ASSESSMENT OF GERMINATION PERCENTAGE AND SEEDLING VIGOUR IN SELECTED MAIZE GENOTYPES IN WUKARI, TARABA STATE, NIGERIA

ABSTRACT

Assessment of seedling vigour in six selected maize (*Zea mays* L.) genotypes was evaluated in the screen house of the Department of Crop Production and Protection, at the Teaching and Research Farm of the Federal University Wukari, Taraba State during the 2020 and 2021 cropping seasons. The experiment was laid out in a complete randomized design (CRD) and replicated thrice. Seed vigour indicators were number of sprouting, mean emergence time, germination percentage, seedling fresh weight (g), seedling dry weight (g), seedling root length (cm), seedling vigour index I and seedling vigour index II. The seed matrices measured were hundred seed weight (g), seed width (mm), seed length and seed thickness (mm). From the results obtained, the strong, positive and significant (1.00) relationship between the 100 seed weight and seedling germination percentage indicated that, maize germination is mostly determined by its size. Further, the most effective high vigour indicators are root length, seedling length, germination percentage, mean emergence time and number of sprouting at 4 days. However, M1155 recorded the highest seedling (72.33), with the highest corresponding germination percentage of 98%.

Keywords: Germination, Indices, Vigour, Seedling, Emergence

INTRODUCTION

Maize is one of the major cereals in the world. The economic importance of maize is due to the broad possibilities of use in fresh or processed form. However, the development of increasingly productive maize hybrid varieties resulted in a loss of nutritional value, especially with decreases in protein and oil, due to the negative correlation with yield (Uribelarrea *et al*., 2004; Zhang *et al*., 2008; Bueno *et al*., 2009). Another way of improving maize yield is the production and cultivation of high vigour seeds (Ghassemi-Golezani *et al*., 2011). Successful germination and seedling establishment are crucial steps for maintenance and expansion of plant populations and recovery from perturbations (de Melo RB, Franco AC, Silva CO, Piedade MTF, Ferreira CS, 2015). Seed vigour frequently affects seedling size soon after emergence (Perry 1980a; Roberts and Osei-Bonsu 1988). The process of continuous crop production and food security may be defeated when the vigour of seed and seed quality is uncertain. It is therefore important to work on genetically improved maize cultivars for increased yield and higher nutritional value. Genetic improvement in crops is developed to enable the crops to survive in an unlikely change of environmental conditions (ISTA, 2007). International Seed Testing Association (ISTA) definition: ‘Seed vigour is the sum of those properties that determine the activity and performance of seed lots of acceptable germination in a wide range of environments’ (ISTA, 2015). Irrespective of the pattern of pre-emergence seedling growth, the majority of viable seeds are most likely to fail in the post- germination pre-emergence seedling growth phase. Seed testing is the cornerstone of any seed programme. It is an analysis of physical parameters and the physiological quality of a seed lot and it is used for controlling quality parameters during seed handling (Schmidt, 2000). The testing of seeds includes some parameters such as seed weight, purity, moisture content and germination. Although germination testing is the primary and worldwide accepted criterion for seed viability, its results alone could not provide sufficient information about the potential performance of seeds lot (ISTA, 1995). For more accurate information, seed quality is assessed using vigour tests which provide information on the potential behaviour of a seed lot under storage and field conditions (McDonald, 1999). Seed vigour is a concept describing several characteristics associated with seed performance (Schmidt L, 2000). However, previous studies on seed quality testing by other authors demonstrated that a single test may be less effective to efficiently assess the physiological quality of different seed lots (Torres *et al*., 1998; Marcos Filho, 2015; Gaikwad *et al*., 2022). The objective of the Study is to provide a consistent ranking of seedlots in terms of their potential performance, to determine seed quality using the germination test, to estimate the rapid and uniform rate of seedling emergence and to accurately detect differences in physiological potential among tested seed lots.

MATERIALS AND METHODS

Experimental Site

The assessment of seedling vigour in six selected maize genotypes was evaluated at the Teaching and Research Farm of the Federal University Wukari, Taraba State during the 2020 and 2021 cropping seasons. Wukari is situated on latitude 7^0 52’17.00^{0}N and longitude 9^0 46’40.30^{0}E, within the Guinea Savannah agro-ecological zone of Nigeria with annual rainfall of 1058mm-1300mm and the relative humidity dropping to about 15% alongside with the annual temperature of 28^{0}C and 30^{0}C. Its characteristic alfisol soil is clay enriched with subsoil that has relatively high native fertility and it is suitable for the cultivation of a wide variety crops such as yam, soybean, sorghum, maize, rice and other assorted fruits and vegetables (Franke *et al*., 2006).

Experimental Design and Layout

The experiment was laid out in a complete randomized design (CRD), with four replications, in the screen house. A total of 24 pots were used in the experiment, with 20 seeds sown per pot. Therefore, 80 seeds were used for each maize genotype per replication.

Genetic Materials

Comprised of six maize genotypes, viz; local maize variety (L), Sammaz52, Oba98, M1155, Oba super II and M1217), obtained from the Seed Bank of the Department of Crop Production and Protection, Federal University Wukari, Taraba State.

Table 1: Description of the Maize Seed Lots used in the Study

Genotypes	Size	Coat colour	Source
M1155	Medium	White	Teaching and Research Farm, FUW
Oba Super II	Medium	Pale yellow	Teaching and Research Farm, FUW
Oba98	Medium	White	Teaching and Research Farm, FUW
M1217	Medium	Pale yellow	Teaching and Research Farm, FUW
Sammaz52	Medium	Yellow	Teaching and Research Farm, FUW
Local	Medium	White	Teaching and Research Farm, FUW

Seed Germination Test

The seed germination tests were conducted in the screen house between 5th – 15th May, 2020 and 7th - 17th May, 2021. The experimental pots of 12litres capacity were filled with humus-rich loamy soil and moistened with clean irrigation water. All the seeds were given no prior treatment and no fertilizer was used. The germination percentage was assessed at four and ten days after sowing. Seeds were considered as germinated when the radicle appeared from the seed coat.

Cultural practices

In each of the experiments, the twenty four pots were perforated at the base to allow excess water drain off. A sheet of paper was placed on the perforated area inside the pots to control drainage during irrigation and pots were then filled with loamy soil, rich in organic content. Each pot was carefully labelled according to the genotypes contained and replication. Clean irrigation water was used to moisten the soil before seed sowing and twenty seeds were sown directly in each pot at about 2cm depth. During the experiments irrigation water was applied once every day for 10days.

Data Collection

Data were collected on the seed germination and seedling vigour characters of the maize genotypes in the screen house and further evaluated in the laboratory as recommended by Adebisi *et al.* (2016). All sampled seedlings were chosen at random and tagged without bias. Data were collected on the following;

Seed coat colour: Colour of seed coats was observed and determined using colour chart.

Seed length: Seed length was measured in millimeter (mm) using Vernier caliper

Seed width: The width of seed was measured in millimeter (mm) using Vernier caliper.

Seed thickness: The seed thickness was measured in millimeter (mm) using Vernier caliper.

Hundred seed weight: Hundred seeds were counted and their weight measured in gram (g) using sensitive scale.

Days to sprouting: The date of sowing was noted and counted to the day of seedling emergence.

Number of sprout at 4 days: The number of normal seedlings was counted at 4days from the date of sowing.

Number of sprout at 10 days: The number of normal seedlings was counted at termination (10days after sowing).

Standard germination: On the 10th day of germination test, the number of normal, abnormal and dead seedlings in each replication were counted and only the normal seedlings was considered as germinated and expressed in percentage (%).

Calculation:

$$\text{Germination percentage} = \frac{\text{total number of seeds germinated} \times 100}{\text{total number of seeds in all replications}}$$

Seedling length: Five tagged normal seedlings were randomly selected from each genotype and their lengths were measured in centimetre (cm). The seedling length was measured from the base of the seedling to the first leaf.

Number of leaves at termination: The number of leaves were counted and recorded at the end of the experiment (10 days after sowing).

Colour of leaves: At the end of the experiment the colour of leaves was observed and determined using colour chart.

Number of dead seeds at termination: At the end of the experiment, the number of normal seeds was subtracted from the number of seeds sown which resulted to the number of dead seeds per pot.

Total height at termination: The whole plant height was measured from the base of the seedling to the last leaf using the centimetre rule (cm)

Root length at termination: At termination of the experiment, average length of roots for tagged seedling were measured using the centimetre rule and the values recorded in centimetre (cm).

First count mean % germination at 4 Days: The total number of normal seeds were counted at 4 days and divided by the total number of seeds sown and multiplied by 100.

Second count mean % germination at 10 Days: The total number of normal seeds were counted at 10 days and divided by the total number of seeds sown and multiplied by 100.

Seedling fresh weight at termination: At termination, fresh weight of the tagged seedlings was measured using the sensitive weighing balance represented in grams (g).

Seedling dry weight: The normal seedlings which were used to measure seedling length were also used for seedling dry weight measurement. The selected seedlings were kept in butter paper and dried in hot air oven at 80 ± 10C temperature for 24 hours. Then seedlings were removed from oven and allowed to cool in desiccator for 30 minutes before weighing on electronic balance. The average weight of dried seedlings from each replication was calculated and expressed as dry weight of seedling in milligrams (mg) (Anonymous, 2011).

Seedling vigour index-I: Seedling vigour index were calculated by using the formula suggested by Abdul-Baki and Anderson (1973) and expressed as whole number.

Calculation:

Seedling vigour index-I = Standard germination (%) x seedling length (cm)

Seedling vigour index-II: The seedling vigour index II was calculated using the formulae as suggested by Abdul-Baki and Anderson (1973)

Calculation:

Seedling vigour index-II = Standard germination (%) x seedling dry weight (mg)

Seedling emergence index: Seedling emergence index was calculated using formulae as suggested by Maguire (1962).

Calculation:

$$\text{Field Emergence Index (FEI)} = \frac{\text{No. of seedlings emerged}}{\text{Day of first count}} + - + \frac{\text{No. of seedlings emerged}}{\text{Day of final count}}$$

Mean emergence time: The mean emergence time (MET) was calculated for each treatment combination using the formula cited by Ellis and Roberts (1980).

Calculation:

MET= Σ nt /Σn

Where,

n- Number of seeds newly germinated at time

t - Days from sowing

Σn - Final emergence of seedlings

Data Analysis

Data collected were subjected to statistical analysis (ANOVA), using SPSS software (21st Edition) and means were separated using Duncan multiple range test (DMRT). Pearson's correlation analysis was conducted to determine relationships between the measured traits and their influence on one another.

RESULTS AND DISCUSSION

Vegetative Characters of the Maize Genotypes

The mean of vegetative characters of the six maize genotypes show a significant difference in number of days to sprouting, number of sprout at 4 days, days to first leave emergence, number of leaves at termination, seedling length, total plant height and root length. Only the number of sprout at 10 days demonstrated no significant difference. At days to sprouting, M1217 recorded highest figure (4.65) and the least (4.05) was in Local Maize. For the number of sprout at 4 days, Local Maize (5.00) indicated had the highest value and Oba98 (1.75) was the least.

Seed Viability and Vigour Parameters of Maize Genotypes

In the present study, six different Maize genotypes were evaluated as shown in (Table 3). There were significant differences in the values recorded for Hundred Seed Weight, Seedling Length, Seedling Vigour Index-I and Seedling Vigour Index II. For hundred seed weight, M1217 recorded the highest value (38.14). There was no significant difference in the values obtained for the Standard Germination and Seedling Dry Weight.

Physiological Quality Test Traits for Seed and Seedling Quality of Maize Genotypes

The mean values of the physiological traits revealed significant differences in Seedling Length at Termination, Total Plant Height at Termination, Root Length at Termination, Seedling Fresh Weight at Termination, Seedling Vigour Index I and Seedling Vigour Index

II. The root length at termination showed that M1155 had the highest value (11.47cm). Oba Super II recorded the highest seedling fresh weight (2.35g) at termination. However, there was no significant difference in Seedling Dry Weight at Termination.

Physiological Traits for Seed and Seedling Quality of Maize Genotypes

The physiological traits of seeds and seedling quality tests showed that for number of Days to Sprouting, Days to First Leaf Emergence, Number of Leaves at Termination, Hundred Seed Weight and Seed Thickness exhibited significant differences in their values. The Number of Leaves at Termination indicated that Sammaz52 recorded significantly higher value (4.00). Also, M1155 showed a significantly high value (5.90) for first leaf emergence. There was no significant difference in Seed Width, Seed Length and Seed Germination.

Germination Test Performance for Six Maize Genotypes

The germination test performance of the maize genotypes revealed significant differences in the First Count Mean of Germination at 4 Days and the Mean Emergence Time. Local maize had the highest value (25.00) for the First Count Mean of Germination at 4 Days, as well as the Mean Emergence Time, at 1.60. Whereas, values obtained for the Second Count Mean Germination at 10 Days and Standard Germination Test showed no significant difference.

Seedling Survival and Seedling Vigour Index of Maize Genotypes

In estimating the survival and seedling vigour indexes, the Number of Sprout at 4 Days, the Seedling Vigour Index I and Seedling Vigour Index II all indicated significant differences. For Number of Sprout at 4 Days, local maize (5.00) recorded a better performance. The number of Sprout at 10 Days, number of dead seeds at termination and the standard germination, proved not to show any significant difference.

Seedling Vigour Influence on the Phenology Stage of Maize Genotypes

The results from seed lot characterization obtained by physiological tests were recorded (Table 8). Most seed lots had similar germination results, varying from 80% to 70% for M1155, Oba Super II, Oba 98 and Local Maize cultivars while, there was low germination percentage in Sammaz52 and M1217 with varying results less than 70%. In analyzing the influence of the seedling vigour on the phenology stages, it was possible to observe that the Germination Percentage (%) did not show any significant.

Characterization of Maize Genotypes according to Seedlots

In Table 9, all traits were significantly affected by seedling vigour characters. There were significant differences in the Seedling Fresh Weight, hundred Seed Weight, Days to Sprouting, Root Length, Seedling Length, and Total Plant Height. This indicates a significant difference in the seedling fresh weight in Oba Super II as (2.35), the same significant difference was also found in seedling length for Local Maize as (3.93).

Correlation Coefficient of Traits

Results of correlation analysis revealed that seedling fresh weight exhibited a weak positively significant relationships with seedling dry weight, seedling vigour index-1, seedling vigour index-2, seedling root length and seed width. Also, seedling dry weight showed a weak, yet significant positive relationship with seedling vigour index-1, whereas the influence of the seedling vigour index-2 on seedling dry weight was strong, recording a positive significant value. Seedling vigour index-1 had a positive significant relationship with seedling vigour index-2, 100 seed weight, germination percentage and seed width. Further, the first count mean percentage germination demonstrated a strong positive relationship with mean emergence time, while its association with the field emergence time is significantly negative. The relationship between 100 seed weight and seedling germination percentage is positive, significant and absolute. However, mean emergence time and field emergence index recorded negatively significant correlation.

Discussion

It is not always possible to get an appropriately dependable idea of the field performance of a seed lot on the basis of germination test that is solely conducted in the laboratory. This is because field conditions are seldom optimum, which put them at variance with that is available in the laboratory and this would make emerging seedling suffer some kinds of stresses. However, seedling vigour offer the scope to assess the field and storage performance of seeds, as it can be affected by factors like genetic constitution, environment, seed weight and size, maturity at harvest, deterioration and pathogens, (Dias *et al.*, 2010).

From the study, Super II with the highest value (4.50) for first count mean germination percentage demonstrated the tendency for rapid germination, metabolism, establishment and growth in the field. This, in harmony with Chen *et al.* (2012), is an indication of a superior agronomic performance and yield. Further, the Local and M1155 varieties recorded the highest values for seedling vigour indices I and II (283.27, 72.33) respectively and they are considered to be more vigorous. According to Ibirinde *et al.* (2019), vigorously growing plants exhibit strong tolerance for diseases and have potential for optimum yield.

The strong, positive and significant relationship exhibited by first count mean percentage germination with the mean emergence time indicated that, the mean emergence time is mostly determined by the latter. Also, 100 seed weight demonstrated a strong and significantly positive relationship with the seedling germination percentage, thus showed, that, germination percentage in maize is determined by the seed size. This is in concord with findings of Mondo *et al.* (2013), that maize seed weight influenced its germination potential. Meanwhile, field emergence index exhibited a strong negative significant relationship with first count mean percentage germination and mean emergence time, showing that field emergence index is not a good indicator of the time it takes an ideal maize seed to emerge.

Table 2. Mean Values of the Vegetative Characters of the Maize Genotypes

Traits	M1155	SUPER II	OBA98	M1217	S52	L
DTS	4.15^{b}	4.45^{ab}	4.30^{ab}	4.65^{a}	4.55^{a}	4.05^{c}
NOS@4D	3.50^{ab}	4.50^{a}	3.50^{ab}	1.75^{b}	4.75^{a}	5.00^{a}
NOS@10D	16.00	14.00	1575	12.00	12.75	14.50
DTFLE	5.90^{a}	6.00^{a}	6.05^{a}	6.05^{a}	6.20^{a}	5.30^{b}
NOL@T	4.05^{ab}	3.85^{ab}	3.80^{b}	3.90^{ab}	4.10^{a}	4.00^{ab}
SL(cm)	3.23^{b}	2.81^{c}	2.74^{c}	2.70^{c}	2.81^{c}	3.93^{a}
TPH(cm)	27.85^{ab}	26.43^{b}	24.02^{c}	25.26^{b}	26.67^{ab}	29.44^{a}
RL(cm)	11.47^{a}	10.92^{a}	10.84^{a}	10.43^{ab}	8.92^{c}	9.23^{S52}

The Table is ranked in rows
S52=Sammaz 52, L= Local Maize, NOS@4D=Number of Sprout at 4 Days, NOS@10D=Number of Sprout at 10 Days, DTFLE=Days to First Leaf Emergence, NOL@T=Number of Leaves at Termination, SL=Seedling Length, TPH=Total Plant Height, RL=Root Length

Table 3. Seed Viability and Vigour Parameters of Different Genotypes of Maize

Genotype	**100SW(g)**	**SG (%)**	**SL(cm)**	**SDW(g)**	**SVI-I(g)**	**SVI-II(mg)**
M1155	36.27^{ab}	98.00	3.23^{b}	0.91	200.84^{b}	72.33^{a}
SUPER II	35.97^{ab}	70.00	2.81^{S52}	0.62	197.70^{b}	47.34^{b}
OBA98	30.69^{b}	78.75	2.74^{c}	0.65	204.39^{b}	51.79^{ab}
M1217	38.14^{a}	60.00	2.70^{c}	0.72	163.92^{b}	42.70^{b}
S52	30.65^{b}	63.75	2.81^{S52}	0.87	189.30^{b}	55.84^{ab}
L	32.98^{b}	72.50	3.3^{a}	0.86	283.27^{a}	62.47^{ab}

The ranging was recorded in column.
S52=Sammaz 52, L= Local Maize, SW- Hundred Seed weight, SG- Standard Germination, SL- Seedling Length, SDW- Seedling Dry Weight, SVI- I- Seedling Vigour Index I, SVI- II- Seedling Vigour Index

Table 4. Analysis of Variance for Physiological Quality Test Traits after Seed and Seedling Quality Tests of Six Maize Genotypes

Traits	**M1155**	**SUPER II**	**OBA98**	**M1217**	**S52**	**L**
DTS	4.15^{S52}	4.45^{ab}	4.30^{aS52}	4.65^{a}	4.55^{a}	4.05^{c}
DTFLE	5.90^{a}	6.00^{a}	6.05^{a}	6.05^{a}	6.20^{a}	5.30^{b}
NOL@T	4.05^{ab}	3.85^{ab}	3.80^{b}	3.90^{ab}	4.10^{a}	4.00^{ab}
100SW(g)	36.27^{ab}	35.97^{ab}	30.69^{b}	38.14^{a}	30.65^{b}	32.98^{b}
SW(cm)	4.10	2.37	6.08	6.12	3.00	1.93
ST(cm)	0.96^{b}	0.91^{b}	0.96^{b}	0.89^{b}	0.94^{b}	3.00^{a}

SL(cm)	0.05	0.45	0.48	0.51	0.53	0.43
SG(%)	80.00	70.00	78.75	60.00	63.75	72.50

The Table is Ranged in Rows.
S52- Sammaz 52, L- Local Maize, DTS- Days to Sprouting, DTFLE- Days to First Leaf Emergence, NOL@T- Number of Leave at Termination, 100SW- Hundred Seed Weight, SW- Seed Width, ST- Seed Thickness, SL- Seed Length, SG- Standard Germination.

Table 5. Mean Values of Seedling Traits after Physiological Traits after Seed and Seedling Quality of Six Maize Genotypes

Genotypes	SL@T (cm)	WPH@T (cm)	RL@T (cm)	SFW@T(g)	SDW@T(g)	SVI I	SVI II
M1155	3.23^{b}	27.85^{ab}	11.47^{a}	2.31^{a}	0.91	200.84^{b}	72.33^{a}
SUPER II	2.81^{S52}	26.43^{aS52}	10.92^{a}	2.35^{a}	0.62	197.70^{b}	47.34^{b}
OBA98	2.74^{c}	24.02^{c}	10.84^{a}	1.87^{S52}	0.65	204.39^{b}	51.79^{ab}
M1217	2.70^{c}	25.26^{S52}	10.43^{ab}	1.79^{c}	0.72	163.92^{b}	42.70^{b}
S52	2.81^{S52}	26.67^{aS52}	8.92^{c}	1.81^{c}	0.87	189.30^{b}	55.84^{ab}
L	3.93^{a}	29.44^{a}	9.23^{c}	2.19^{ab}	0.86	283.27^{a}	62.47^{ab}

The ranking is done in column.
S52- Sammaz 52, L- Local Maize, SL@T- Seedling Length at Termination, TPH@T-Total Plant Height at Termination, RL@T- Root Length at Termination, SFW@T- Seedling Fresh Weight, SDW@T- Seedling Dry Weight, SVI I- Seedling Vigour Index I, and SVI II- Seedling Vigour Index II

Table 6. Analysis of Variance of Germination Test Performance for Six Maize Genotypes

Genotypes	FCMG @ 4 Days (%)	SCMG@10 Days (%)	MET	SG (%)
M1155	17.50^{ab}	98.00	0.89^{ab}	98.00
SUPER II	22.50^{a}	70.00	1.30^{ab}	70.00
OBA98	17.50^{ab}	78.75	0.98^{ab}	78.75
M1217	8.75^{b}	60.00	1.60^{a}	60.00
S52	23.75^{a}	63.75	1.39^{a}	63.75
L	25.00^{a}	72.50	1.39^{ab}	72.50

The Table is Ranked in Column
S52- Sammaz 52, L- Local Maize, FCMG@4D-First Count Mean Germination at 4 Days, SCMG@10D- Second Count Mean at 10 Days, MET- Mean of Emergence Time and SG- Standard Germination.

Table 7. Analysis of Variance of Seedling Survival and Seedling Vigour Index across the Six Maize Genotypes

Genotypes	NOS@4D	NOS@10D	SVI I	SVI II	NDS@T	SG (%)
M1155	3.50^{ab}	16.00	200.84^{b}	72.33^{a}	4.00	98.00
SUPER II	4.50^{a}	14.00	197.70^{b}	47.34^{b}	6.00	70.00
OBA98	3.50^{ab}	15.75	204.39^{b}	51.79^{ab}	4.25	78.75
M1217	1.75^{b}	12.00	163.92^{b}	42.70^{b}	8.00	60.00
S52	4.75^{a}	12.75	189.30^{b}	55.84^{ab}	7.25	63.75

L	5.00^{a}	14.50	283.27^{a}	62.47^{ab}	5.55	72.50

The Table is Ranked in Column.
S52- Sammaz 52, L- Local Maize

Table 8. Analysis of Variance of Seedling Vigour Influence on the Phenology Stage of the Six Maize Genotypes

Genotypes	Germination (%)	Seedling vigour
M1155	98.00	High
SUPER II	70.00	Intermediate
OBA 98	78.75	Intermediate
M1217	60.00	Low
Sammaz 52	63.75	Intermediate
Local maize	72.50	Intermediate

Table 9. Characterization of Six Maize Genotypes according to their Seed lots

Genotype	SFW(g)	100SW(g)	Vigour Indicators				
			DTS	RL(cm)	SL(cm)	TPH(cm)	SDW(mg)
M1155	2.31^{a}	36.27^{ab}	4.15^{b}	11.47^{a}	3.23^{b}	27.85^{ab}	0.91
SUPER II	2.35^{a}	35.97^{ab}	4.45^{ab}	10.92^{a}	2.81^{b}	26.43^{ab}	0.62
OBA98	1.87^{S52}	30.69^{b}	4.30^{ab}	10.84^{a}	2.74^{c}	24.02^{c}	0.65
M1217	1.79^{c}	38.14^{a}	4.65^{a}	10.43^{ab}	2.70^{c}	25.26^{b}	0.72
S52	1.81^{c}	30.65^{b}	4.55^{a}	8.92^{c}	2.81^{b}	26.67^{ab}	0.87
Local	2.19^{ab}	32.98^{b}	4.05^{c}	9.23^{c}	3.93^{a}	29.44^{a}	0.86^{ns}

The Ranking is done Column.
S52- Sammaz 52, L- Local Maize, SFW (g)= Seedling Fresh Weight, 100SW(g)= One Hundred Seed Weight, DTS= Days to Sowing, TPH(cm)= Total Plant Height, SDW(m/g)= Seedling Dry Weight

Table 10: Correlation Coefficient of Traits

TRAIT	SFW	SDW	SVI-1	SVI-2	FCM%G	100SW	MET	SG%	RL	FEI	SW	ST	SL
SFW		0.352**	0.184*	0.378**	0.110	-0.183	0.077	-0.189	0.204*	-0.323	0.256*	0.017	0.056
SDW			0.208*	0.891**	0.218	-0.024	0.222	-0.034	-0.046	0.101	0.207	0.151	0.027
SVI-1				0.409**	-0.110	0.511*	-0.314	0.515*	0.000	0.090	0.416**	0.016	0.154
SVI-2					0.176	0.336	0.042	0.319	-0.017	0-211	0.226	0.091	0.106
FCM%G						0.033	0.901**	0.031	0.043	-0.752**	0.139	-0.278	0.386
100SW							-0.336	1.000**	0.159	0.198	0.193	-0.541	0.407
MET								-0.326	0.012	-0.724**	0.026	-0.049	0.215
SG%									0.175	0.204	0.193	-0.541	0.407
RL										0.119	0.039	-0.315	0.022
FEI											-0.115	0.016	-0.189
SW												0.014	0.119
ST													-0.318*
SL													

*, ** = significance at 0.001 and 0.005 respectively
SFW = seedling fresh weight (g), SDW = Seedling dry weight (g), SVI-1 = Seedling vigour index-1, SVI-2 = Seedling vigour index-2, FCM%G = First count mean germination percentage at 4 days, 100SW = 100 seed weight (g), MET = Mean emergence time, SG% = Seedling germination percentage, RL = Root length (cm), FEI = Field emergence time, SW = Seed width (cm), ST = Seed thickness (cm) and SL = Seed length (cm)

Conclusion

As an important aspect of seed quality certification, seed vigour assessment is necessary to ascertain seed genetic purity, health, vigorous growth and high yield in crops. Three seedling vigour traits (mean germination percentages, root length and mean emergence time) were observed to have direct influence on the establishment, vigorous growth, agronomic performance and yield in maize. There is a strong, positive relationship between seed weight and seedling germination percentage, indicating that, germination in maize seeds is mostly determined by its size. It can be concluded, that, Variety M1155 had a high seedling vigour, while M1212 demonstrated a low seedling vigour, whereas Super II, OBA 98, Sammaz 52 and the Local maize exhibited intermediate seedling vigour. Therefore, M1155 is mostly recommended for cultivation in Wukari, Taraba state.

REFERENCES

Adebisi, M.A, (2016). Seed and Seedling Vigour in Tropical Maize Inbred Lines. *Plant Breeding and Seed Science*, 67: 88-91.

Bueno, L. G., Chaves, L. J., Oliveira, J. P., Brasil, E. M., Reis, A. J. S., Assunção, A. Pereira A.F. Ramos M. R. (2009) Controle genético do teor proteico nos grãos e de caracteres agronômicos em milho cultivado com diferentes níveis de adubação nitrogenda. *Pesquisa Agropecuária Brasileira* 44: 590-598.

Chen, F., Liu, L., Chen, F. and Jia, G. (2012). The ecological characteristics of seed germination and seedling establishment of Manglietia patungensis: Implication for species conservation. *American Journal of Plant Science*. Vol. 3, 1455–1461.

Dias, M. A. N., MONDO, V. H. V. and CICERO, S. M. (2010). Maize seed and weed competition. *Journal of Seed Science, Londrina*, v.32, p.93-101.

Ellis, R. H., and Roberts, E. H., (1980). Towards a Rational Basis for Testing Seed Quality. In Seed Production (ed. P.D. Hebblethwaite), pp 605-645. Butterworths, London.

Franke, A.C., Ellis-Jones, J., Tarawali, G., Schulz, S., Hussaini, M.A., Kureh, I., White, R., Chikoye, D., Douthwaite, B., Oyewole, B.D., Olanrewaju, A.S., (2006). Evaluating and scaling-up integrated Striga hermonthica control technologies among farmers in northern Nigeria. Crop Prot. 25, 868–878.

Gaikwad Priyanka A., Avchar, B. K. and Kanade, M. B. (2022) allelopathic effect of aqueous extracts of trichodesma indicum (l.) R. Br. And tribulus terrestris l. On seed germination and seedling growth of maize and wheat. Int. j. res. biosci. agric. technol.10(1), 54-59.

Ghassemi-Golezani K. and Dalil, B. (2011) Seed Ageing and Field Performance of Maize under Water Stress. *African Journal of Biotechnology*. PP 18377-18380.

Ibirinde, D. O., Balogun, K., Uloko, J. E. and Adetunji, A. S. (2019). Biofortification of quality protein maize with beta carotene. *Asian Journal of Agricultural and Horticultural Research*. 4(4), pp. 1-11

ISTA (2007). International Rules for Seed Testing. Handbook of Vigour Test Methods. 3rd. Ed ISTA, Zurich. Switzerland.

ISTA. (2015). International Rules for Seed Testing. Basserdorf, Switzerland: *International Seed Testing Association*.

Schmidt L, (2000). Guide to handling of tropical and subtropical forest seed. Danida Forest Seed Centre.

ISTA, (1995). Understanding seed vigour / prepared by the ISTA Vigour Test Committee. Zurich, Switzerland: International Seed Testing Association 3.

Mondo, V. H.V, Cicero, S. M., Dourado-Neto, D., Pupim, T. L. and Dias, M. A. N. (2013). Seed vigor and initial growth of corn crop. *Journal of Seed Science*, Londrina, v.35, n.1, p.64-69.

McDonald, M. (1999). Seed deterioration: physiology, repair and assessment. *Seed Science and Technology*. 27(1):177- 237.

Schmidt, L, (2000) Guide to handling of tropical and subtropical forest seed. Danida Forest Seed Centre.

Torres, S. B. (1998). Testes de vigor em sementes de maxixe (Cucumis anguria L.) com ênfase ao teste de condutividade elétrica. Revista Brasileira de Sementes. (2):480-483.

Marcos, Filho J. (2015). Seed vigor testing: an overview of the past, present and future perspective. Scientia Agricola. 72(4): 363-374.

Uribelarrea M. Below F. E. and Moose S. P. (2004) Grain composition and productivity of maize hybrids derived from the Illinois protein strains in response to variable nitrogen supply. Crop Science, 44: 1593-1600.

Zhang, J. Lu X.Q. Song X. F. Yan J. B. Song T. M. Dai J. R. Rocheford T. and Li J. S. (2008) Mapping quantitative trait loci for oil, starch, and protein concentrations in grain with high- oil maize by SSR markers. Euphytica, 162: 335-334.

Kazem Ghassemi-Golezani; Shabnam Heydari and Sirous Hassannejad, (2015). Seed vigor of maize (Zea mays) cultivars affected by position on ear and water stress. *Azarian Journal of Agriculture*. Vol (2) Issue 2: 40-45.