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Assessment of Laboratory and Field Germination Percentages for Sugargraze and Columbus Grass Seeds

[*1,2]Dahiru, M., [2]Abdurrahaman, S.L., [2]Muhammad, A.I., [1,2]Muhammad, A.S. and [2]Kabir, A.U.

[1]Department of Animal Health and Production Technology, Binyaminu Usman Polytechnic, P.M.B. 013 Hadejia, Jigawa State, Nigeria

[2]Department of Animal Science, Federal University Dutse, P.M.B. 7156, Dutse, Jigawa State, Nigeria

*Corresponding author's email:mansurdahiru793@gmail.com

Abstract

The experiment was conducted to assess the laboratory and field germination percentages of the two forage sorghum. The laboratory assessment was conducted in the Animal Science Laboratory, Federal University Dutse, whereas the filed experiments were conducted in two (2) distinct locations; Binyaminu Usman Polytechnic and Federal University Dutse, Teaching and Research Farms (BUPoly and FUD farms) in the year 2023 rainy season. The data collected from the laboratory assessment was subjected to T-test using Microsoft excel (10th Edition) for the determination of germination percentages, while the field trial was arranged in a Randomized Completely Block Design (RCBD) in factorial layout consisting of two factors; Forage sorghum cultivars (Sugargraze and Columbus grass) and Planting spacing (10 x 30 cm, 15 x 45 cm and 25 x 75 cm); these were combined and replicated four (4) times. The data collected from field germination assessment were subjected to analysis of variance (ANOVA) using Genstat Statistical package (17th Edition), and means differences were separated using Student-Newman Keuls Test (SNK) at a 5% level of significance. In laboratory seed germination two hundred (200) seeds each of the cultivars were used, replicated ten times with twenty (20) seeds per Glass Petri dish and kept at (28 – 30 ^{0}C) for a week. The petri dishes were monitored daily, counted and recorded for the sprouted seeds for determination of percentage germination rate in each replication. The results of the germination percentages of Sugargraze and Columbus grass seeds were 92.50% and 81.50%, respectively. In the field germination, observation, counting and recording were carried out daily from the sowing date until constant numbers of the germinated planted seeds were counted within seven (7) days in each treatments and replicates. In both research locations (BUPoly and FUD farms), there were significantly ($P<0.05$) higher percentages of germination in Sugargraze (99.29% and 98.76%) compared to Columbus grass (93.07% and 89.69%). About the effect of spacing, there were no significant differences ($P>0.05$) in field germination in either location.

Keywords: Assessment, Germination, Seedling, Sprout, Sugargraze and Seeds

Introduction

One of the most crucial parts of the agricultural production system is seed planting. In the plant's life cycle, however, the stages of seed germination and seedling development are essential since more healthy seedlings guarantee more crop stands in the field and, thus, a higher yield (Devi *et al*., 2022). There are various elements that make up seed quality, such as physiological and physical characteristics (Zhu *et al*., 2010). Physical characteristics of the seeds, such as completeness, color, and purity, can be used to determine their quality (Wulansari *et al*., 2023). Farmers can increase production by using high-quality seeds, but one of the biggest issues they face in the field is poor seedling formation, which is impacted by meteorological factors, field management techniques, and seed quality (Zhu *et al*., 2010). Two reasons why high-vigor seeds can increase the yield of forage and fodder are that they promote rapid and uniform seedling emergence from the seedbed, which results in vigorous plants, and the ability to achieve plant population density under a variety of environmental conditions due to the high percentage of seedling emergence (Ghassemi-Golezani *et al*., 2008).

A C4 herbaceous annual grass, sorghum (*Sorghum bicolor* (L) Moench) is cultivated from seed in the summer to produce feed (Pushparajah and Sinniah, 2018; Srinivasa Rao *et al*., 2013). According to Pushparajah and Sinniah (2018), it is thought to be the sixth most significant grain in the world. Developed for grazing, green chop, or hay, Sugargraze (*Sorghum*

bicolor L. × Sweet sorghum × Sorghum sudanese L.) is a premium three-way cross of Sorghum, Sweet Sorghum, and Sudan grass (Kumar *et al*., 2022; Ranajit *et al*., 2022; Kar *et al*., 2016). Sugargraze produce excellent fodder due to their rapid growth rate, multi-cut (3-5), sweet, succulent stalks, and broad, deep green leaves (Bandara *et al*., 2016; Kar *et al*., 2016). Argentina is the birthplace of the forage sorghum known as Columbus grass (*Sorghum almum* parodi), which is a stable and well-balanced hybrid of Sudanese grass (*Sorghum sudanese*) and grain sorghum (*Sorghum bicolar*) (Muhammad, 2019; Na-Allah *et al*., 2017). Columbus grass is one of the numerous fodder plants that have been brought to Nigeria for use in both extensive and intensive ruminant livestock production systems (Muhammad, 2019). In addition to evaluating the field germination percentages of the two forages (Sugargraze and Columbus grass), the primary goal of this experiment is to ascertain the impact of cultivars and plant spacing on field germination percentages.

Materials and methods

Description of the study areas

The experiments were conducted in two (2) locations in the year 2023 rainy season. The first location was the Teaching and Research Farm of Binyaminu Usman Polytechnic, Hadejia, Jigawa State, coordinates of latitude $12^0$28' N and longitude $10^0$01' E (Muhammad *et al*., 2023). The second location was the Teaching and Research Farm of the Faculty of Agriculture, Federal University, Dutse, Jigawa State, coordinates of latitude 11.00^0 N to 13.00^0 N and longitude 8.00^0 E to 10.15^0 E (Gumel *et al*., 2020). The means monthly weather parameters: temperature (°C), relative humidity (%) and total rainfall (mm) were reported in Table 1.

Soil sampling and analysis

Soil samples from each of the experimental fields were collected at random using a soil auger at 0-15 cm and 15-30 cm depths. The soil samples were air-dried, sieved, and analyzed for physical (Clay, Silt and Sand) and chemical properties (pH , Organic Carbon, Total Nitrogen, Available Phosphorus and Zinc, Caution Exchange Capacity: Ca^{2+}, Mg^{2+}, K^+ and Na^+) base on the procedure of Black (1965) and the results were presented in Table 2.

Experimental test materials

The experimental materials were Sugargraze (*Sorghum bicolor L. × Sweet sorghum × Sorghum sudanese L.*) and Columbus grass (*Sorghum bicolor L. × Sorghum sudanese*); the seeds were sourced from National Animal Production Research Institute (NAPRI) Shika, Zaria.

Laboratory germination percentage of the sugargraze and columbus grass seeds

The laboratory seeds germination test method (between paper method) was used as described by (Bicksler, 2011); two hundred (200) seeds each of Sugargraze and Columbus grass were used with Twenty (20) seeds each per well labelled Glass Petri dish and replicated Ten (10) times. The cut substrate papers (double-folded papers towel) were fit in the sterilize glass petri dishes and the seeds were placed uniformly in between the moist double-folded substrate papers with none of the seeds touching each other. Adequate amount of distilled water was sprayed to completely moisten the papers without soaking. The glass petri dishes were sealed with lid covers, set in a bright location of the lab, and left at room temperature (between 28 and $30\ ^0$C) for a period of seven (7) days. The Petri dishes were examined; the sprouted seeds were counted for each replicate and were recorded after seven days, to calculate the % germination rate or germinability (Bicksler, 2011).

Treatments combination and experimental design for the field germination assessment

The experimental plots were laid in a Randomized Completely Block Design (RCBD) consisting of two factors; Forage sorghum cultivars (Sugargraze and Columbus grass) and Planting spacing (10 x 30 cm, 15 x 45 cm and 25 x 75 cm), these were combined and replicated 4 times as shown in Table 3.

Experimental plots for the field germination assessment

The total land areas for the trial in each of the two locations were 15 m x 14.5 m (217.5 m^2) and the plot size was 3 m x 2 m (6 m^2), an alley of 0.5 m and 1 m were left between plots and replicates, respectively. The land was ploughed and harrowed once and the plots were made to provide a clean seeds bed to enhance early seeds germination.

Sowing date and depth

The sowings were carried out on 24th July and 07th August at BUPoly and FUD Farms in rainy season of the year 2023 respectively. However, the seeds were sown at depth of 4-6 cm (Dutta *et al*., 2021; Forage, 2021).

Statistical data analysis

The laboratory germination assessment data collected was subjected to T-test using Microsoft excel (10th Edition) for the determination of percentages, while for the field germination percentages, the data were subjected to analysis of variance (ANOVA) using Genstat Statistical package (17th Edition), and means differences were separated using Student-Newman Keuls Test (SNK) at a 5% level of significance.

Results and Discussion

Laboratory germination percentages of sugargraze and columbus grass seeds

The germination percentages of Sugargraze and Columbus grass seeds were shown in Figure 1. As germination days increased, the percentages of laboratory germination increased markedly for all cultivars. In contrast to Sugargraze, which had germination percentages of 58.50% and 92.50% on days 2 and 4, Columbus grass had germination rates of 39.50%, 70.50%, and 81.50% on days 2, 4, and 6, respectively. Unlike Columbus grass seeds, which required six days to germinate fully, Sugargraze seeds did so in barely four days. Based on the data, the percentages of the Columbus and Sugargraze grass seeds are 81.50% and 92.50%, respectively. The results of these experiments agreed with those of Devi *et al.* (2022), who found that in the lab, 92%, 92%, 96%, 88%, and 88% of the seeds of tomatoes, groundnuts, black grams, maize, and rice germinated. It's well known that

studies on the germination of seeds in laboratories seldom accurately anticipate germination in natural environments. Wulansari *et al.* (2023) state that to ensure seed quality, field test methodologies need to be explored at.

Effects of cultivars and plant spacing on field germination percentage

Table 4 shows the results for the effects of cultivars and spacing on field germination percentage. In both research locations, Sugargraze exhibited a significantly ($P<0.05$) higher percentage of germination than Columbus grass. In BUPoly and FUD farms, respectively, Sugargraze had the highest germination rates (99.29% and 98.76%), which were substantially ($P<0.05$) higher than Columbus grass's 93.07% and 89.69%. Regarding the effect of spacing, there were no appreciable variations ($P>0.05$) in field germination in either location. The field germination percentage of the cultivars were higher than 74.44% reported by Ishiaku *et al.* (2016) and 85.00% recorded from previous study by Olanite *et al.* (2010) and Kallah *et al.* (1999) in *Sorghum almum*. Variations observed in the field germination percentage of the forage sorghum could be attributed to hardness of the seeds and higher soil moisture content as at the time of sowing. These were in agreement with the reports of Ishiaku *et al.* (2016) and Omokanye *et al.* (2001) who stated that high moisture stress can results into poor seed germination and death of seedling which eventually can cause poor stand count and low yield in earlier planting.

Conclusion

In summary, the results showed that while Sugargraze seeds germinated in only four days, Columbus grass seeds took 6 days. However, in the field assessment, Sugargraze had the highest germination percentage values (99.29% and 98.76%), which were higher than Columbus grass (93.07% and 89.69%) in BUPoly and FUD farms, respectively. There were no differences in either location as far as spacing was concerned. The results of the investigation showed that because the two types of forage sorghum seeds differed in nature, there were significant disparities in the emergence in the laboratory and field over the observation periods. On the other hand, the hardness of the seeds and soil moisture stress at the time of planting could be the reason for variances in the field germination percentage of the forage sorghum cultivars. It is recommended that you plant forage sorghum seeds, particularly Columbus grass seed when the soil is very wet since moisture stress leads to poor seed germination and seedling death, which can ultimately result in low biomass production and poor stand count.

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Table 1: Weather reports of the two study locations (Hadejia and Dutse)

Months	Hadejia			Dutse		
	TP (°C)	RH (%)	TR (mm)	TP (°C)	RH (%)	TR (mm)
May	29.80	44.80	-	35.80	44.80	68.30
June	22.10	38.70	62.50	33.50	53.60	299.80
July	22.20	54.20	153.00	31.50	48.30	122.40
August	29.50	41.70	198.00	30.40	39.70	305.20
September	27.60	54.40	60.50	30.10	57.20	184.10
October	24.50	37.40	30.00	32.20	74.40	13.00
November	24.50	69.50	-	32.60	75.60	-
Total	NA	NA	503.50	NA	NA	992.8
AVR	25.74	48.67	NA	32.30	56.22	NA

Source: *JARDA (2023). TP=Temperature, RH=Relative humidity, TR=Total rainfall and NA=Not applicable*

Table 2: Physical and chemical properties of soils of the two (2) study locations

Parameters	Hadejia (BUPoly Farm)		Dutse (FUD Farm)	
	0 – 15cm	15 – 30cm	0 – 15cm	15 – 30cm
Physical properties				
Particle size (%)				
Sand	92.00	94.00	96.96	92.96
Clay	1.00	1.00	1.76	1.76
Silt	7.00	5.00	1.28	5.28
Textural Class	Sand	Sand	Sand	Sand
Chemical properties				
pH (H_2O)	6.38	6.36	5.81	5.59
pH ($CaCl_2$)	5.55	5.83	5.29	4.98
Total Nitrogen (%)	0.11	0.07	0.105	0.14
Organic Carbon (%)	0.40	0.11	0.10	0.26
P (mg/kg)	6.90	8.61	12.40	15.00
Ca (cmol/kg)	2.39	1.79	1.96	2.24
Exchangeable cation				
Mg^{2+}(cmol/kg)	1.69	2.52	0.98	0.96
K^{+}(cmol/kg)	0.40	0.26	0.26	0.18
Na^{+} (cmol/kg)	0.62	0.66	0.14	0.16
Zn^{2+} (mg/kg)	7.11	2.99	0.64	0.03

Source: Soil analysis (2023).

Table 3: Treatments combination

Treatment	Combination
T1	**C1S1**
T2	**C1S2**
T3	**C1S3**
T4	**C2S1**
T5	**C2S2**
T6	**C2S3**

Forage Sorghum Cultivars: *(Sugargraze = C1 and Columbus Grass = C2) while,* ***Planting Spacing:*** *(10 x 30 cm = S1, 15 x 45 cm = S2 and 25 x 75 cm = S3).*

Table 4: Effects of spacing and cultivars on field germination percentage

Treatment	%Germination	
	BUPoly	**FUD**
Cultivar (C)		
Sugargraze (C1)	99.29^{a}±0.61	98.76^{a}±0.94
Columbus grass (C2)	93.07^{b}±0.61	89.69^{b}±0.94
P – value	<0.001	<0.001
Spacing (S)		
10 x 30 cm (S1)	97.12^{a}±1.16	96.37^{a}±1.15
15 x 45 cm (S2)	94.09^{a}±1.16	92.95^{a}±1.15
25 x 75 cm (S3)	93.70^{a}±1.16	93.36^{a}±1.15
P – value	0.105	0.106
Interaction		
C*S	NS	NS

Means ± SEM follows by same letter(s) within treatment column are not significantly (NS) different using SNK at 5% probability level.

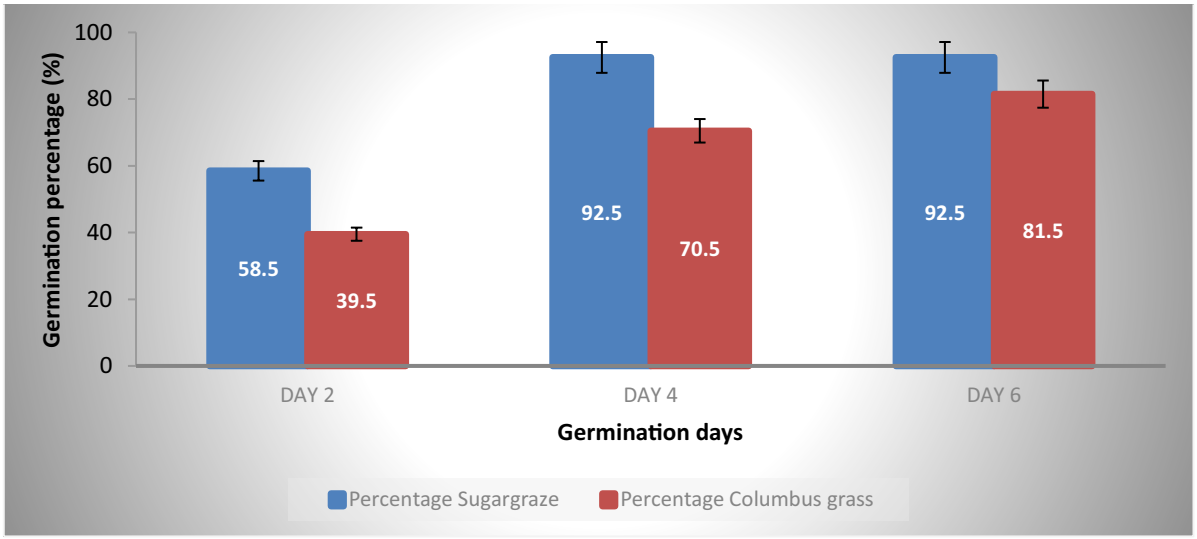

Figure 1: Laboratory seeds viability test with percentage of germinated seeds (viable seeds) of the Cultivars (Sugargraze and Columbus grass)