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Assessment of Seedling Vigour Characteristics in Kenaf (*Hibiscus Cannabinus* L) Genotypes

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ABSTRACT

Knowledge of extent of variation in seed quality characteristics is necessary to identify genotypes with superior seed quality performance. Information on seedling vigour traits in kenaf genotypes grown in Nigeria is limited. The study was conducted to determine the extent of variation in seedling vigour traits among 21 kenaf genotypes grown in Nigeria and to determine the relationship among some of the vigour traits. The seedling vigour traits assessment was conducted in the laboratory and the screen house of the Department of Plant Breeding and Seed Technology, Federal University of Agriculture, Ogun State, Nigeria. Observations were made on seed germination rate, seed weight, seedling length, seedling vigour index, rate of seedling emergence, plant height, seedling fresh weight, seedling dry weight, seedling growth rate. The experiment was laid out in completely randomized design with three replicates. Data collected were subjected to analysis of variance while significant means were separated using Tukey's Studentized Range (HSD) test at 5 % probability level. The data were also subjected to correlation and principal component analyses. Considerable variations were observed for all the laboratory and screen house seedling vigour traits suggesting that selection for further improvement in kenaf plant is possible due to large varietal differences present. Energy of germination, seed germination, 100 seed weight, seedling length, seedling vigour index, plant height, seedling fresh weight and number of leaves per plant contributed substantially to variation among the kenaf genotypes. These characters could be used as dependable selection criteria in kenaf improvement. Genotypes G45 2^3, G45 2^4 and Taining2 24^4 had the best seedling vigour traits compared to other genotypes. Significant and positive relationships were observed between seedling emergence and speed of germination and seedling vigour index whereas unexpectedly, seed germination had a weak and positive correlation with seedling emergence and seedling vigour. The three identified genotypes with best seedling vigour traits could be used as seed producing parents in seed improvement strategy in kenaf.

Keywords: genotype, correlation, seed quality, seed improvement.

INTRODUCTION

Kenaf (*Hibiscus canabinus*) belongs to the family Malvaceae. The specie is a fast growing annual crop capable of two cropping season a year with the aid of irrigation. It is specifically grown for its fibre but a few varieties have edible leaves (Weber *et al.,* 2002). Kenaf is a non woody plant of a very short growth cycle of between 100 to 130 days. The plant is much less exacting in its cultural and climate requirements. It is tolerant of poor soil conditions. The crop, however, requires little care during its growing period (Danalatos and Archontoulis, 2004). Kenaf is indigenous to tropical Africa and East Indies. Kenaf has been in use in central Africa as long ago as 4000 B.C. Throughout the ages, the people have eaten it, fed it to their animals, used it for weaving of clothing materials and stalking plants. The plant is not new in Nigeria. In Nigeria, it has been used for making ropes and for other domestic purposes such as erecting fence and thatching for dwelling while the leaves have also been used for food (Aimin, 2006).

Kenaf holds a lot of promise and hope of serving as a cash crop for farmers in the savanna. Unfortunately, in recent times, many farmers are no longer interested in growing the crop as they are faced with harvesting and decorticating problems as well as poor economic returns (Adamson *et al.*, 1979). The variety of uses of kenaf makes its production in Nigeria to be great concern. According to Soyinka (1990), fertilizer application, harvesting, seed production and storage, plant breeding, processing technologies, poor seedling vigour and establishment among others are the annual problems faced in kenaf production in Nigeria.

Seed quality components have been reported to depend on the genetic characteristics of the plant, however, it is also strongly affected by the seed developmental conditions of the female plants, harvesting and handling procedures as well as storage conditions (Adebisi *et al.,* 2013). Seed/ seedling vigour is one of the important components of seed quality, which can be defined as the sum total of those properties of the seed that determine the level of activity and performance of the seed or seed lot during germination and seedling emergence (Hampton and Tekrony, 1995). Vigour test represents significant technological advances in seed quality control. Adeyemo and Fakorede (1995) and Mponda *et al.* (1997) have shown that seedling vigour can also be a selection criterion when breeding for improved seed yield in crops.

Although, there are some constraints and enormous challenges facing the Nigeria fibre industry, if appropriate remedies are taken such as if available resources are properly harnessed, total annual production of kenaf fibre is likely to increase drastically and importation brought down to the barest minimum level. For this to be achieved, it is necessary to carry out studies on seedling vigour in kenaf in order to identify kenaf genotypes with rapid seedling growth and vigour for use in screening and crop improvement programme. However, information on seedling vigour characteristics of kenaf genotypes grown in Nigeria is scarce. This study was therefore carried out to investigate the extent of variation in seedling vigour traits in twenty-one kenaf genotypes, determine the relationships between various seedling vigour traits in kenaf and identify genotypes with rapid seedling growth and vigour for use in future crop improvement programme.

MATERIALS AND METHODS

Seed material

Seeds from 21 kenaf genotypes were obtained from the Institute of Agricultural Research and Training (IAR&T) Ibadan, Oyo State, Nigeria from the 2012/2013 cropping season harvest and used for the study. There was no information on the seedling vigour characteristics of the crop but the little information available was on their relative fibre, seed yield and performance under ambient conditions.

Experimental Site and Design

The experiments were carried out in the Seed Laboratory as well as the screen house of the Department of Plant Breeding and Seed Technology, Federal University of Agriculture, Abeokuta (Latitude 7.1^{0}N and longitude 3.2^{0}E), Ogun State. A completely randomized design with three replicates was used for the laboratory and the screen house tests.

Seed Quality Assessment

Clean seeds from 21 kenaf genotypes were divided into two batches. One batch (with 300 seed lots) was used for laboratory assessment while the second batch (with 300 seed lots) was used for screen house evaluation between June and July, 2013 and the trial was repeated one month later between September and November, 2013. Seed and seedling vigour characters of the kenaf genotypes were evaluated using the procedure stated below.

Laboratory test

***Standard Germination*:** One hundred seeds of each genotype and replicated three times were placed in Petri dishes lined with moistened paper towels at 25^{o}C temperature in an incubator (ISTA, 1995). Seed germination percentage was computed as follows (equation 1):

$$\text{Standard Germination} = \frac{\text{Number of seed germinated}}{\text{Number of seed sown}} \times 100 \quad \ldots\ldots(1)$$

Speed of germination: Speed of germination was computed as follows (equation 2):

$$Gt = \sum (Gt/\ Tt) \quad \ldots\ldots(2)$$

Where Gt=germination percentage at tth day
Tt=day of germination test

***Seedling length*:** This was assessed by measuring the length in centimetres (cm) from the tip of the cotyledon to the point of radicle emergence with a metric ruler.

Seedling Vigour Index (SVI): This was determined by multiplying percentage seed germination by the average of seedling length after 7 days of germination and divided by 100 (Kim *et al.,* 2002; Adebisi, 2004).

Seed Weight: Weight of 100 seeds was determined for each genotype in three replicates using sensitive scale.

Screen house test

***Seedling Emergence*:** Seedling emergence was determined after 10 days using the equation of ISTA (1995) as follows (equation 3):

$$\text{Seedling Emergence} = \frac{\text{Number of seedling emerged at 10 days}}{\text{Number of seeds planted}} \times 100 \quad \ldots\ldots (3)$$

Number of leaves: At the 20th day, leaves of 20 randomly selected seedlings were counted from each replicate and the average computed.

Seedling height*:* The heights of 20 randomly selected seedlings were measured after 20 days of sowing (in centimeter) using metric ruler.

*Speed of emergence***:** Speed of emergence calculated using formula (equation 4).

$$Gt = \sum (Gt/ Tt) \quad \ldots\ldots (4)$$

Where G t= emergence percentage at t^{th} day
Tt = day of emergence test

Seedling fresh weight**:** This was determined by weighing 20 randomly selected seedlings (in grammes) at 20 days after emergence.

Seedling dry weight**:** This was measured using 20 randomly selected seedlings, by drying them in the oven at 130^0C for one hour at 20 days after emergence and afterwards weighing them with sensitive weighing scale.

Seedling growth rate**:** This was calculated using equation 5.

$$SGR = \sum (St/ Tt) \quad \ldots\ldots (5)$$

Where St=seedling fresh weight at t^{th} day
Tt=day of weight determination

Data Analysis

Data on each trait were subjected to the following statistical analyses using Statistical Package for Social Sciences (SPSS) statistical software version (16.0). However, due to the non significant differences of the seed quality characters between the two trials using Tukey HSD test at 5% and 1% probability level, data obtained from the two trials were averaged and analysed. A one-way Analysis of variance (ANOVA) was used to determine whether or not genotype effect was significant over the two trials. Tukey HSD test at 5% probability level was used for separation of significant means for each trait. To identify traits most responsible for variation among the 21 genotypes, principal component analysis was carried out on the data. Correlation coefficients were determined among the traits to determine the extent of relationships among the various traits.

RESULTS

Results in Table 1 shows the mean squares values of the laboratory and screen house determined characters in 21 kenaf genotypes. For seed quality determined in the laboratory, genotype effect was highly significant ($P \leq 0.01$) on speed of germination and 100 seed weight but significant ($P \leq 0.05$) on seedling length and seedling vigour index. Similarly, for screen house test, genotypes effect was highly significant on speed of emergence, seedling emergence, seedling height, seedling fresh weight, seedling dry weight, number of leaves and seedling growth rate.

Table 2 shows the mean performance of laboratory determined characters evaluated in 21 kenaf genotypes. The result shows that speed of germination of the 21 genotypes slightly differed from each other. However, genotypes G45 2[3], Taining2 24[4], Vi 100 10[1], Ac 313 24[4], Purple flower and local line had distinct higher values of speed of germination, though not significantly different from other genotypes. In contrary, seed germination value of AU-75 41[3] was the highest (67 %) though not significantly different from values recorded with G45 2[3], AV 2452 4[A] and local line (62 and 65%). However, HC 683 31[1] had the lowest seed germination percentage (37%). For 100 -seed weight, Ac 313 30[2] had a distinct highest value (2.94 g) while Ex shika 24[4] and HC 683 31[1] recorded similar lowest value of 2.16 g. In terms of seedling length, HC 683 31[1] had the longest length 9.28 cm which were not significantly different from most other genotypes while AC-60-282 15[1] had the shortest length of 1.24 cm that was not significantly different from other genotypes. Seedling vigour index varied among the genotypes with Taining2 24[4], HC 683 31[1], and G45 2[3] recording the highest values of 3.64, 3.38 and 3.18, respectively which was not significantly different from values obtained with AC 313 24[4], purple flower and AU-75 41[3].

Table 1: Summary of analysis of variance showing the mean square values of the laboratory and screen house traits in Kenaf genotypes

Source of Variation	Replication	Genotype	Error
(a) Laboratory			
Speed of germination	19.152	202.835**	54.894
Standard germination (%)	104.611	176.074	109.319
100 seed weight (g)	0.036*	0.153**	0.011
Seedling length (cm)	3.936	9.365*	4.227
Seedling vigour index	0.758	2.024*	1.027
(b)Screen house			
Speed of emergence	1.667	143.783**	31.538
Seedling emergence %	123.512*	224.253**	29.9991
Seedling height (cm)	4.815	22.919**	6.150
Seedling fresh weight (g)	1.310	21.462**	3.405
Seedling dry weight (g)	0.129	0.698**	0.150
Number of leaves	4.306	10.788**	1.590
Seedling growth rate	0.000	0.001**	0.010

**Significant at 0.01 (1%) probability level; *Significant at 0.05 (5%) probability level

Table 2: Mean performance of laboratory determined characters evaluated in 21 kenaf genotypes

Genotypes	Speed of germination	Standard germination (%)	100 seed weight (g)	Seedling length (cm)	Seedling vigour index
Taining2 24[4]	58[ab]	45[de]	2.48[cdefg]	5.91[ab]	3.64[a]
Ex Giwa 34[1]	50[b]	53[bc]	2.63[abcde]	2.91 [ab]	1.46[b]
Ac 313 24[4]	57[ab]	58[b]	2.84[ab]	4.00 [ab]	2.32[ab]
Local line	57[ab]	62[a]	2.69[abcd]	2.05 [b]	1.28[b]
Purple flower	57[ab]	58[b]	2.44[defg]	4.57 [ab]	2.60[ab]
2QQ 17[1]	55[ab]	62[a]	2.47[cdefg]	2.82 [ab]	1.75[b]
A-60-282	42[b]	51[bc]	2.33[efg]	3.32 [ab]	1.89[b]
AC-313 30[2]	41[b]	43[de]	2.94[a]	2.13 [b]	0.92[b]
Au 2452 4[A]	40[b]	62[a]	2.64[abcde]	3.05 [ab]	1.86[b]
G45 2[3]	63[a]	65[a]	2.20[g]	4.89 [ab]	3.18[a]
G45 2[4]	47[b]	53[bc]	2.62 [abcde]	3.20 [ab]	1.69[b]
25 krad 3[1]	42[b]	52[bc]	2.79 [abc]	3.13 [ab]	1.65[b]
A-60-282 15[1]	50[b]	53[bc]	2.71 [abcd]	1.24 [b]	0.65[b]
Au-24-525	37[b]	47[cd]	2.66 [abcde]	1.88 [b]	1.78[b]
Cuba 108 19[2]	47[b]	52[b]	2.55 [bcdef]	2.20 [b]	1.16[b]
Ex Shika 24[4]	40[b]	50[b]	2.16 [g]	2.31 [b]	1.27[b]
Vi 100 10[1]	55[ab]	58[b]	2.74 [abcd]	3.22 [b]	1.93[b]
Ac 313 29[3]	40[b]	45[de]	2.65 [abcde]	1.52 [b]	0.69[b]
Cuba ovate 51[1]	37[b]	55[b]	2.25 [fg]	2.87 [ab]	1.48[b]
Au-75 41[3]	48[b]	67[a]	2.35 [efg]	3.55 [ab]	2.35[ab]
HC 683 31[1]	37[b]	37[e]	2.16 [g]	9.28[a]	3.38[a]
Grand mean	48	54	2.53	3.34	1.85

Means followed by the same alphabet along the column are not significantly different from one another according to Tukey's HSD range test at 5% probability level.

The mean performance of seedling vigour traits determined in the screen house among 21 kenaf genotypes is presented in Table 3. Speed of emergence percentage ranged between 33 and 62 % with purple flower with the highest speed of emergence (62 %) while HC 583 31[1] had the lowest speed of emergence with 33% but most of the genotypes had statistically similar values. For seedling emergence, genotype Taining2 24[4] had the highest value with 67 % which were not statistically different from values recorded by purple flower and 25 krad 3[1] with values of 65 and 63 % respectively. However, AC 313 30[2] had the lowest emergence with 38 %. With seedling height, most of the genotypes were not significantly different from one another and the values ranged between 7.50 cm and 19.15 cm with Cuba ovate 51[1] recording the highest height of 19.15 cm while Ex Shika 24[4] had the shortest height of 7.50 cm. For seedling fresh weight, 25 krad 3[1] had the highest fresh seedling weight of 12.08 g while AV-2452 4[A] recorded the lowest fresh seedling weight with 1.16 g. In respect of seedling dry weight, the highest seedling dry weight of 2.17 g was obtained with G452[4] while the lowest seedling dry weight was obtained with Au 24 52 4[A] with 0.30 g. The highest number of leaves was obtained in Cuba ovate 51[1] with value of 14.00 which was not significantly different from value of 11.25 recorded with AC-313 30[3] while other genotypes had statistically similar values. For seedling growth rate, the highest growth rate was recorded by G45 2[4] with 0.07g/day while the lowest growth rate was obtained in Au 2452 4[A] with 0.01g/day while other genotypes had statistically similar values.

Table 3: Mean performance of seedling vigour traits determined in the screen house among 21 kenaf genotypes

Genotypes	Speed of emergence (%)	Seedling emergence (%)	Seedling height (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Number of leaves	Seedling growth rate (g/day)
Taining2 24[4]	38[bcd]	67 [a]	9.71 [b]	4.66 [cde]	0.91 [bcd]	5.28 [e]	0.03 [bcd]
Ex Giwa 34[1]	38 [bcd]	53[abcd]	15.13[ab]	3.50[de]	0.42[cd]	8.1[abde]	0.01[bcd]
Ac 313 24[4]	50[abcd]	53[abcd]	14.75[ab]	4.94[cde]	1.02[abcd]	7.75[bcde]	0.03 [bcd]
Local line	45[abcd]	58[abc]	11.69[ab]	4.64[cde]	1.02[abcd]	7.10[cde]	0.03 [bcd]
Purple flower	62[a]	65[ab]	12.81[ab]	9.46[abc]	1.62[abc]	6.29[de]	0.05 [abc]
2QQ 17[1]	42[bcd]	42[cd]	9.27[b]	5.33[cde]	0.82[bcd]	9.00[bcde]	0.03 [bcd]
A-60-282	40[bcd]	46[cd]	10.80[b]	3.64[cde]	0.48[bcd]	9.99[abcd]	0.02 [bcd]
AC-313 30[2]	38[bcd]	38[d]	11.30[b]	4.70[cde]	0.53[bcd]	11.25[ab]	0.02 [bcd]
Au 2452 4[A]	45[abcd]	45[cd]	15.13[ab]	1.33[e]	0.30[d]	9.67[bcd]	0.01 [d]
G45 2[3]	52[abc]	57[abc]	10.46[b]	7.46[abcd]	1.41[abcd]	8.17[bcde]	0.05 [abcd]
G45 2[4]	52[abc]	55[abcd]	10.59[b]	11.32[ab]	2.17[a]	6.76[cde]	0.07 [a]
25 krad 3[1]	53[ab]	63[ab]	8.87[b]	12.08[a]	1.66[ab]	9.17[bcd]	0.06 [ab]
A-60-282 15[1]	45[abcd]	58[abc]	11.93[ab]	7.79[abcd]	0.87[bcd]	9.67 [bcd]	0.02 [bcd]
Au-24-525	45[abcd]	45[cd]	7.65[b]	1.61[e]	0.29[d]	7.00[cde]	0.01[cd]
Cuba 108 19[2]	48[abcd]	48[bcd]	12.29[ab]	5.96[bcde]	0.88[bcd]	9.75 [bcd]	0.03 [bcd]
Ex Shika 24[4]	38[bcd]	43[cd]	7.50[b]	5.69[bcde]	0.70[bcd]	8.84 [bcd]	0.02 [bcd]
Vi 100 10[1]	35[cd]	43 [cd]	10.97[b]	4.60[cde]	0.50[bcd]	9.84 [bcd]	0.02 [bcd]
Ac 313 29[3]	42[bcd]	42 [cd]	13.47[ab]	4.91[cde]	0.70[bcd]	10.50 [bc]	0.02 [bcd]
Cuba ovate 51[1]	38[bcd]	42 [cd]	19.15[a]	6.07[bcde]	0.70[bcd]	14.00[a]	0.02 [bcd]
Au-75 41[3]	42[bcd]	43 [cd]	11.78[ab]	5.99[bcde]	0.52[bcd]	9.61 [bcd]	0.02 [bcd]
HC 683 31[1]	33[d]	43 [cd]	9.76[b]	5.81[bcde]	0.80[bcd]	8.80 [bcde]	0.03 [bcd]
Grand mean	44	50	11.67	5.79	0.87	8.89	0.03

Means followed by the same alphabet are not significantly different from one another according to Tukey's HSD range test at 5% probability level.

Table 4 shows correlation coefficients between laboratory and screen house determined characters evaluated over 21 kenaf genotypes. The result shows that seedling emergence had highly significant and positive correlation with speed of germination (r = 0.358) and significant and positive correlation with seedling vigour index (r = 0.295). Conversely, negative and significant correlation was obtained between seedling plant height and seedling vigour index (r = -0.253). Number of leaves had negative and highly significant correlation with speed of germination (r = -0.397) and seedling vigour index (r = -0.383). However, the correlations among other characters were not significant in most cases.

Table 4: Correlation coefficient between laboratory and screen house determined characters evaluated over 21 kenaf genotypes (N = 63)

Screen house traits	Laboratory traits				
	Speed of germination	Seed germination (%)	100 seed weight (g)	Seedling length (cm)	Seedling vigour index
Speed of emergence	0.247*	0.217	0.126	0.063	0.161
Seedling emergence (%)	0.358**	0.103	0.115	0.209	0.295*
Seedling height (cm)	-0.142	0.112	0.051	-0.106	-0.253*
Seeding fresh weight (g)	0.070	0.43**	-0.097	0.135	0.063
Seedling weight (g)	0.151	0.083	-0.054	0.156	0.166
Number of Leaves	-0.397**	-0.073	-0.073	-0.238	-0.383**
SGR (g/day)	0.124	0.060	-0.070	0.171	0.180

**Correlation is significant at 0.01 probability level; *Correlation is significant at 0.05 probability level

SGR- Seedling growth rate

The principal component analysis result for the 12 characters evaluated in kenaf genotypes is presented in Table 5. The arithmetic sign of the coefficient is irrelevant since a common rule of thumb for determining the significance of a trait coefficient is to treat coefficient greater than 0.30 as having a large enough effect to be considered important. Traits having less than 0.350 coefficient values were considered to be of no effect to the overall variation observed in the present study (Adebisi *et al.*, 2010). The PCI accounted for 34.610% of the variability and was dominated by speed of germination (0.396), seedling length (0.378) and seedling vigour index (0.456), speed of emergence (0.736), seedling emergence (0.775), seedling fresh weight (0.774), seedling dry weight (0.882), leaves number (0.528) and seedling growth rate (0.866). PC2 accounted for 17.912 % of the total variation and related to seedling length (0.716), seedling vigour index (0.789), seedling height (0.417), seedling fresh weight (0.400), and number of leaves (0.420). Similarly, PC3 accounted for 13.802 % and was dominated by speed of germination (0.664), seed germination (0.613), 100 seed weight (0.561) and seedling length (0.409). However, PC4 accounted for 10.308 % and was dominated by seed germination (0.609), 100 - seed weight (0.394), seedling height (0.586) and number of leaves (0.446).

Table 5: Result of principal component analysis for the 12 characters evaluated across 21 kenaf genotypes

Characters	Components			
	PC1	PC2	PC3	PC4
Total variance	4.153	2.149	1.656	1.237
% of variance	34.610	17.912	13.802	10.308
Cumulative %	34.610	52.521	66.324	76.632
Speed of germination	**0.396**	-0.320	**0.664**	0.217
Standard germination (%)	0.188	-0.020	**0.613**	**0.609**
100 seed weight(g)	-0.075	0.296	**0.561**	**-0.394**
Seedling length (cm)	**0.378**	**-0.716**	**-0.409**	0.168
Seedling vigour index	**0.456**	**-0.789**	-0.137	0.218
Speed of emergence	**0.736**	0. 286	0.156	0.064
Seedling emergence (%)	**0.775**	0.013	0.214	-0.194
Seedling height (cm)	-0.239	**0.417**	0.010	**0.586**
Seedling fresh weight (g)	**0.774**	**0.400**	-0.275	0.054
Seedling dry weight(g)	**0.882**	**0.350**	-0.188	0.030
Number of leaves	**-0.528**	**0.420**	-0.330	**0.446**
Seedling growth rate	**0.866**	0.329	-0.223	0.020

Bolded: Significant contribution is 0.3507

DISCUSSION

The study revealed that significant genotype effect for all the characters except seed germination in 21 genotypes of kenaf indicated that differences existed among the genotypes studied. The significant differences among some of the genotypes for these characters further suggest, that selection for these traits among kenaf genotypes for further improvement is possible due to large variability present. The differences observed in the twelve characters among the genotypes may be attributed to diverse genetic background of the kenaf genotypes studied. The results suggest the possibility of improving seed quality traits through genotypic selection. Considerable differences were observed by Adebisi (2004) in sesame and Kehinde *et al.*, (2005) in West Africa okra, Mponda *et al* (1997) in sesame, Ayo- Vaughan *et al* (2012) in NERICA, Adebisi *et al* (2013a, b) in groundnut and bambara genotypes.

Among the genotypes studied, G45 2^4 showed better seedling vigour in term of seedling dry weight and seedling growth rate. HC 583 31^1 showed poor performance in term of speed of germination, seed germination and speed of emergence. Also, AV24-525 4^A performed poorly in terms of seedling fresh weight, seedling dry weight and seedling growth rate. These poor performances may be due to environmental factors or dormancy in terms of seed germination.

The principal component analysis revealed that speed of germination, seed germination, 100 seed weight, seedling length, seedling vigour, plant height, seedling fresh weight and number of leaves contributed substantially to variation among 21 genotypes of kenaf. These characters could be used as dependable selection criteria because of high contribution to the total variation. This is in agreement with Clifford and Stephenson, (1975); Kehinde *et al.*, (2005); Okelola, (2005) and Adebisi, *et al.*, (2006), who reported that the first three principal components were the most important in reflecting the variation pattern among genotypes and the characters highly associated with those should be used in differentiating genotypes.

Result of the correlation analysis revealed that different characters had different association with each other. Adebisi, (2008) pointed out that strong and positive correlation suggests that selection for one character could be used to indirectly select for another character but this can cause difficulties during selection if the association is between desirable and undesirable traits. The positive and significant correlation observed between seedling emergence and speed of germination as well as seedling vigour index indicated that seeds with improved emergence, increase in speed of germination and seedling vigour index will lead to a corresponding increase in speed of germination, seedling vigour index and number of leaves. However, negative and significant correlation of number of leaves with seedling vigour index and speed of germination indicates that seed of superior seedling vigour level and good speed of germination will not lead to production of more leaves in kenaf. Unexpectedly, seed germination had a weak correlation values with seedling emergence and seedling vigour.

CONCLUSIONS AND RECOMMENDATIONS

Varietal differences occurred among the 21 kenaf genotypes for all laboratory and field seed quality traits. Genotypes G45 2^3, G45 2^4 and Taining2 24^4 had the best seed quality traits compared to other genotypes. Energy of germination, seed germination, 100 seed weight, seedling length, seedling vigour index, plant height, seedling fresh weight and number of leaves contributed substantially to variation among the kenaf genotypes. Significant and positive relationships were established between seedling emergence and speed of germination and seedling vigour. Unexpectedly, seed germination had weak association with seedling emergence and seedling vigour. The three genotypes (G45 2^3, G45 2^4 and Taining2 24^4) identified with superior seedling vigour traits can be used as seed producing parents in seed improvement programme in kenaf. Identified characters with high contribution to variation in the kenaf genotypes could be used as dependable selection criteria in kenaf seed improvement strategy.

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