

EFFECT OF GENOTYPES AND SEED PRODUCTION ENVIRONMENTS ON SEED QUALITY OF SESAME (*SESAMUM INDICUM* L.)

BY

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ABSTRACT

Fourteen genetically diverse sesame (*Sesamum indicum* L.) genotypes were grown under three diverse plant populations during 2001 and 2002 cropping seasons. Seeds from each harvest were subjected to different seed quality tests such as standard germination and seed vigour traits, and data generated were analyzed. Seed quality traits were considerably affected by the genotypes and growing conditions i.e. plant population and cropping seasons. Genotypes with superior seed quality were prevalent at 166,667 and 266,667 plants ha⁻¹. Genotype 73A-11 was among the best performing genotypes with consistently highest germination values, excess water stress germination (EWSG) and moderate field emergence, plumule length and seedling vigour, and was closely followed respectively by Yandev 55, 530-6-1, 73A-97 and C-K-2. A close relationship was found among seed germination, seedling vigour and field emergence. This indicated that these traits could be improved by selecting for seed of high germination. Heritability and genetic advance results revealed that the five seed quality traits were highly heritable in almost all the environments and therefore offer unlimited scope for selection. Two plant populations (166,667 and 266,667 plants ha⁻¹) could be used for good seed production of sesame genotypes under tropical conditions.

Key words: *Genotypes, plant population, seed production, seed quality, sesame.*

INTRODUCTION

There has been considerable expansion in sesame cultivation beyond the traditional growing areas due to the removal of the initial production constraints through agronomic and breeding research and some modest extension and promotional activities. Seeds are biological input in crop production which determine the effectiveness of other resources. It is noteworthy that seed quality assurance for sesame has not been established in Nigeria. Okolo and Fajana (1998) reported that for seed quality assurance of sesame to be in place in Nigeria, genetic, analytical, physiological and sanitary seed qualities have to be critically evaluated both in the

field and in the laboratory. It is for this reason that this crop has not been listed by National Seed Service in Nigeria.

Seed quality, according to Hampton (2002), is a standard of excellence in certain characters or attributes that will determine the performance of the seed when sown or stored. Most of the quality characteristics are polygenically inherited; and will therefore be influenced by the environment to a large extent (Labuschangne *et al.*, 2002). Several studies have shown that seed quality can be largely influenced by a wide range of environmental factors during seed production, harvesting, processing, storage and including treatments such as seed priming (Tesnier *et al.*, 2002; Adebisi,

2004).

Farmers traditionally grow sesame crop at different plant densities (Olowe and Busari, 1994). Limited information is available on the physiological response of sesame seeds to its environment, especially biotic factors. Understanding a factor such as plant density, which is associated with resource use and biotic stress, would help in the genetic improvement of the crop and development of improved management practices for increased and sustainable seed and grain production. Those factors of the production environment which dictate the quality of seeds produced include temperature, available moisture during seed development and maturation, incidence of diseases and pests in the field and at storage, management practices, harvest conditions and post-harvest seed handling (Tekrony, *et al.*, 1980; Adeyemo *et al.*, 1998; Adebisi and Ojo, 2001; Ojo and Dashiell, 2002 and Ajala, 2003).

Pollock and Roos (1972) identified two separate aspects of vigour - genetic vigour, which is seen as heterosis (hybrid vigour), as the differences in vigour between two genetic lines and physiological vigour, as the difference in vigour between two seed lots of the same genetic line. Genotypic differences in the quality of seed provide an opportunity for employing genotypic selection as a method of improving seed quality (Adebisi, 2004). Research and development work in this area, important as it is, has been relatively scanty.

The objective of this study, therefore, was to investigate the influence of 14 genotypes and seed production environments on the various seed quality components of sesame.

MATERIALS AND METHODS

Seeds of 14 sesame genotypes were sourced from National Cereals Research Institute, Badegi, Niger State, Nigeria. The seeds were sown under three plant populations during two years of 2001 and 2002 cropping seasons under rain-fed field conditions at the Teaching and Research Farm of University of Agriculture, Abeokuta. These treatments formed experimental environments as follows: Environment 1 = 50 x 15cm with 133,333 plants ha⁻¹, Environment 2 = 60 x 10cm with 166,667 plants ha⁻¹ and Environment 3 = 75cm x 5cm with 266,667 plants ha⁻¹. The plant populations and seasons, therefore, created six environments. Seeds were sown in the field in late season September 20, 2001 and harvested in December 2001 / January 2002 and repeated mid season on July 15, 2002 and harvested in November 2002. At each plant population in each year, the experiments were laid out in a randomized complete block with three replicates. Plots consisted of four rows of 3m long and spaced 50, 60 and 75cm apart and seedlings were thinned at 3 weeks after sowing to about 15cm, 10cm and 5cm plant-to-plant spacing. All cultural practices were carried out according to the peculiar local conditions.

At maturity, seed samples from each genotype and environment were obtained from 30-randomly picked plants from the two inner rows. The seed samples were placed under ambient laboratory room conditions for 14 days and thereafter subjected to the following seed quality tests:

Standard Germination: The test was performed according to ISTA (1995). Three 100-seed replicates of each genotype were germinated in 11cm diameter petri dishes inside moistened

paper towels with 5ml of distilled water and placed inside the incubator for germination. After seven days of germination, the proportion of germinated seed (visibly emerged normal radicles) was expressed as normal germination percentage.

Excess Water Stress Germination (EWSG): The test differed from the "standard" one only in the higher moisture level (10ml of distilled water) of the latter's substratum as described by Lovato and Cagalli (1992).

Plumule Length: The plumule length of ten randomly picked normal seedlings was measured in centimeters (AOSA, 1983).

Seedling Vigour Index: Seedling vigour level of each genotype was calculated by multiplying percentage normal germination by the average of plumule length of each genotype after seven days of germination (Kim *et al.*, 1994) and divided by 1000 (Adebisi, 2004).

Field emergence: Four sub samples of 50 seeds for each genotype under each environment were hand-sown in furrows of 2.0m, 0.30m apart and 0.05m deep in the field. Soil medium was kept moderately wet for emergence. The number of emerged seedlings was counted at 14 days after sowing and expressed as percentage of seed sown.

Data Analysis

Mean seed germination, EWSG and field emergence were firstly transformed using angular (arcsine) transformation. All data collected were subjected to analysis of variance using GENSTAT (2001) 10.0 statistical package with split-split plot analysis and G x E effects were tested according to Peterson (1985) and Moot and McNeil (1995). Treatment means for all components were compared using

Duncan's (1955) Multiple Range tests at 5% probability level.

Broad sense heritability (H^2B) and genetic advance (GA) were calculated according to methods outlined by Allard (1960) for each of the environments, thus:

$$H^2B = (\bar{a}^2_{gx} / \bar{a}^2_{gx} + \bar{a}^2_{ex}) \times 100$$

Where \bar{a}^2_{gx} is the genotypic variance of character x, while \bar{a}^2_{ex} is the environmental variance for character x.

$$GA = (K) \bar{a}A(H)$$

Where K is a selection differential (2.06) at 5% probability level, while $\bar{a}A$ is the phenotypic standard deviation and H is Heritability in broad sense.

Correlation analyses were computed across the plant populations during the two seasons using GENSTAT correlation procedures.

RESULTS

Results in Table 1 show that season, genotype and population effects were either significant ($P = 0.05$) or highly significant ($P = 0.01$) for all the seed quality components except population effect, which was not significant on EWSG and field emergence. The two-way interactions of population x season, genotype x season and genotype x population, as well as that of genotype x population x season effects were either significant or highly significant for all the traits. The coefficients of variation ranged from 4.6% for standard germination to 10.4 for seedling vigour index.

From the results in Table 2, significant differences were recorded among the genotypes in respect of the seed quality components evaluated. High standard germination values (77% 78%) were recorded for Yandev 55, 93A-97, 73A-11, 530-6-1, 73A-97 and C-K-2 while Goza had the lowest germination of 68%. Values of EWSG for 73A-11 and 530-6-1

genotypes (70% and 72% respectively), though not significantly different, were higher than other genotypes whereas the lowest value of 62% occurred in Pbt11 No.1. Significantly higher plumule lengths of between 5.28 cm and 5.56 cm and seedling vigour index of between 4.73 and 4.77 were observed for E8, Yandev 55 and Goza while higher field emergence of 71% and 69% was obtained for C-K-2 and 73A-97 respectively.

In Table 3, the overall standard germination, EWSG, plumule length and field emergence at 166,667 and 266,667 plants ha⁻¹ were similar. However, seeds produced under 166,667 plants ha⁻¹ had higher seedling vigour index of 4.55, which was significantly higher than 4.09 and 4.29 obtained at 133,333 and 226,666 plants ha⁻¹ respectively. Examination of season effects on the seed quality components showed that 2001 season recorded significantly higher standard germination and EWSG of 75% and 70% respectively compared to 70% and 64% obtained in 2002 season.

As shown in Table 4, significant differences were observed for all the seed quality traits examined under different plant populations and season environments. Highest standard germination (80%), EWSG (71%), plumule length (4.5 cm), seedling vigour index (4.4) and field emergence (66%) occurred for seed produced under 266,667 plants ha⁻¹ environment in 2001 season. For 2002 season, seeds produced from 166,667 plants ha⁻¹ environment had maximum standard germination (75%), EWSG (65%), plumule length (5.7cm) and seedling vigour index (4.6). Field emergence of seeds obtained from 133,333 plant ha⁻¹ environment was greatest (68%) in 2002 season. Comparison of the mean

values among seasons revealed greater standard germination and EWSG occurred in seed produced in 2001 compared to 2002 season whereas higher plumule length, seedling vigour index and field emergence were recorded in 2002 compared to 2001 season.

Results in Table 5 indicated that at 133,333 plants ha⁻¹, all the genotypes had standard germination of 70% and above except for 73A-94. At higher population of 166,667 plants ha⁻¹, all the genotypes recorded standard germination of 70% and above while only C-K-2, 93A-97, 73A-11 and 530-6-1 recorded greater standard germination values of 77% and above. When the population was increased to 266,667 plants ha⁻¹, three of the best varieties under populations 133,333 and 166,667 plants ha⁻¹ (530-6-1, 73A-11 and 73A-97) as well as Yandev 55 and C-K-2 had significant higher values of 80% and above. EWSG was significantly greater in Yandev 55, Goza, Type A, 73A-97 and Domu with values of 70% and above at 133,333 plants ha⁻¹. This figure was not significantly higher than those recorded by 530-6-1, 73A-97 and C-K-2. Domu and 93A-97 recorded greater EWSG of 73% at 166,667 plants ha⁻¹. This figure was not significantly higher than those recorded by 530-6-1, 73A-97 and C-K-2 whereas 530-6-1 had significantly highest value of 81% at 266,667 plants ha⁻¹.

As shown in Table 6, Goza, Yandev 55 and E8 consistently showed significantly higher plumule length of between 4.8 and 5.8cm under each of the three plant populations, compared to other genotypes. Only Goza and E8 had greater seedling vigour index when compared to other genotypes at the population density of 133,333 and 166,667 plant ha⁻¹. Field emergence was highest in Yandev 55, 73A-

11, 530-6-1, 73A-94, 69B-88Z and 73A-93 at 133,333 plants ha⁻¹ whereas only Pbt11 No. 1 had the highest emergence of 87% when the population was increased to 166,667 plants ha⁻¹. At 266,667 plants ha⁻¹, five genotypes (93A-97, 73A-11, 530-6-1, 73A-97 and C-K-2) were observed to have greater field emergence.

From the result in Table 7, standard germination and field emergence tests had high heritability estimates with high genetic advance estimates in all the six environments. All the other seed quality traits had high heritability along with high genetic advance in the entire six environments except at E5 where low heritability estimates of between 36 and 39% were obtained.

In Table 8, highly significant and positive correlations were observed between standard germination and EWSG in 2001 ($r = +0.56^*$) and 2002 ($r = +0.69^{**}$) seasons. It is noteworthy that standard germination was though positively and significantly correlated with seedling vigor index ($r = +0.52^*$) only in 2001 season, it was negatively correlated ($r = -0.47$) in 2002 season. Standard germination was strongly correlated with field emergence in 2001 ($r = +0.49^*$) and 2002 ($r = +0.50^*$) seasons. High positive and significant correlations were found between plumule length and seedling vigor index in 2001 ($r = +0.89^{**}$) and 2002 ($r = +0.68^{**}$) seasons. Seedling vigor index was positively correlated ($r = +0.36$) with field emergence mainly in 2001 season.

DISCUSSION

The results revealed significant differences among the genotypes for all the seed quality traits evaluated, suggesting that selection for good seed quality traits among sesame genotypes for further

improvement is possible due to the large variability present. Mponda *et al.* (1997) and Ajala *et al.* (2003) obtained a considerable variation in seedling vigour of Tanzanian sesame and cowpea populations respectively, which were attributed to diverse genetic background of the genotypes. The effect of plant population on all the seed quality traits, except EWSG indicated that seed performance was modulated by population density. Significant season effect on all the traits could be attributed to better growth environment characterized by high temperatures and more regular timely rainfall (Appendix 1). The significant genotype x plant population interaction effects revealed that variations in all the seed quality traits among the selected sesame genotypes were due to differences in plant populations. Also, significant population x season interaction effects on all the seed quality traits indicated that changes in climate resulting from yearly cultivation of sesame under different plant populations influenced its seed quality traits. All the traits had highly significant genotype x season interactions, implying that changes in climatic conditions relatively influenced genotype performance. Significant interaction of genotype x population x season for the five seed quality traits, suggested that changes in climate and soil conditions during the season and differences in plant populations were responsible for differences noticed in seed quality among the genotypes. The relatively low coefficients of variation (4.6-10.4%) for the five traits measured indicated that experimental error was low and thus, selection for seed quality traits could be done with greater reliability.

Genotype 73A-11 was among the best performing genotypes with a

consistent high standard germination, EWSG field emergence and with moderate plumule length and seedling vigour index. This was closely followed by Yandev 55, 530-6-1, 73A-97 and C-K-2, in that order, with superior seed germination, field emergence and high to moderate seedling vigour. A markedly higher germination was shown by standard germination than EWSG, suggesting that higher moisture level of the substratum had exerted a retarding effect on germination.

In the developing countries, researchers may generally not afford the resources required to compare genotypes for seed quality components at several plant populations. Seeds produced at the population of 166,667 and 266,667 plants ha⁻¹ had increased standard germination, EWSG, plumule length and field emergence across all the genotypes and seasons. Seedling vigour index was best at 166,667 plants ha⁻¹ and thereafter decreased significantly. The superiority of 73A-11 and 530-6-1 was also evident at higher population with remarkable differences in standard germination, EWSG and field emergence at 266,667 plants ha⁻¹. Also 73A-11, 530-6-1, Yandev 55 and 73A-94 were among genotypes with high plumule length and seedling vigour index at both 166,667 and 266,667 plants ha⁻¹. Seed produced under 266,667 plants ha⁻¹ in 2001 gave superior seed quality just as seeds produced in the 166,667 plants ha⁻¹ in 2002 season equally had distinct seed quality except for field emergence. Higher standard germination and EWSG values were observed in 2001 season whereas in 2002 season, plumule length, seedling vigour index and field emergence had higher values due to increase in plant populations. The differences in seed quality between the seasons may be due to variation in climatic

conditions experienced in the field.

The high heritability estimates and genetic advance values for standard germination and field emergence tests in all the six environments indicated that these traits were highly heritable. Hence, seed production environments did not influence these traits considerably and therefore reduced the scope for selection. The fact that plumule length, seedling vigour index and EWSG tests had high heritability with high genetic advance revealed that they were highly heritable in most of the environments except at 266,667 plants ha⁻¹ in 2001 season where seed production environments influenced these traits.

A pre-planting germination test has been shown to correlate with field emergence in some studies (Hall and Weisner, 1990, Bruggink *et al.*, 1991, Boersma *et al.*, 1996, Adebisi *et al.*, 2003), but to have very little association with field emergence in other studies (Powell and Matthews, 1985, Bark-Sabo and Dolincka, 1988). In an attempt to explain these different outcomes, Hampton and Coolbear (1990) suggested that when seed samples are of high quality, producing standard germination above a threshold level of about 70% for soybean, there would be a good correlation of the standard germination test result with field emergence. However, if the seed samples are of lower quality with some samples germinating below the threshold, poor correlation of germination with field emergence will be found. The present findings appear to substantiate this theory as germination values of most seed samples used in this study were 70% and above and a close association was found with field emergence in the two seasons (2001 and 2002) as well as seedling vigour in 2001 season.

Table f: Combined analysis of variance showing the mean squares of seed quality components of 14 sesame genotypes evaluated under three plant populations in two seasons

Source of variation	DF	Standard germination (%)	EWSG (%)	Plumule length (cm)	Seedling vigour Index	Field emergence (%)
Replicate	2	195.61	133.88	2.53	116.36	267.32
Season (S)	1	3242.92**	2310.19**	57.14**	1289.29**	613.75**
Error (a)	2	214.04	180.20	3.45	99.09	47.08
Population (p)	2	136.69**	21.02ns	2.53**	441.54**	60.12ns
P x S	2	916.60**	84.63*	3.8**	1374.33**	291.15**
Error (b)	8	9.05	13.51	0.20	19.87	14.56.18
Genotype (G)	13	195.6*	133.88*	2.53**	116.36*	267.12**
G x S	13	167.63**	233.01**	1.89**	159.26**	140.42**
G x P	26	104.02**	233.20**	1.03**	90.45**	156.08**
G x P x S	26	198.91**	249.66**	1.41**	109.94**	142.42**
Error (c)	156	10.76	12.48	0.21	18.60	16.82
Total	251					
CV (%)		4.6	5.5.3	10.0	10.4	6.6

* significant at 5% level ; ** significant at 1% level , ns : not significant

EWSG: Excess water stress germination

Table 2: Mean seed quality components of 14 sesame genotypes grown over three plant populations and two season environments.

Genotype	Standard* germination (%)	Water* stress germination (%)	Plumule length (cm)	Seedling vigour index	Field* emergence (%)
Yandev 55	77 _a	69 _b	5.28 _a	4.74 _a	67 _{ab}
93A-97	76 _a	68 _{bc}	4.54 _{bc}	4.26 _c	62 _{bc}
Goza	68 _d	66 _c	5.55 _a	4.73 _{ab}	58 _c
Type-A	70 _{cd}	65 _{cd}	4.87 _{bc}	4.13 _c	59 _{bc}
73A-11	77 _a	70 _a	4.53 _{bc}	4.29 _{bc}	68 _{ab}
530-6-1	79 _a	72 _a	4.53 _{bc}	4.30 _{bc}	66 _b
73A-94	73 _{bc}	67 _b	4.93 _b	4.46 _b	66 _b
69B-88Z	76 _{ab}	66 _c	4.67 _{bc}	4.41 _b	66 _b
EB	71 _c	63 _{de}	5.56 _a	4.78 _a	63 _{bc}
Domu	72 _c	67 _b	4.72 _{bc}	4.04 _c	64 _{bc}
73A-97	78 _a	69 _b	4.40 _c	4.13 _c	69 _a
GK-2	77 _a	69 _b	4.42 _c	4.16 _c	71 _a
530-3	72 _c	64 _d	4.77 _{bc}	4.14 _{bc}	63 _{bc}
Ftil Nb1	71 _{cd}	62 _e	4.61 _{bc}	4.00 _c	61 _c
Mean	74	67	4.80	4.60	65

*Percentage values (%) after angular transformation

Values within a column with letter subscripts in common are not significantly different at P 0.05

It is very noteworthy to note the findings on EWSG, where the high moisture level of the moist paper stimulated the germination process of vigorous seed and resulted in high correlation with standard germination, seedling vigour index and field emergence in 2001 and 2002 seasons. Seedling vigour index only correlated with the field emergence in 2001 season. Strong correlation found between plumule length and seedling vigour index in the two seasons indicated that the two traits were intrinsically related. Seeds with good

germination were able to give good plumule length and maintain high seedling vigour index.

CONCLUSION

Genotypes responded differently to plant population and cropping season environments. However, the recommended 166,667 plants ha⁻¹ can be used for good seed production of sesame genotypes, despite their diverse genetic backgrounds under tropical conditions. Plant population is a predictable

Table 3: Effect of plant populations and seasons on seed quality components of sesame

Seed Quality Components	Environments				
	E1	E2	E3	S1	S2
*Standard germination (%)	73 _b	75 _a	75 _a	78 _a	70 _b
*EWSG (%)	66 _a	67 _a	67 _a	70 _a	64 _b
Plumule length (cm)	5.60 _b	4.90 _a	4.87 _a	4.32 _b	5.27 _a
Seedling vigour index	4.10 _c	4.55 _a	4.29 _b	4.08 _b	4.54 _a
*Field emergence (%)	64 _a	64 _a	65 _a	63 _b	66 _a

Values within a row with letter subscripts in common are not significantly different at $P < 0.05$

EWSG: Excess water stress germination

*Percentage values (%) after angular transformation.

E1 = 133,333 plants ha⁻¹ E2 = 166,667 plants ha⁻¹ E3 = 266,667 plants ha⁻¹

S1 = 2001 cropping season, S2 = 2002 cropping season

environmental factor that affects seed quality traits of sesame. Therefore, it should be studied carefully to obtain higher seed yield with relatively superior seed quality traits.

Incorporation of superior seed quality characteristics into improved sesame genotypes of tropical origin is highly practicable and recommended.

Seed certification of sesame could be encouraged and incorporated into National Seed Service Programme of Nigeria. The results of this study should provide

information towards achieving this.

Sesame seed must be tested for germination and vigour in different environments to determine the favourable conditions for sesame seed production.

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Table 4: Effect of plant population and season environments interaction on seed quality components of sesame

Environment	2001 season	2002 season	Mean
Seed germination			
133,333plants ha ¹	78 _b	67 _c	73 _b
166,667plants ha ¹	75 _b	75 _a	75 _a
266,667plants ha ¹	80 _a	69 _b	75 _a
Mean	78 _a	70 _b	
EWSG			
133,333plants ha ¹	70 _{ab}	63 _b	67 _a
166,667plants ha ¹	69 _{ab}	65 _a	67 _a
266,667plants ha ¹	71 _a	64 _{ab}	68 _a
Mean	70 _a	64 _b	
Plumule length			
133,333plants ha ¹	4.3 _b	4.9 _b	4.6 _b
166,667plants ha ¹	4.2 _b	5.7 _a	5.0 _a
266,667plants ha ¹	4.5 _a	5.2 _c	4.9 _a
Mean	4.3 _b	5.3 _a	
Seedling vigour index			
133,333plants ha ¹	4.1 _b	4.1 _c	4.1 _b
166,667plants ha ¹	3.9 _b	5.3 _a	4.6 _a
266,667plants ha ¹	4.4 _a	4.3 _b	4.4 _a
Mean	4.1 _b	4.6 _a	
Field emergence			
133,333plants ha ¹	61 _b	68 _a	65 _{ab}
166,667plants ha ¹	62 _b	55 _b	64 _b
266,667plants ha ¹	66 _a	65 _b	66 _a
Mean	63 _b	66 _a	

Values within a column with letter subscripts in common are not significantly different at P ? 0.05. Seasons means followed by the same letter in the row are not significantly different at P < 0.05

Table 5: Effect of genotypes and plant population environments on seed germination and excess water stress germination over two seasons in sesame.

Genotypes	*Standard germination (%)			*Water stress germination (%)		
	E1	E2	E3	E1	E2	E3
Yandev 55	72 _b	74 _{bc}	84 _a	72 _a	62 _{cd}	74 _b
93A-97	72 _b	78 _{ab}	78 _b	64 _c	73 _a	67 _c
Goza	70 _b	71 _c	64 _d	74 _a	64 _c	60 _d
Type A	70 _b	75 _b	65 _d	71 _{ab}	67 _{bc}	58 _d
73A-11	73 _b	78 _{ab}	80 _b	67 _c	69 _b	73 _b
530-6-1	77 _a	77 _{ab}	82 _{ab}	63 _c	71 _{ab}	81 _a
73A-94	69 _c	77 _{ab}	74 _c	62 _d	69 _b	70 _b
69B-88Z	78 _a	73 _c	75 _c	63 _d	64 _c	71 _b
E8	71 _b	73 _c	68 _d	68 _b	59 _d	62 _c
Domu	77 _a	75 _{bc}	64 _d	72 _a	73 _a	57 _d
73A-97	76 _{ab}	75 _{bc}	84 _a	70 _{ab}	70 _{ab}	68 _c
C-K-2	71 _b	80 _a	80 _{ab}	59 _d	70 _{ab}	77 _b
530-3	70 _b	76 _b	71 _c	61 _d	64 _c	67 _c
Pbtill No1	71 _b	70 _c	74 _c	65 _c	63 _c	60 _d
Environment mean	73	75	75	67	67	68

Values within a column with letter subscripts in common are not significantly different at $P < 0.05$

*Mean values after angular transformation

E1 = 133,333 plants ha^{-1} E2 = 166,667 plants ha^{-1} E3 = 266,667 plants ha^{-1}

Table 6: Effect of genotypes and plant population environments on plumule length, seedling vigour index, field emergence over two seasons in sesame

Genotype	Plumule length (cm)			Seedling vigour index			*Field emergence (%)		
	E1	E2	E3	E1	E2	E3	E1	E2	E3
Yandev 55	5.3 _a	5.1 _a	4.8 _{ab}	4.80 _a	4.75 _a	4.77 _a	69 _a	68 _b	64 _b
93A-97	4.8 _b	4.3 _b	4.5 _b	4.32 _b	4.12 _c	4.33 _{ab}	61 _b	55 _d	69 _a
Goza	5.9 _a	5.2 _a	5.6 _a	5.08 _a	4.77 _a	4.15 _b	60 _{bc}	61 _c	55.7 _c
Type A	4.2 _c	5.2 _a	5.2 _a	3.62 _c	4.82 _a	3.97 _{bc}	51 _d	63 _c	63 _b
73A-11	4.1 _c	4.7 _{ab}	4.8 _{ab}	3.70 _c	4.53 _{ab}	4.63 _{ab}	68 _a	68 _b	69 _a
530-6-1	3.9 _{cd}	4.9 _{ab}	4.8 _{ab}	3.67 _c	4.70 _a	4.53 _{ab}	67 _a	62 _c	71 _a
73A-94	4.9 _b	5.0 _{ab}	4.9 _{ab}	4.12 _b	4.73 _a	4.52 _{ab}	71 _a	61 _c	65 _b
69B-88Z	4.5 _{bc}	4.9 _{ab}	4.6 _b	4.52 _a	4.43 _{bc}	4.28 _b	68 _a	62 _c	68 _{ab}
E8	5.8 _a	5.6 _a	5.3 _a	5.00 _a	5.10 _a	4.20 _b	53 _{bc}	72 _b	54 _c
Domu	4.2 _c	4.7 _b	5.3 _a	3.95 _c	4.37 _{bc}	3.80 _c	65 _{bc}	63 _c	63 _b
73A-97	4.0 _c	4.6 _b	4.7 _b	3.67 _c	4.20 _b	4.52 _{ab}	71 _a	63 _c	73 _a
C-K-2	3.9 _{cd}	4.8 _b	4.5 _b	3.38 _c	4.57 _a	4.37 _{ab}	66 _{bc}	76 _b	70 _a
530-3-1	5.2 _a	4.4 _b	4.7 _b	4.12 _a	4.10 _c	4.20 _b	59 _c	62 _c	66 _b
Pbt11 No1	3.9 _{cd}	5.5 _a	4.5 _b	3.4 _c	4.75 _a	3.83 _c	60 _{bc}	87 _a	65 _b
Environmental	4.6	7.7	4.9	4.09	4.55	4.29	64	66	65
Mean									

Values within a column with letter subscripts in common are not significantly different at $P \geq 0.05$

E1 = 133,333 plants ha⁻¹ E2 = 166,666 plants ha⁻¹ E3 = 266,667 plants ha⁻¹

*Mean values after angular transformation

Table 7: Heritability (H^2_B) and genetic advance (GA) of seed quality components in sesame under six environments.

Components	E1	E2	E3	E4	E5	E6
Standard germ (%)	72(9.8)	78(8.86)	72(0.84)	66(11.28)	70(8.78)	94(31.95)
EWSG (%)	81(5.45)	88(18.6)	72(0.39)	87(18.99)	37(3.61)	92(30.87)
Plumule length	83(0.07)	60(0.01)	60(0.05)	64(0.11)	38(0.02)	73(0.10)
Seedling vigour index	58(0.32)	57(0.44)	81(0.75)	55(0.97)	39(0.2)	78(0.09)
Field emergence (%)	60(8.1)	80(15.57)	76(12.28)	71(14.56)	53(7.73)	90(17.20)

Values in parenthesis are for GA as % of mean

E1 = 133,333 plants ha⁻¹ and 2001 season

E2 = 133,333 plants ha⁻¹ and 2002 season

E3 = 166,667 plants ha⁻¹ and 2001 season

E4 = 166,667 plants ha⁻¹ and 2002 season

E5 = 266,667 plants ha⁻¹ and 2001 season

E6 = 266,667 plants ha⁻¹ and 2002 season

$$H_b = \frac{^2g}{^2ph} \times 100$$

$$\text{Genetic advance (GA)} = K_A H \times 100$$

K is a selection differential (2.06 at 5%)

Table 8: Pearson correlation coefficients among seed quality components in two seasons across three plant population environments (n = 42).

Seed Quality Components		EWSG	Plumule length	Seedling vigour index	Field emergence
Standard germination	S1	0.56*	0.09	0.52*	0.49*
	S2	0.69**	-0.29	-0.47	0.50*
EWSG	S1		-0.06	0.20	0.36
	S2		-0.16	0.41	0.25
Plumule length	S1			0.89**	0.22
	S2			0.68**	-0.31
Seedling vigour index	S1				0.36*
	S2				0.07

*, ** significant at 5% and 1% levels of probability respectively

S1 = Cropping season of 2001,

S2 = Cropping season of 2002.

Appendix 1: Mean monthly temperature, rainfall and relative humidity for the study months (2001 – 2002)

Months	2001			2002	
	Mean Temp. (°C)	Relative Humidity (%)	Rainfall (mm)	Mean Temp. (°C)	Relative Humidity (%)
January	25.6	73.7	2.6	26.74	63.15
February	26.2	53.4	8.6	30.9	66.20
March	26.8	68.2	80.0	31.73	68.48
April	25.6	72.0	105.0	28.05	79.5
May	25.0	75.9	154.3	27.68	74.02
June	24.2	81.1	135.9	26.46	81.55
July	23.8	82.8	135.5	24.8	88.05
August	26.5	83.3	57.4	25.4	81.25
September	20.6	79.7	199.3	26.4	77.7
October	21.6	74.0	54.5	27.35	81.3
November	21.4	70.3	17.4	29.25	77.55
December	22.0	84.9	950.5	30.45	90.70
Mean Annual	24.1	74.9	79.2	27.93	77.45

Source: Ogun Sate River Basin Development Authority, Abeokuta.

REFERENCES

- Adebisi, M. A. (2004). Variation, Stability and Correlation Studies in Seed quality and yield components of sesame (*Sesamum indicum* L.) Ph.D Thesis, University of Agriculture, Abeokuta, Nigeria, 117pp.
- Adebisi, M. A.; Ajala, M. O. and Rasaki, N. O. (2003). Comparison of seed vigour of sesame in laboratory and field tests. *Jour. Trop. Forest Resources* 19(3): 21-23.
- Adebisi, M. A. and Ojo, D. K. (2001). Effect of genotypes on soyabean seed quality development under West African rainfed conditions. *Pertanika J. Trop. Agric. Sci.* 24 (2): 139-145.
- Adeyemo, M. O.; Ojo, A. O. and Aderibigbe, S. A. (1998). Effect of age of drying on pod length and viability of seed of beniseed. Proceeding of first national workshop on beniseed "Opportunities for research, production and marketing" L. O. Busari, A. A. Idowu and S. M. Musari eds. National Cereals Research Institute (NCRI) Badeggi, Nigeria. Pp.163-167.
- Ajala, M O. (2003). Influence of seed quality attributes on field emergence of pigeonpea (*Cajanus cajan* L.) and winged bean (*Psophocarpus tetragonolobus* L.). *Tropical Agriculture (Trinidad)* 80 (2):118-122.
- Ajala, M O; Adebisi, M A and O A Akingbogun. (2003). Variability for seedling vigor in tropical cowpea (*Vigna unguiculata* (L) Walp. *Moor Journal of Agric Research* 4 (1): 54-59.
- Allard, R. W. (1960). Principles of plant breeding. John Wiley and Sons Inc. New York.

- AOSA (1983) Association of Official Seed Analysts. Seed vigour testing handbook No. 32.
- Bark-Sabo G and Dolincka, B. (1988). Complex stress vigour test: a new method for wheat and maize seeds. *Seed Science and Technology* 16: 63-73.
- Bruggink, H.; Kraak, H. L. and Bekendam J. (1991). Some factors affecting maize (*Zea mays* L.) cold test results. *Seed Science and Technology* 19: 15-23.
- Genstat 2001. Genstat 10.0 Committee of the Statistics. Dept. Rothamsted Experimental Station. 2002. Genstat 10 Reference Manual. Clarendon Press Oxford
- Boersma, M. Law, M. and Adkins, S. W. (1996). Assessment of soybean seed vigour tests for Eastern Australia. *Australian J. of Expt. Agric.* 36: 99-103.
- Hall, R. D. and Weisner, L. E. (1990). Relationship between seed vigour tests and field performance of 'Regar' meadow bromegrass. *Crop Science* 30: 987-990.
- Hampton, J. G. (2002). What is seed quality? *Seed Science and Technology* 30: 1-10.
- Hampton, J. G. and Coolbear, P. (1990). Potential versus actual seed performance; can vigour testing provide an answer? *Seed Science and Technology* 18: 125-218.
- ISTA. (1995). International Seed Testing Association. International rules for seed testing. Rules 1995. *Seed Science and Technology*, 13: 322-326.
- Kim, S. H., Choe, Z. R., Kang, J. H., Copeland, L. O. and Elias, S. G. (1994). Multiple seed vigour indices to predict field emergence and performance of barley. *Seed Science and Technology* 22: 29-
- Labuschangne, M. T., Mamuya, T. N. and Koekemoeri, F. P. (2002). Canonical variate analysis of bread making quality characteristics in irrigated spring wheat (*Triticum aestivum*). *Cereal Research Communications* 30, 1-2: 195-201.
- Lovato, A. And Cagalli, S. (1992). Sugar beet (*Beta vulgaris* L.) seed vigour compared in laboratory and field tests. *Seed Science and Technology* 21: 1-6.
- Moot, D. J. and McNeil, D. L. (1995). Yield components, harvest index and plant type in relation to yield differences in field pea genotypes. *Euphytica* 86: 31-40.
- Mponda, O K K; Morse, S; Gibbon, D and Arthur, A E. (1997). Genetic studies in seedling vigor in sesame. *Annals of Applied Biology* 131: 161-170.
- Ojo D. K. and Dashiell, K. E. (2002). Gene action of seed longevity, plant height and yield characters in a soybean (*Glycine max* (L)) Merr cross. *Asset Series* 2(2): 151-156.
- Okolo, T. O. and Fajana, L.A. (1998). Implication of improved beniseed production and marketing on the national seed programme in Nigeria. Proceeding of First National Workshop on beniseed (Busari, L. D., Idowu, A. A. and Musari S. M. ed) pp. 100-109. National Cereals Research Institute (NCRI) Badeggi, Nigeria.

- Olowe, V. I. O. and Busari, L. O. (1994). Appropriate plant population and spacing for sesame (*Sesamum indicum* L.) in the Southern guinea Savannah of Nigeria. *Tropical Oilseeds Journal* 4: 20-25.
- Peterson, R. G. (1985). Design and analysis of experiments. Marcel Dekker Inc. New York, USA.
- Pollock, B. M. And Roos, E.E. (1972). Seed and seedling vigour. In: Seed biology, T.T. Kozlowoski ed. 311-387. Academic Press, London, New York.
- Powell, A. A. and Matthews, S. (1985). Detection of difference in the seed vigour of seed lots of Kale and Swede by the controlled deterioration test. *Crop Research* 25: 55-61.
- Tekrony, D. M.; Egli, D. B. And Philis, A. D. (1980). Effect of field weathering on the viability and vigour of soybean seed. *Agronomy Journal* 72: 749-753.
- Tesnier, K. Stookman-Donkers, H. M., Van-Pylen, J. G., Vander-Geest, H. M., Bino, R. J. and Groot, S. P. C. (2002). A controlled deterioration test for *Arabidopsis thaliana* reveals variation in seed quality. *Seed Science and Technology* 79: 149-165.