable. Both significant linear and nonlinear interaction components have been observed for many crops. For instance, Singh *et al*. (1995) observed this result in soybean and Dewdar (2013) for cotton. Low CVs and very high coefficients of determination for the two yield parameters are indicative of uniformity in experimentation.

High productive and most stable genotypes are desirable in plant breeding programmes, therefore genotypes that combined the two characters would be mostly preferred. Ranking of the stability of the genotypes for CF yield performance differed with models. This explains the differences in the principles and procedures guiding functionality of each model to effectively classify the genotype as stable or unstable. Conflict in the ranks of the genotypes for stability of CFW had been reported for other crops (Lin *et al*., 1986; Adewale *et al*., 2010).

However, rankings by few of the models employed in this study were similar. This implies those models that gave similar results may be used in place of one another. Since the models were based on different principles and only few similar results were obtained, it could be deduced that performances of those genotypes, which stability were suggested by multiple models, were more reliable. For instance, G8 was ranked within the first most stable seven genotypes in CFW by the four stability models employed in this study. On the other hand, G21, which was ranked among the six most stable genotypes by Finlay-Wilkinson, Kang's rank sum and Wricke's ecovalence model, was listed as fairly stable (16th) by superiority index model. Similarly, G6 and G7 were ranked very stable by superiority index model, but less stable by other models. There may be some exceptions to this results where a genotype was ranked almost similarly. In such situations, genotypes that are classified in a group by more than one models may strictly belong to such group. The G29 had comparatively high CFW, all the four models ranked it unstable. This result is in line with the reports of Kaya & Ozer (2014), that stability often associate with a relatively low yield in environments.

The results of this study has also shown that yield of the kenaf genotype fluctuates with changes in locations. Similar results of variation in the ranking ability of the models for CFW were obtained for BFW. Though G13 was among the lowest BF yielding, it was identified as among the most stable genotypes by Finlay-Wilkinson model, while Wricke's ecovalence suggested the genotype as one of the least stable for BFW. Conversely, Kang's rank sum and superiority index models placed the genotype (G13), as averagely (16th most) stable. Similarly, G5 was second most stable by superiority index model, but no other model ranked the genotype within the first 15 genotypes with respect to BFW. Genotype 30 was ranked highly stable by Finlay-Wilkinson model, while Kang's rank sum, Wricke's ecovalence and superiority index models ranked highly unstable. For this reason, there may be a relationship among the three models that listed the genotypes unstable. All the models suggested G29 as unstable in both CF and BF production. Though disagreement among the efficacy of the model in selection of stable genotypes also occurred for the BFW, it can be deduced that certain models may be related in their efficacy.

All the models used for the stability analysis correlated with one another, but not with the mean yield of the crop. Consequently, any of the models would be sufficient to select the stable genotypes in a kenaf breeding for fibre yield programme. Information on the associations of selection procedures of stability models with crop yield were not consistent. It was found in this study that mean yields of both fibre types did not correlate with any of the stability models. Akcura & Kaya (2008) in their analysis of stability of wheat genotypes using several models found that the yield did not correlate with Kang's rank sum among others. Dewdar (2013) also reported that yield stability and high mean yield of cultivars of cotton are not mutually exclusive. On the contrary, Sahin *et al*. (2012) found positive association of the mean yield with Wricke's ecovalence model and negative correlation with superiority index model in seed yield of orchard grass. Similarly, Kaya & Ozer (2014) reported significant correlations of mean yield of triticale with superiority index model, but non-significant correlation with Wricke's ecovalence model. There is also incongruity in the relationship among yield stability models. This study showed correlations among the stability models, but Fikere *et al.* (2014) found no significant correlation among superiority index, Finlay-Wilkinson and Wricke's ecovalence models in stability studies on field peas. However, Bujak *et al.* (2014) found significant correlation between Wricke's ecovalence and Kang's rank sum models, used for stability studies on maize.

CONCLUSION

Genotypes 8 and 13 are prominent among the most stable genotypes for core and bast fibre, respectively. Genotype 29 is high yielding for CF and BF production, but unstable, hence it suggested for improvement for stability. Both yield and stability should be considered for selection of kenaf for fibre yield because no relationship exist between yield and stability models. Any of the four models considered can be used to select the stable genotypes in a kenaf breeding for fibre yield programme.

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