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Effect of Different Sowing Methods on Growth and Fodder Yield of Switch Grass (*Panicum virgatum* L.) in Jega Semi-arid Zone of Kebbi State, Nigeria

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Abstract: A study was conducted during the 2016 rainy season at Jega Teaching and Research farm of Kebbi State University of Science and Technology to investigate the effect of sowing methods on the growth parameters, herbage and dry matter (DM) yield of Switch grass (*Panicum vargatum*) in the semi-arid zone of Nigeria. Treatment consisted of three sowing methods (broadcasting, dibbling and drilling) which were laid out in randomized complete block design (RCBD) replicated three times among three blocks. Each plot in each block was measuring, 2 m × 1 m. Seeds of Switch grass were sown manually at the rate of 5.6 kg/ha for all the treatments and NPK fertilizer was applied across the treatments at the rate of 100 kg/ha. The experiment lasted for 12 weeks during which the growth parameters and plant establishment counts were measured while fresh herbage and DM were determined after harvesting at the end of the period. The sowing methods had significant effect ($p < 0.05$) on the growth parameters and herbage yield. The highest plant height (116.52 cm), leaf width (0.98 cm), leaf length (43.10 cm) and leaf number (9.37) was recorded for dibbling sowing method. Also, the highest fresh herbage (13.70 t/ha) and DM yield (2.33 t/ha) were recorded for dibbling sowing method. However, the mean establishment counts were not significantly ($p > 0.05$) affected by the sowing methods. The results suggested that Switch grass can be successfully established in Sudan savanna zone by dibbling sowing methods for good growth performance, herbage and DM yield.

Key words: Fodder yield, Switch grass, sowing methods.

1. Introduction

The bulk of ruminant animal production in the semi-arid environments has long subsisted on bush grazing of natural pastures of low nutritive value found in the savanna areas. These animals consequently grow slowly, produce small milk and reproduce at long intervals [1, 2]. In an attempt to improve the nutritional needs of ruminants in fragile environments like that of the arid and semi-arid regions of Nigeria, research efforts suggested that farmers should diversify their production systems by integrating high-value sown pasture crops [3] such as *Panicum virgatum* (Switch grass).

Switch grass (*P. virgatum*) is a perennial warm season grass belonging to the family of Poaceae. It is one of the dominant species of the Central North America tall grass prairies, where it occurs naturally from 55° N in Canada, United States and Mexico [4]. Switch grass is a new addition to the sown pastures of Nigeria. Dale and David [5] discovered that Switch grass does well on a wide variety of soil types; it is drought tolerant and produces well on shallow, rocky soils. Soil pH should be 5.0 or above and where soil test indicates medium or higher P_2O_5 and K_2O, no fertilization is needed at sowing [5].

In spite of the fact that current academic research works on the production of the crop have largely

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evaluated its adaptability on small scale plots in varying environments [6], the potential of Switch grass as feed for stock in Nigeria has not been exploited. USDA/NRCS [7] reported that Switch grass is an excellent feed for stock especially palatable before the plants flower. According to Gray *et al*. [8], Switch grass contains appreciable crude protein level of 14%-20% during early season (April-late May) and two different harvests are possible: June and August. However, there is currently no information on the potential impacts of large-scale Switch grass growth and production on natural resources and environments of the Savannah zones. Uncertainty surrounds the effective sowing methods suitable for Switch grass in savanna zones of Kebbi State and the lack of information on the other basic agronomics dictated that research should be undertaken to develop a capacity for predicting impact of Switch grass in semi-arid environments and Nigeria at large. Korres and Frond [9] reported that beside other agronomic factors, seed rates and sowing methods are the major factors which determine the overall crop vigor and ultimate yield of Switch grass.

It is on this basis that the study was embarked upon to investigate the different sowing methods as it influences the growth characteristic, fodder and dry matter (DM) yield of Switch grass in the semi-arid area of Kebbi state.

2. Materials and Methods

A field trial was conducted during the 2016 rainy season between the months of July to September at Jega Teaching and Research farm of Kebbi State University of Science and Technology. The area is located in the Sudan savanna agro-ecological zone of Nigeria (latitude: 12°11′ N; longitude: 4°16′ E) at an altitude of about 350 m above the sea level. The climate of the area is semi-arid with erratic and scanty rainfall (500-600 mm) that usually lasted for five months (May-September) and long dry period (October-April). The relative humidity ranges from 21% to 47% during the dry season and 51% to 79% during the rainy season. Temperature ranges from 14 °C to 30 °C and 27 °C to 41 °C during rainy and dry seasons, respectively [10].

Treatments consisted of three sowing methods (broadcasting, dibbling and drilling) which were laid out in a randomized complete block design (RCBD) and replicated three times amongst three blocks. The land was prepared manually using hand hoeing. Gross plots measuring 7 m × 5 m (35 m^2) were demarcated. Three blocks separated by 1 m between were laid out in an east to west direction containing three plots each (2 m × 1 m) separated by 0.5 m within making a total of nine plots.

Seeds of Switch grass obtained from United State of America through Sokoto State Energy Research Center of Usmanu Danfodio University were sown by direct seeding (manually) at the rate of 5.6 kg/ha for all the treatments. Spacing of 30 cm (intra and inter row) and 50 cm apart at a planting depth of 1 cm was used for dibbling and drilling methods and covered with soil. Seeds were evenly spread after raking for broadcasting method and were slightly covered with soil. NPK fertilizer at the rate of 100 kg/ha was applied across the treatments as supplemental nutrient source at two weeks after planting. Weeding commenced at two weeks after establishment and weeds were controlled manually using hand hoe after every two weeks throughout the 12 weeks duration of the experiment.

Leaf length was measured from the base of the leaf stalk to the tip of the leaf; leaf width was also measured at the widest portion of the leaf while the plant height was measured from the base of the plant stand to the tip of the tallest leaf. All measurements were done with the use of a tape and recorded in centimeter.

Plant establishment counts were done at four weeks after sowing (WAS) by counting the stands in dibbling (50 cm apart), for drilling a random distance of 50 cm was used while in broadcasting, stands count was established by using a quadrant at random points. The herbage yield determination was taken by cutting the plants from each treatment at the height of 5 cm

above the ground level at 12 WAS using a weighing balance scale in kilogram which was latter converted to tone/ha. Fresh cut plants were later air dried until constant weight was recorded to estimate the total DM yield in tone/ha.

3. Data Collection and Analysis

Data on plant establishment counts, herbage yield and the growth parameters (plant height, leaf number, leaf length and leaf width) were taken and recorded at 3, 6, 9 and 12 WAS. Five randomly selected plants were tagged for data collection. The data were subjected to analysis of variance using Statistical Analysis System (SAS) [11]. Least significant difference (LSD) was carried out for means separation where significant difference was observed.

4. Results and Discussion

The mean stands establishment counts, herbage and DM yield as influenced by sowing methods are presented in Table 1. There was no significant effect ($p > 0.05$) of sowing methods on stand establishment counts of Switch grass. Broadcasting sowing method recorded the highest value of 62.3% while drilling sowing method recorded the least value of 56.0%. This is in line with generally held opinions [12-14] that decreasing spacing between stands increases plant population per unit area. The response of herbage yield of Switch grass to sowing methods was significantly affected ($p < 0.05$). Herbage and DM yield (13.70 t/ha and 2.33 t/ha) obtained from dibbling sowing method were significantly higher than those obtained from drilling (9.10 t/ha and 1.82 t/ha) and broadcasting (8.00 t/h and 1.52 t/ha) sowing methods. This contradicts the work of Evans [15] who reported that the herbage yield in *Lablab* was higher by the influence of broadcasting than dibbling and drilling sowing methods. Ezenwa *et al*. [16] reported that there was little consistency in the effects of establishment methods on yield of components of pasture or total yield. This was also similar to the findings of Onifade and Akinola [17] with no significant difference in the total DM yield in *Chloris gayana-Stylosanthes guianensis* c.v. cook mixture.

The results of the plant height, leaf length, leaf width and number of leaves are presented in Tables 2-5, respectively.

The sowing methods had significant ($p < 0.05$) effect on the plant height particularly at 8 WAS and 10 WAS. The highest (116.52 cm) plant height was recorded in dibbling and the least (61.53 cm) was observed in broadcasting. This observation could be due to variation in the planting depth and minimal competition between stands in dibbling sowing method

Table 1 Establishment counts, fresh herbage and dry matter (DM) yield of Switch grass as affected by sowing methods.

Sowing methods	Establishment counts (%)	Fresh herbage yield (t/ha)	DM yield (t/ha)
Broadcasting	62.30	8.00[b]	1.52[c]
Dibbling	59.00	13.70[a]	2.33[a]
Drilling	58.33	9.10[b]	1.82[b]
LSD	32.07	2.70	0.19

[a, b, c] Means in the same column with different superscript are significant ($p < 0.05$).

Table 2 Plant heights (cm) of Switch grass as affected by sowing methods.

Treatments	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS
Broadcasting	24.53	54.43	64.40	60.18[b]	61.53[b]
Dibbling	24.39	64.57	75.13	111.03[a]	116.52[a]
Drilling	23.80	65.58	78.58	66.02[b]	66.78[b]
Significant	NS	NS	NS	*	*
LSD (0.05)	10.78	15.93	24.03	28.40	22.47

[a, b] Means followed by the same letter within the same treatment are statistically the same ($p < 0.05$).

WAS: weeks after sowing; NS: not significant; *: significant.

Table 3 Leave lengths (cm) of Switch grass as affected by sowing methods.

Treatments	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS
Broadcasting	16.61	36.53	46.93[b]	31.32[b]	33.70
Dibbling	17.35	41.03	54.33[a]	40.20[a]	43.10
Drilling	18.54	41.83	50.30[ab]	32.73[ab]	36.37
Significant	NS	NS	*	*	NS
LSD (0.05)	9.10	5.40	4.62	8.21	10.01

[a, b] Means followed by the same letter within the same treatment are statistically the same ($p < 0.05$).
WAS: weeks after sowing; NS: not significant; *: significant.

Table 4 Leave width (cm) of Switch grass as affected by sowing methods.

Treatments	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS
Broadcasting	0.14[a]	0.30[a]	0.33	0.73[b]	0.60[b]
Dibbling	0.44[b]	0.70[b]	0.80[a]	0.98[a]	0.82[a]
Drilling	0.19[c]	0.31[b]	0.33[b]	0.86[ab]	0.73[ab]
Significant	*	*	*	*	*
LSD (0.05)	0.04	0.09	0.09	0.20	0.19

[a, b, c] Means followed by the same letter within the same treatment are statistically the same ($p < 0.05$);
WAS: weeks after sowing; *: significant.

Table 5 Number of leaves/plant of Switch grass as affected by sowing methods.

Treatments	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS
Broadcasting	4.60	4.27	4.80	5.53[b]	6.33[b]
Dibbling	4.30	4.67	5.00	8.33[a]	9.27[a]
Drilling	4.40	4.67	5.07	5.93[b]	6.07[b]
Significant	NS	NS	NS	*	*
LSD (0.05)	0.04	0.09	0.09	0.20	0.19

[a, b] Means followed by the same letter within the same treatment are statistically the same ($p < 0.05$).
WAS: weeks after sowing; NS: not significant; *: significant.

which enhanced proper nutrients utilization. This observation supports the work of Cook *et al.* [13] who reported that planting depth and spacing favor general plant performance.

The highest (54.33 cm) and the lowest leaf length (46.93 cm) were recorded for dibbling and broadcasting sowing methods at 6 WAS, respectively. Significant ($p < 0.05$) response in leaf length was observed from dibbling sowing method at 6 WAS and 8 WAS. This might be attributed to the spacing in dibbling since the stands experience little or no inter-specific competition for limited resources compared to closely spaced stands as in broadcasting which depressed leaf production/plant owing to increased plant population per unit area. This is in line with the work of Hassan [14] who reported that widely spaced plants tend to bear more leaves due to less competition compared with those closely spaced plants.

The leave width of Switch grass was significantly ($p < 0.05$) influenced by sowing methods throughout the trial period with the highest leave width (0.98 cm) obtained from dibbling at 8 WAS while the lowest leave width (0.14 cm) was recorded from broadcasting at 2 WAS. This could be as a result of small number of stands/unit areas which support proper light utilization, hence stem strength and leave widening in dibbling than drilling and broadcasting. This is inconformity with the findings of Korres and Froud [9].

The response of number of leaves/plants of Switch grass was not significantly ($p > 0.05$) affected at 2, 4 and 6 WAS as contrast ($p < 0.05$) to eight weeks and 10 weeks. The highest leaf number/plant, 8.33 and

9.27 were recorded in dibbling at eight weeks and 10 weeks, respectively. This observation contradicts the findings of Prasahar *et al.* [18] who reported that sowing seeds of grasses by broadcasting method showed significant increase in all vegetative characteristics including the leaf number.

5. Conclusions

The results conducted from this study indicate that Switch grass can be successfully established in Sudan savanna zone by dibbling sowing methods for good growth performances, herbage and DM yield.

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