EFFECT OF SOWING DATE ON THE GERMINATION AND LONGEVITY OF SEEDS OF MAIZE (*Zea mays*) CULTIVARS GROWN UNDER*Striga*INFESTED FIELD.

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ABSTRACT

Determination of the best sowing date that would produce high quality seeds of two maize cultivars was conducted at the Federal University of Technology, Minna, Nigeria. Three sowing dates (May, June and July) and two cultivars (SAMMAZ-17, which is a *striga* tolerant, and SUWAN-1-SR-Y, which is a *striga* susceptible) were selected for the trial. Seeds of these cultivars were sown accordingly and harvested at physiological maturity (95 Days after sowing)The study was a 2 x 3 factorial combinations arranged in a Completely Randomized Design (CRD) and replicated four times. Samples of seeds of each of the treatment combinations were placed in small open plastic plates measuring 300 ml and then placed in an incubator at 30 ^{0}C and a relative humidity of 85 %. This was aimed at accelerating the ageing of the seeds. Seed samples were drawn for germination test prior to storage and at two weeks intervals afterwards for 14 weeks. Seed quality was evaluated using 100-seed weight, seed moisture content, germination test, germination rate index, germination index and electro-conductivity test. Seeds of SAMMAZ-17 cultivar sown in July germinated and stored significantly higher than the other treatments. Sowing seeds of SAMMAZ-17 cultivar in July in areas with similar climatic and environmental condition is recommended.

Keywords: Maize, germination, vigour, striga, cultivar.

INTRODUCTION

Maize (*Zea mays* L.) belongs to the family Poaceae and it is grown as a multipurpose crop. It is considered as the queen of the cereal and is one of the most important cereal crops in the world (Neelam*et al.,* 2018). It is also the most widely-grown staple food crop in sub-Saharan Africa occupying more than 33 million ha each year (Food and Agriculture Organization Corporate Statistical Database [FAOSTAT], 2015). Multi-purpose uses of maize have made it a popular and most widely cultivated crop after wheat and rice in the whole world. In Nigeria, maize is consumed either fresh or processed.It is a major source of energy for humans and farm animals contributing 15-50 % of the energy in human diets in sub-Saharan Africa (Locke *et al.,* 2013). Two important components of maize cropping systems are variety and sowing date. Proper selection of these components can help in improving maize yield and seed quality (Chand *et al.,* 2017). Planting date is one of the most important aspects of management in agricultural system, which can affect yield through influencing emergence date, plant density, normal growth, pollination and maturity date. Delaying sowing date results in decreased maize seed yields and quality (Panahi*et al.,* 2010).

Seed performance can be limited by environmental conditions prior to or after physiological maturity. Thus, for optimal seed quality, sowing at the appropriate time to fit the specific maturity length is critical. The response of each crop to differences in weather conditions is important for improving yield and seed quality, hence enhancing food security, especially in developing countries (Akinnuoye-Adelabua and Modi, 2017). Selection of good cultivar and sowing at proper time are the most important factors of cropping system that enhances sustainable production (Ali *et al.,* 2018).

There is generally a gradual decline in germinability and subsequent vigour of the resultant seedling associated with a high susceptibility to stress upon crop establishment due to improper sowing date of crop species (Farrant *et al.,* 2017).

Among the stages of the maize plant life cycle, seed germination, seedling emergence and establishment are key processes in the survival and growth of plants (George and Rice, 2019). Germination is regulated by duration of wetting and the amount of moisture in the soil (Nielsen 2015).

Striga is considered to be the greatest biotic constraints to cereal production in Africa (Kamara *et al.,* 2007). The degree of *striga* damage depends on the susceptibility of the cultivar, the *striga* species present, the level of infestation, and any additional stress imposed by the environment. However, seed yield and quality is a complex quantitative trait that is greatly influenced by the environmental fluctuations and other factors (Ibrahim and Khidir, 2012). Weeds, such as *striga* being a biological component also form part of the environment (Adesina *et al.,* 2014). In the present study, it is hypothesized that *striga* infestation has an effect on seed quality of maize cultivars sown at different times in this agro-ecology of Nigeria. To test this hypothesis, seeds of two maize cultivars (*striga* tolerant and *stiga* susceptible) were produced under varying sowing dates in a striga infested environment and stored at different temperatures.

MATERIALS AND METHODS

Seeds of two maize cultivars (SAMMAZ-17 and SUWAN-1-SR-Y), sown at different dates (early in May; mid in June; late in July), in a striga infested field, were harvested. The treatments consisted of factorial combinations of the two maize cultivars and the three sowing dates arranged in a Completely Randomized Design (CRD), replicated four times.

Moisture Content Determination

The initial moisture content (MC %) of the seed was determined using the oven drying method at 130 ^{0}C for one hour according to (ISTA, 2006) and was expressed on wet weight basis as follows:

$$\frac{\text{Weight of wet seeds} - \text{weight of oven dried seeds}}{\text{Weight of wet seed}} \times 100$$

100-Seed Weight

Hundred seeds were counted at random from the harvested produce of each treatment in four replicates. The seeds were weighed using Mettler balance and values were recorded in grams.

Seed Storage and Germination

After threshing and cleaning, seeds were dried further at ambient temperature (30 ^{o}C) for 14 days in the laboratory of Department of Crop Production. Samples of seeds of each of the treatment combinations were placed in small open plastic plates measuring 300 ml and then placed in an incubator at 30 ^{0}C and a relative humidity of 85 %. This was aimed at accelerating the ageing of the seeds. The seeds were stored in the environment for 14 weeks. Seed samples were drawn for germination test prior to storage at two weeks intervals afterwards for 14 weeks. This was done by counting four replicates of 30 seeds each of the treatment combinations which were placed on filter paper moistened with distill water in plastic Petri-dishes. The Petri-dishes were carefully arranged in seed germination chamber at a constant temperature of 35 °C. Germination counts were taken every-other-day and results were expressed in percentages.

Seed Vigour

Germination rate index (GRI) and germination index (GI) were calculated and seed leachate electro-conductivity was measured to determine seed vigour as indices of seed quality at all the storage periods.

Germination rate index

Germination rate index (GRI) shows the percentage of germination per day. This was calculated using the relationship developed by Esechie (1994) thus:

GRI (% day^{-1}) = $\sum$ (Ni/i) ; Where N is the percentage of seeds germinated on day I, The higher the value of the GRI, the higher and faster the germination (Kader, 2005).

Germination index

Germination index is a comprehensive vigour measuring parameter which combines both germination percentage and speed (spread, duration and high and low events) (Kader, 2005). It was calculated using a modification of the relationship developed by Benech-Arnold (2000) thus:

GI = (14 x n1) + (12 x n2) + ...+ (2 x n14)

Where n1, n2......., n14 are the number of seeds that germinated on the first, second and subsequent days until the 14^{th} day, respectively; 14, 12... and 2 are the weights given to the number of seeds that germinated on the first, second and subsequent days respectively.

Electro-conductivity test

Four replicates of 30 seeds each were counted from lots harvested at each of the sowing dates into beakers to which 30 ml of distilled water was then added. The seeds were left in water for 24 hours after which the mixture was stirred and the supernatant decanted into clean beaker (ISTA, 2006). The electro-conductivity of the supernatant was measured using Jenway DDS-307 conductivity meter. The values were expressed in Siemens per meter (Sm^{-1}).

Data analysis

Data collected were subjected to analysis of variance (ANOVA) using Minitab 7.0 version and means were separated using Tukey test at 5 % level of probability where significant differences among the treatments were obtained. Data in percentages were transformed to arcsin values in order to obtain a reliable interaction between treatment means before they were analyzed.

RESULTS

Table 1 shows the effect of sowing date on the seed germination percentage (GP) of two maize cultivars.

Table 1: Effect Sowing Date on the Seed Germination Percentage of Maize Cultivars

	STORAGE PERIOD (WEEKS)						
CULTIVAR	0	2	4	6	8	10	12
SAMMAZ 17	90.56a	86.95a	85.28a	82.36a	73.61a	72.23a	70a
SUWAN-1-SR-Y	85.97a	83.76a	80.01a	75.86a	74.43a	73.05a	73.32a
SE±	1.84	2.42	2.27	2.38	3.5	2.59	2.5
SOWING DATE							
EARLY	90.00a	87.09b	85.01b	81.04b	75.81b	74.18b	75.40b
MID	76.86b	70.85c	68.33b	63.52c	55.01b	52.91c	49.18c
LATE	97.92a	98.13a	94.59a	92.91a	91.24a	90.84a	90.41a
SE±	2.25	2.97	2.78	2.92	4.28	3.17	3.06
CULT*SD	*	*	*	*	*	*	*

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 acc
Tukey test

There was no significant difference between GP of the seeds of the two maize cultivars before and throughout the period of storage. Sowing date significantly affected the germination of seeds. Prior to storage, seeds harvested from early and late sown plants germinated significantly higher than those of mid sown plants. Following storage from two weeks up till the end of study, seeds extracted from late sown plants germinated significantly higher than those of other sowing dates. Furthermore, except at 4 and 8 WAS, the early sown seeds also germinated significantly higher than the seeds extracted from mid sown plants.

Table 2: Interaction Effect of Sowing Date on the Seed Germination Percentage of Maize Cultivars

		STORAGE PERIOD (WEEKS)						
CULTIVAR*SOWING DATE		0	2	4	6	8	10	12
SAMMAZ 17	EARLY	97.50a	95.83ab	95.85a	90.00ab	83.33ab	80.85ab	80.00ab
	MID	75.00c	65.85c	65.25b	62.07c	45.85c	44.18c	39.18d
	LATE	99.17a	99.18a	95.83a	95.00a	91.65a	91.68a	90.82a
SUWAN-1-SR-Y	EARLY	82.50bc	78.35bc	74.18b	72.07bc	68.30abc	67.50b	70.80bc
	MID	78.73c	75.85c	72.50b	64.97c	64.18bc	61.65bc	59.17c
	LATE	96.67ab	97.08ab	93.35b	90.82a	90.82ab	90.00a	90.00ab
	SE±	3.19	4.2	2.19	4.12	6.06	4.48	4.32

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 accordi
Tukey test

The highest cultivar×sowing date interaction was recorded in seeds harvested from lately sown SAMM throughout the period of the experiment. These values were significantly similar to those of early sown of the same cultivar as well as that of lately grown SUWAN-1-SR-Y. Seeds of mid sown SAMMAZ-1

...lowest cultivar*sowing date interaction which was statistically similar to that of early and mid-grown ... SUWAN-1-SR-Y. Throughout the storage period, there was no significance difference between GRI of ...s of the two maize cultivars (Table 3). However, significant difference was observed throughout the ... periods for the three sowing dates.

Table 3: Effect Sowing Date on the Seed Germination Rate Index (%-Day) of Maize Cultivars

	STORAGE PERIOD (WEEKS)							
...LTIVAR	0	2	4	6	8	10	12	14
...MAZ 17	37.19a	35.49a	35.21a	32.43a	28.89a	30.32a	32.17a	32.27a
...WAN	34.17a	36.53a	35.42a	32.43a	29.63a	31.94a	29.91a	31.32a
SE±	1.27	1.3	1.27	1.25	2.13	0.96	2.05	1.59
...ING DATE								
EARLY	34.94b	34.37b	35.83ab	30.94b	32.50a	31.56b	29.13ab	32.53b
MID	31.05b	31.77b	30.52b	27.19b	21.88b	24.58c	26.98b	18.61c
LATE	41.04a	41.87a	39.58a	27.19a	33.40a	37.12a	37.01a	44.24a
SE±	1.55	1.59	1.55	27.19	2.61	1.17	2.52	1.94
...LT*SD	*	*	*	*	ns	*	ns	*

...s followed by the same letter (s) in the same column are not significantly different at $p<0.05$ according to ...est

Prior to storage, the highest GRI (41.04 $\%^{-day}$) was recorded by seeds extracted from the late sown plants; which was significantly greater than the 34.94 $\%^{-day}$ and 31.05 $\%^{-day}$ obtained from seeds of the early and late sown plants respectively. Except at 8 and 12 WAS, GRI values recorded with seeds of the late sown plants were significantly higher than those extracted from early and mid-sown plants. There was generally no significant difference between the seeds of early and mid-sowing dates.

When seeds were not stored, the highest interaction effect was recorded in SUWAN late. This value (41.88 $\%^{-day}$) was significantly higher than the value recorded from seeds of mid-sown plants of the same cultivar but significantly similar to other interaction values. At 2, 6 and 14 WAS, the highest interaction values recorded in SUWAN late was statistically similar to those of early and late SAMMAZ-17 cultivar, but significantly higher than those of other interaction values. The trends recorded at 4 and 10 WAS were similar to those of 2, 6 and 14 WAS (Table 4).

Table 4: Interaction Effect of Sowing Date on the Seed Germination Rate Index of Maize Cultivars

CULTIVAR*SOWING DATE		STORAGE PERIOD (WEEKS) 0	2	4	6	8	10	12
SAMMAZ 17	EARLY	36.54ab	38.54ab	41.25a	33.13ab	32.71a	33.33abc	30.42a
	MID	34.81ab	29.16b	27.29b	25.21b	19.38a	20.00d	30.42a
	LATE	40.21a	38.75ab	37.08ab	38.96a	34.58a	37.36a	35.69a
SUWAN	EARLY	33.33ab	30.21b	30.42b	28.75b	32.29a	29.79bc	27.85a
	MID	27.29b	34.37b	33.75ab	29.17b	24.38a	29.17c	23.54a
	LATE	41.88a	45.00a	42.08a	39.38a	32.22a	36.88ab	38.33a
	SE±	2.19	2.26	2.19	2.17	3.36	1.66	3.56

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 according to Tukey test

The effect of sowing date on the seed germination index (GI) of two maize cultivars is shown in (Table 5). Significant difference was not recorded between GI of the seeds of the two maize cultivars throughout the period of storage, while sowing date significantly affected the GI of seeds of the two cultivars.

Table 5: Effect Sowing Date on the Seed Germination Index of Maize Cultivars

CULTIVAR	STORAGE PERIOD (WEEKS) 0	2	4	6	8	10	12
SAMMAZ 17	360.83a	362 00a	388.37a	323.67a	291.80a	292.00a	290.20a
SUWAN-1-SR-Y	341.00a	337.70a	329.50a	307.00a	296.00a	307.30a	304.70a
SE±	7.6	13.3	7.23	9.54	15.8	10.4	13.6
SOWING DATE							
EARLY	353.75b	341.80ab	338.50b	311.00b	304.50a	305.80b	297.00b
MID	306.75c	312.80b	278.25c	254.00c	218.30b	217.80c	194.50c
LATE	392.25a	393.00a	385.50a	381.00a	359.00a	375.50a	400.80a
SE±	9.31	16.3	8.85	11.7	19.3	12.7	16.7
CULT*SD	*	ns	*	*	*	*	*

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 according to Tukey test

Before storage, the highest GI (392.25) recorded in the seeds of late sowing was significantly higher than 353.75 recorded in seeds of the early sown plants which was in turn significantly higher than 306.75 in mid sown plants. Similar trend were recorded during storage except at 2 and 8 WAS where early sowing had statistically similar values to late sowing.

Prior to storage, the highest cultivar*sowing date interaction (394.00) was observed in the SAMMAZ-17 cultivar with the late sowing date. The mid sowing date recorded the least 305.50) from the SUWAN-1-SR-Y cultivar. During storage, the least GI value (155.00) was ded from the mid sowing date of SAMMAZ- 17 cultivar by 12 WAS; and 178.00 from owing date of SUWAN-1-SR-Y cultivar (Table 6).

tion Effect Of Sowing Date on the Seed Germination Index of Maize Cultivars

OWING	STORAGE PERIOD (WEEKS)							
	0	2	4	6	8	10	12	14
EARLY	380.00ab	380.00a	381.50a	349.50a	326.50a	337.50ab	325.00ab	339.00ab
MID	308.50c	315.50a	258.00b	243.00b	184.00b	180.50d	155.00c	156.50c
LATE	394.00a	390.50a	376.50a	378.50a	365.00a	358.00a	390.50a	361.5ab
EARLY	327.50bc	307.50a	295.50b	272.50b	282.50ab	274.00bc	269.00b	257.00bc
MID	305.00c	310.00a	298.50b	265.00b	252.50ab	255.00cd	234.00bc	178.00c
LATE	390.50a	395.50aa	394.50a	383.50a	353.00a	393.00a	411.00a	410.50a
SE±	13.2	23	12.5	16.5	27.3	18	23.6	25.8

l by the same letter (s) in the same column are not significantly different at $p<0.05$ according to

re was no significance difference between cultivar*sowing date interaction in 2 WAS n both cultivars. Unlike SAMMAZ-17 cultivar*sowing date interaction, SUWAN-1-SR-Y sowing date was significantly different throughout the storage periods compared to the er two sowing dates. Although, there was no significant difference between the two tivar*sowing date at 2 WAS from both cultivars.

ble 7 shows effect of sowing date on the seed electro-conductivity (EC) of two maize tivars. Except at zero week where the EC values recorded between the two cultivars were nificantly similar, SUWAN-1-SR-Y had significantly higher EC values. Seeds harvested m late grown crops recorded significantly lowest EC values throughout the period of the periment. These were followed by those of early sowing and the highest values were corded in mid sowing.

Table 7: Effect Sowing Date on the Seed Electro-Conductivity of Maize Cultivars

CULTIVAR	STORAGE PERIOD (WEEKS) 0	2	4	6	8	10	12
SAMMAZ 17	29.43a	30.63b	31.97b	33.11b	35.27b	38.35b	41.49b
SUWAN	39.02a	45.65a	46.34a	49.50a	50.86a	52.83a	55.56a
SE±	3.38	2.27	1.24	1.1	1.17	1.01	0.81
SOWING DATE							
EARLY	29.69b	35.64b	36.55b	39.09b	40.65b	42.51b	43.93b
MID	56.39a	61.80a	63.26a	67.07a	70.25a	75.1a	81.6a
LATE	16.60b	16.99c	17.55c	17.75c	18.30c	19.15c	20.05c
SE±	4.14	2.77	1.51	1.35	1.43	1.24	0.99
CULT*SD	*	*	*	*	*	*	*

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 acc Tukey test

The interaction effects of sowing date on the seed EC of two maize cultivars is shown in Table 8. Before the seeds were stored, the least leachate seeds value were recorded by SAMMAZ-17 cultivar at late sowing date (15.60) while the highest value (63.78) was recorded by SUWAN-1-SR-Y at mid-sowing date. At 2 and 4 WAS, SAMMAZ-17 at early, late and SUWAN-1-SR-Y at late sowing date were significantly lower than other sowing dates. A similar trend was observed at 6, 8, 10 and 12 WAS, but SAMMAZ at late sowing date and SUWAN-1-SR-Y at late sowing date were significantly lower than SAMMAZ EARLY *which in turn*, was significantly lower than the other sowing dates. At 14 WAS, SAMMAZ LATE was significantly lower than other seeds sown at different sowing dates, while SUWAN MID recorded the highest leachate value.

Table 8: Interaction Effect Of Sowing Date on the Seed Electro-Conductivity of Maize Cultivars

CULTIVAR*SOWING DATE		STORAGE PERIOD (WEEKS)							
		0	2	4	6	8	10	12	14
SAMMAZ 17	EARLY	23.70bc	24.43c	25.75c	26.53c	27.83c	28.83d	29.20d	30.38d
	MID	49.00ab	51.70b	54.00b	56.05b	60.83b	68.63b	77.03b	84.1b
	LATE	15.60c	15.78c	16.15c	16.75d	17.18d	17.60e	18.25e	18.55f
SUWAN	EARLY	35.68bc	46.85b	47.95b	51.65b	53.47b	56.20c	58.65c	62.83c
	MID	63.78a	71.90a	72.52a	78.10a	79.67a	81.58a	86.18a	91.38a
	LATE	17.60c	18.20c	18.55c	18.75cd	19.43cd	20.70e	21.85e	23.63e
	SE±	5.86	3.92	2.14	1.91	2.03	1.75	1.4	0.5

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 according to Tukey test

Statistically, there was no significant difference between the two cultivars in terms of 100-seed weight (table 9). Although SAMMAZ-17 was heavier (21.21 g) as against SUWAN-1-SR-Y (21.09 g). The sowing date effect was significant on the 100-seed weight. The highest value of the 100-seed weight belonged to the early sowing date with average of 22.80 g. while the lowest average was recorded by the late sowing date at 18.55 g. There was no significant difference between the early- and the mid-sowing dates. However, the two sowing dates were significantly higher than the late-sowing date

Table 9: Effect of Sowing Date on the Seed Weight of Maize Cultivars Sown at Different Dates

CULTIVAR	
SAMMAZ 17	21.21a
SUWAN-1-SR-Y	21.09a
SE±	0.22
SOWING DATE	
EARLY	22.80a
MID	22.11a
LATE	18.55b
SE±	0.27
CULT*SD	*

Means followed by the same letter (s) in the same column are not significantly different at p<0.05 according to Tukey test

Table 10 shows the interaction effect of sowing date on the seed weight of two maize cultivars. There was no significant difference between the seeds sown dates at early and mid-sowing dates of the two cultivars; which differ significantly against the seeds sown late of the two cultivars.

Table 10: Interaction Effect of Sowing Date on the Seed Weight of Maize Cultivars

CULTIVAR*SOWING DATE		
SAMMAZ 17	EARLY	22.80a
	MID	22.70a
	LATE	18.14b
SUWAN-1-SR-Y	EARLY	22.81a
	MID	21.53a
	LATE	18.95b
	SE±	0.38

Means followed by the same letter (s) in the same column are not significantly different at $p<0.05$ acco Tukey test

DISCUSSION

In this study, environmental variations, including striga infestations, associated with sowin dates affected seed development and maturation causing variations in the germinatio percentage of the progeny seed lots. Seeds from the late sown maize (July) had hig germination percentage compared with the seeds from other sowing dates. This might be du to the favourable weather conditions including stable and sufficient rains which allowed rapi and maximum accumulation of photosynthetes at the dent stage of development, as well a low infestation rate of the *striga* weed at the period. The ability of the seeds from late sow date to germinate faster might also be attributed to greater food reserves accumulated in th seeds. Seed development of the mid-sown plants, coincided with the usual dry spells o August and extreme *striga* infestation which adversely affected the seed-filling period. Thi condition is known to reduce the germination and longevity of seeds of crop species. Thi phenomenon agrees with the findings of Atera*et al.* (*2012*) who reported that the damag *striga* causes, include poor seed-filling, which varies between fields and areas. The earlie reports that maize seed germinability and vigour varies depending on production environmen is reported by Copeland and McDonald (2012). Tesso and Ejeta (2011) acknowledged th fact that seeds which reach physiological maturity under extreme *striga* infestations hav lower germinability and vigour. Conversely, this result disagree with Soleymani an Shahrajabian (2012) who reported that sowing date had no effect on seed quality of barle under semi-arid conditions. This may be genetic, location specific (production environment) or crop dependent.

High leachate in seeds from plants of mid-sown dates suggests that the seeds are characterized with weak coats which exudes constituents easily during ageing; this might have accounted for the low vigour as expressed through its low germination percentage. This study confirms the earlier work of Farhadi*et al.* (2014) who observed that stressful environmental condition, such as *striga* infestation, cause cell membrane of seeds to become thin and lead to more leakage of electrolytes.

Seeds from both cultivars at late sowing date (July) had the lowest seed moisture content and 100-seed weight but recorded the highest germination percentage and vigour. This may not be unconnected with the fact that the well filled seeds matured into the cessation of rains, this implies that gradual drying of the seeds was enhanced which might be responsible for the reduction in moisture content of the seeds; the weight of the seed is a function of the moisture content of the seeds. This suggests that the weather during seed maturation influences the moisture content and weight of the progeny seeds which in turn determine its germinability (quality). This study was in agreement with Bakker (2001) who observed that moisture content reduction in seeds is initiated during maturation of seeds and orthodox seeds can be dried to low **moisture content** without any damage.

CONCLUSION AND RECOMMENDATION

To minimize effect of *striga* infestation on maize seed quality, understanding the interaction between sowing date, cultivar and the environment plays a major role. Late-sowing date (July) in the study area, experienced optimal temperature and rainfall as well as tolerance to *striga* infestation for good seed quality production. Plants sown at this date produced seeds which mature into the dry season; this enhanced gradual and effective drying of the seeds. Seeds from SAMMAZ-17 cultivar outperformed those from SUWAN-1-SR-Y as they attained physiological maturity under striga infestation. Therefore, sowing maize seeds around July in areas with similar environmental and climatic conditions will yield quality seeds.

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