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RESEARCH ARTICLE

EFFICIENCY OF STANDARD GERMINATION AND VIGOUR TESTS IN PREDICTING FIELD EMERGENCE OF SESAME *Sesamum indicum* L. SEEDS

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ABSTRACT

This study was carried out at the National Centre for Genetic Research and Biotechnology (NACGRAB), Moor Plantation, Apata, Ibadan in 2014. The aim was to investigate the efficiency of standard germination and vigour tests in predicting field emergence of five accessions of *Sesamum indicum*: PBG009020, PBG009030, PBG009061, PBG009063 and PBG009064 respectively. The experiment consisted of both laboratory and field emergence tests. The laboratory test was laid out in completely randomized design (CRD) while field experiment was randomized complete block design (RCBD). Data collected were subjected to analysis of variance (ANOVA) and means separated with the Least Significant Difference at 5% probability level. Correlation analysis was carried out between laboratory test and field emergence. The *Sesamum indicum* accessions were tested and ranked in order of seed quality for predicting emergence of seeds of sesame accessions, while accelerated aging was used in determining field emergence of the seeds. The result indicated that NGB00963 had the highest response to field emergence test and accelerated aging test, while NGB00920 and NGB00961 responded better to standard germination, emergence index and accelerated aging. Similarly, NGB00930 had the lowest electric conductivity while NGB00964 had the lowest response to the entire tests carried out.

KEYWORDS: Sesame seeds, germination, emergence, accessions

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INTRODUCTION

Sesame (*Sesamum indicum*) is among the most important oil seed crops with high oil content of 46-64 per cent and 6355 Kcal kg-^{1} dietary energy (Sanjay and Goel, 1994). Sesame is otherwise known as the "Queen of oil seeds" by virtue of its excellent quality oil and utility. However, the germination potential of sesame seed is very low compared to other oil seed crops and often reduces before planting time which makes it difficult for farmers to predict appropriate seed rate per unit land area (Sanjay and Goel, 1994). Information on prediction of field emergence of sesame using laboratory tests is limited. Munamava *et al.* (2004) suggested electrical conductivity and accelerated aging tests for predicting field emergence in sesame. It is therefore important to identify quality tests that could predict field emergence in sesame seeds. Seed quality is a complex concept encompassing several attributes including genetic quality, seed health, physical aspects, germination and vigour. Germination capacity is a crucial aspect of seed quality. Therefore, germination tests are often used to determine maximum germination potential of a seed lot under optimum condition. Seed industries use standard germination test for labeling their seeds (AOSA, 2002). However, this test has its drawbacks as it could only predict field emergence under ideal environmental conditions. Therefore, vigour test has proven to be more useful as predictor of field emergence than the standard germination test (Delouche and Baskin, 2004).

Seed vigour is a component of seed quality that has bearing on field emergence and storability. It is ability of a seed to germinate and sustain its growth under a wide range of environmental conditions. Accelerated aging technique provides a tool for quantitative estimate of seed vigour and was initially developed as a test to estimate longevity of seed in commercial storage (Delouche and Baskin, 2004).It has been used to predict the life span of a number of different species. Recently, electrical conductivity (EC) test was used for evaluating seed germination and membrane integrity of some crops and also found suitable for assessing seed aging and storability. Since seed vigour is highly complex, the test has been used for measuring one or more deteriorations in seed quality (Hampton, 1992). The problem in predicting field germination is that it is impossible to predict weather conditions with necessary precision. Vigour test is one possible solution, although it does not predict performance for a particular set of fluctuations; rather, it predicts the general ability of seeds to germinate normally over a range of adverse conditions. However, additional tests could be used to better predict seedling emergence under a wide range of field conditions (Munamava *et al.,* 2004). Aging leads to deterioration of both germination and seed vigour. If laboratory germination test fails to indicate vigour differences within combined data of all the accessions, mean germination would give a better identification of vigour test differences.

Seed testing is used to determine seed viability and vigour. It is concerned with the number of seeds that emerges from soil under stress conditions and purity of seed lots. Due to variation and change in environment, it is possible to have different results from different locations of the world in terms of germination and vigour tests. Therefore, vigour test aims at predicting emergence of a particular seed lot with regard to a particular environmental condition (Munamava *et al.,* 2004).

Therefore this study was carried out to investigate the response of sesame emergence under stress condition and predict field emergence of *Sesamum indicum* seeds in the field.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the National Centre for Genetic Research and Biotechnology, (NACGRAB), Moor plantation, Apata, Ibadan in 2014. The Centre is located on latitude $7^{o}\,23'$ N and longitude of $3^{o}\,50'$ E, with annual rainfall of 1600 mm – 1800 mm per annum and mean temperature of 33°C.

Source of Experimental Materials

Five accessions of sesame: PBG009020, PBG009030, PBG009061, PBG009063 and PBG009064 were obtained from the National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan.

Laboratory Experiments

The experiment was divided in two sets: Laboratory and field emergence tests. Laboratory seed quality test was carried at the Seed Testing Laboratory of NACGRAB. Field emergence experiment was also conducted at the NACGRAB Experimental Farm. The experiment was laid out in a completely randomized design (CRD) and replicated four times with 100 seeds per replicate. The seed quality was investigated using standard germination, accelerated aging and electric conductivity tests.

Standard Germination Test

Standard germination test was conducted using river bed sand as a substratum. The sand was sieved with 2 mm sieve to ensure uniform particle size. Seed germination was assayed by placing 100 seeds per replicate in sand inside plastic trays and covered with moist sand of about 1cm level. The size of each plastic tray holding the test samples was 0.4m x 0.6m. The sand trays were kept at room temperature of 25°C for 7 days. Germination percentage were calculated by expressing the number of seedling per replicate that emerged 7 days after planting as a percentage of the number of seeds planted (ISTA, 2003). Germination percentage was determined seven days after planting (AOSA, 2002).

Accelerated Ageing Test (Stress Test)

Five accessions of sesame were subjected to accelerated aging condition in four replications. Four hundred seeds were placed on a wire mesh suspended in a container over 40 ml of distilled water in a sealed accelerated aging box (AOSA, 2002). The boxes were covered and placed in an accelerated aging chamber of relative humidity near 100 percent at 43°C for 72 hours. Thereafter, the seed samples were removed and planted in the same manner as in standard germination test. Germination percentages were calculated by expressing the number of seedlings per replicate that emerged 7 days after planting as a percentage of seeds planted (ISTA, 2003).

Electrical Conductivity (Biochemical Test)

Electrical conductivity test was carried out to assess the extent of membrane damage due to natural aging after 12 months in storage. Electrolyte leakage was measured from 100 seeds per replicate incubated for 24 hrs in 250 ml flasks containing 100 ml of distilled water at 25ºC using the conductivity meter. The flasks were covered to prevent contamination and were gently shaken at 6 hours intervals. Electric conductivity was measured for two replicates and expressed in µs/cm/g.

Field Experiment

A reconnaissance survey was first carried out in order to obtain first hand information about the study site. Ploughing and harrowing was done before laying out the experiment. The field experiment was laid out in a randomized complete block design (RCBD) with four replications. Each accession was planted using 1-row plot, each row was 2m long. The plots were arranged in a serpentine fashion to allow for easy data collection. The accessions were planted manually at the rate of one hundred seeds per replicate. Emergence percentage was determined seven days after planting. Emergence Index (EMI) was calculated by taking the germination counts at 5, 7 and 9 days after planting (AOSA, 2002).

Data Analysis

The germination data was log- transformed before subjecting them to analysis of variance (ANOVA). The means were separated using the Least Significant Difference (LSD) at 5% probability level. Correlation analysis was carried out between the laboratory test and field emergence test.

RESULTS AND DISCUSSION

Table 1 shows that NGB00961 had best performance in vigour in laboratory test as well as field test while NGB00961, NGB00963 performs well in three laboratory tests and was ranked 4th due to its poor performance on the field which reveals that the accession performed well under optimum condition but could not withstand stress in the field. NGB00920 had poor performance under optimum condition but recorded better performance in the field than NGB00963. The result indicated that germination test was less effective in ranking seed lots for field emergence. NGB00930 had poor performance under favorable condition and was ranked 3rd on the field which indicates that their accession was vigorous and standard germination test was less effective in predicting field emergence. Similarly, NGB00964 was ranked 5th under optimum environmental condition and also 5th on the field which shows that the accession was of low vigour. The result showed that standard germination test was less effective in ranking sesame accessions.

Table 1: **Ranking of the Different Accessions with the Tests Result**

ACS No.	STG	RK	ACA	RK	CON	RK	FEM	RK
NGB00961	100	1	100	1	4.26	1	54.50	1
NGB00964	85.75	5	70	5	4.37	2	31.92	5
NGB00963	99.75	2	93.5	2	4.91	4	34.08	4
NGB00920	96.50	3	89.5	3	4.66	3	43.50	2
NGB00930	96.25	4	76.25	4	6.59	5	42.08	3
LSD(0.05)	9.44		15.00		0.74		1.03	

Key: ACS NO-Accession Number, STG- Standard Germination Test, ACA – Accelerated Aging Test, CON – Conductivity Test, FEM – Field Emergence, RK - Rank

Table 2 shows that accession NGB00920 with r^2 value of 71%, means there is a relationship with accelerated aging test. Also, NGB00930 had r^2 value of 61% which indicate a positive relationship with standard germination test; NGB00961 with r^2 value of 86% meant that the accession had a very strong relationship with electric conductivity test. Similarly, NGB00963 with r^2 value of 54% also indicated a relationship between the accession and field emergence. However, NGB00964 with r^2 value of 38% implied that there was no relationship between the accession and field emergence index. The result indicated that electric conductivity accelerated aging and standard germination tests could be used for predicting field emergence of sesame in the tropics.

Table 2: **Relationship between the Accessions and Test Results**

Source	Accession	R^2	Coefficient of Variance
ACA	NGB00920	0.7133	2.7771
STG	NGB00930	0.6132	1.4916
CON	NGB00961	0.8589	8.7221
EMG	NGB00963	0.5433	44.794
EMI	NGB00964	0.3819	12.544

Table 3 shows that NGB00920 has the lowest mean value for standard germination with 4.58, 3.36 for electric conductivity test, and 26.25 for germination at day 5, 35.25 for germination at day 7 and 37.5 for germination at day 9, with the highest value of 5.78 for emergence index and 91 for accelerated aging. NGB00930 with 4.57 for standard germination and highest value of 4.12 for electric conductivity, 26.50 at 5 day after planting, but recorded the lowest value for the rest of the tests carried out, being 27.75, 28.50, 4.99 and 76.25. The accession NGB00961 responded most to standard germination test with 4.62, but recorded the lowest values for electric conductivity being 1.79, 44.00, 51.75, 51.25 and 5.32, respectively for germination at day 5, 7 and 9 and the highest value for accelerated aging. NGB00963 recorded low response to standard germination with 4.61, and 3.52 for electric conductivity. It had the highest value in all the germination tests (58.50, 69.50, and 70.50), but responded to field emergence with 5.31 and 93.50 for accelerated aging test. NGB00964 respond least to the entire test carried out with the lowest value for germination at day 5.

Table 3: **Mean values of all the Tests**

Accession	STG	CON	GERM 5	GERM 7	GERM 9	EMI	ACA
NGB00920	4.58	3.36	26.25	35.25	37.50	5.78	91.00
NGB00930	4.57	4.12	26.50	27.75	28.50	4.99	76.25
NGB00961	4.62	1.79	44.00	51.75	51.25	5.32	100.00
NGB00963	4.61	3.52	58.50	69.50	70.50	5.31	93.50
NGB00964	4.46	2.51	25.00	30.50	34.00	5.37	70.00
LSD(0.05)	0.11	0.74	26.57	29.64	31.00	1.03	15.00

Table 4 shows that standard germination had a strong relationship with accelerated aging (85%), germination at day 5 (63%), day 7 (62%), and day 9 (56%) but indicated a weak relationship with electric conductivity (14%) and emergence index (4%).The result showed that electric conductivity had a weak relationship with all other tests conducted. Seed germination at day 5 had a strong relationship with seed germination at day 7 (99%) and day 9 (98%) and accelerated aging test (67%), but a weak relationship with seed emergence index (12%). Seed germination percentage at day 7 had a strong relationship with accelerated aging test (72%), but weak relationship with other tests. Similarly, germination percentage at day 9 had a strong relationship with accelerated aging test (68%), but poor relationship with emergence index. Similarly, emergence index had a weak relationship with accelerated aging (33%).

Table 4: **Correlation among the Tests on Tropical Sesame Accessions**

	STGTR	CON2	GERMP5	GERMP7	GERMP9	EMI	ACA
STGTR	-						
CON2	0.14	-					
GERMP5	0.63	-0.13	-				
GERMP7	0.62	-0.17	0.99	-			
GERMP9	0.56	-0.10	0.98	1.00	-		
EMI	-0.04	-0.25	-0.12	0.04	0.08	-	
ACA	0.85	-0.31	0.67	0.72	0.68	0.33	-

CONCLUSION

The results showed that electric conductivity, accelerated aging and field emergence are suitable for predicting seed emergence of sesame accessions. However, accelerated aging test was the best predictor of seed emergence of *Sesamumindicum* accessions in the field. The accession NGB00963 recorded highest response to field tests while, NGB00920 and NGB00961 responded most to accelerated aging and standard germination at day 5.

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