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Effect of Sowing Methods on Growth and Seed Yield of Rhodes grass (*Chloris gayana* L. Kunth) Cultivars Under High Terraces Soil

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Abstract

The effects of four sowing methods on growth and yield of two Rhodes grass (*Chloris gayana* L. kunth) cultivars under high terraces soil were investigated at a farm of Elamn Elgisai scheme-Eddamer in River Nile State, Sudan for two consecutive seasons (2017/18 and 2018/19). The results showed that broadcast sowing significantly improved growth and yield parameter compared to the other sowing methods. Sowing broadcast on flat produced highest plant height, leaf area and higher number of spikes per plant, while sowing broadcast on ridges produced highest 1000 - seed weight and higher seed yield of the crop. Cultivars were varied from each other for seed yield and other recorded characters. Fine cut cultivar was superior to reclaimer cultivar in all growth parameters, while reclaimer cultivar was superior to fine cut cultivar in 1000 seed weight and the final seed yield.

Keywords: Rhodes grass, high terraces sowing methods

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أثر طرق الزراعة على النمو وإنتاجية الحبوب لأصناف حشيشة الرودس في أراضى التروس العليا

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المستخلص

تأثير أربعة طرق للزراعة على النمو وإنتاجية الحبوب لصنفين من حشيشة الرودس درست في أراضي التروس العليا في مزرعة بمشروع الأمن الغذائي بالدامر بولاية نهر النيل، السودان لموسمين متتالين(2017/ 18 و 19/2018). أوضحت النتائج أن الزراعة نثراً حسنت معنوياً من مكونات النمو والإنتاجية مقارنة ببقية طرق الزراعة. الزراعة نثراً في الأرض المسطحة نتج عنها أعلى إرتفاع للنبات، مساحة ورقية وأكبر عدد من السنابل بالنبات، بينما نتج عن الزراعة نثراً في السرابات أكبر وزن للألف حبة وأعلى إنتاجية من للحبوب للمحصول. إختلفت الأصناف في مابينها في إنتاجية الحبوب وبعض الصفات الأخرى المسجلة. الصنف فاين كت كان تفوق على الصنف ريكلايمر في كل قياسات النمو، بينما تفوق الصنف ريكلايمر على الصنف فاين كت في وزن الألف حبة وإنتاجية الحبوب.

كلمات مفتاحية: حشيشة الرودس ، التروس العليا ، طرق الزراعة

Introduction

Rhodes grass (*Chloris gayana* kunth) is a perennial or annual leafy grass cultivated as sown pastures in irrigated terraces (Quattrocchi, 2006 and Cook *et al*., 2005). It is a summer – growing, stoloniferous grass. Rhodes grass is an important multi and multi- tillering annual forage for pasture and hay, drought-resistant and very productive, of high quality when young. Its ability to establish rapidly make it valuable for soil conservation (Yossif and Ibrahim, 2013). It is useful as a cover crop and soil improver, as it improves fertility, soil structure and helps to decrease nematode numbers (Cook *et al*., 2005). However, Rhodes grass was shown to outcompete summer weeds and has been considered helpful for controlling their development (Moore, 2006). Seasonal water logging over 30 cm kills the plant (FAO, 2014). Rhodes grass grows on a wide range of soils from poor sands to heavy clays (Arshad *et a*l, 2014).

There are many types of Rhodes grass cultivars but among all fine cut is most popular cultivar. (Arshad, 2015) reported that fine cut cultivar is popular because of its productive yield. The maximum plant height, tillers/plant, leaf area and green fodder yield was also observed for the cultivar fine cut. It was derived from katambora. Production of Fine cut was remarkable when nitrogen fertilization was applied in a separate split dose (Valenzuela and Smith, 2002). Reclaimer, is a fine stemmed Rhodes grass with a very high leaf to stem ratio when compared to other katambora types. Sowing methods vary considerably on different soil types. This is mainly related to irrigation requirements and drainage (Elkarouri and Mansi, 1980). In heavy clay soils the crop should be extensively on ridges to prevent lodging. Hanan (2004) reported that sowing maize on ridges and on flat resulted in the same yield. Also, he reported that sowing on flat or in ridges had no effect on seedling emergence of maize, so there was no difference in number of plant per unit area. Samia (2001) conversely reported that the plant population of alfalfa resulted in a higher plant density when sown on flat compared to that on ridges. Suliman (2018) indicated that sowing sorghum on flat increased plant height, number of panicle/m^2 and seed yield. Also, Mehissi (2017) reported that sowing guar on flat increased growth and seed yield of the crop.

Rhodes grass can be vegetatively propagated or established from seeds. For vegetative propagation, larger clumps can be cut into pieces and planted at one meter distance from each other

(NSWDPI, 2004). Because Rhodes grass seeds are fluffy, they may need to be coated or mixed with a carrier to improve the flow through the seeder (Moore, 2006). Seeds can be broadcasted or shallow-drilled (5 - 10 mm depth) during fall. The seeds can germinate under dry conditions provided that the soil has residual moisture (NSWDPI, 2004).

Research work is little and more studies for this crop are therefore needed. In addition, farmers are not aware of most of its cultural practices such as sowing methods. Therefore, the objective of this study was to investigate the effect of sowing methods on growth and seed yield of two Rhodes grass cultivars (fine cut and reclaimer) under irrigation on the high terraces soil.

Materials and Methods

Afield experiment was conducted for two consecutive seasons (2017/18 and 2018/19) in a farm of Elamn Elgisai Scheme at Eddamer in River Nile State, Latitude 17º 48- N, Longitude 34º 00-E on heavy clay alkaline soil (clay 42.13) with a pH of 9.0.

The treatments consisted of two Rhodes grass cultivars fine cut (I) and reclaimer (E) and four sowing methods which were (broadcast on ridges, line on ridges, broadcast on flat and line (row) on flat). The experiment was laid out in split plot design with four replications. Forage cultivars were assured to the main plots and sowing method to the sub plots. The experimental unit was a plot having an area of 9 m^2 with four ridges or four rows per plot at 60 cm spacing between ridges or rows. The seeds used in the experiment were obtained from Hudieba Research Station. The crop was seeded at a rate of 10 kg/ha on 27th of March in the first season, and on 7th of April in the second season.

The parameters which were measured during the course of the study included plant height, leaf area, number of spikes per plant, 1000 seed weight and seed yield. Plant height was taken at 30, 45 days after sowing and at each cut. Five plants were randomly selected, measured from the soil surface to the plant tip. Average plant height was recorded in cm. Leaf area was determined each time at harvest. Five plants were randomly selected from each plot. The length and the width of leaf were measured. The leaf area was calculated using the following formula:
Leaf area = leaf length ×leaf width ×0.75 as reported by Watson and Watson (1953).

For number of spikes per plant, five plants were randomly selected from each treatment for the last cut. Number of spikes were counted and average was recorded. For 1000 seed weight, a sample containing 4000 seeds was counted for each treatment. A sub sample of 1000 seeds was weighed to determine the 1000 seed weight. For seed yield determination the seeds collected at harvest time from an area of one m^2 for each treatments were weighed and seed yield per hectare was estimated.

Data was analyzed using the least significant difference (LSD) method (Gomez and Gomez, 1984).

Results and Discussion

Plant height (cm):

Sowing broadcast on flat produced higher plant during both seasons except for the first, second and third measurement of the first season compared to the other sowing methods. This increase in plant height was significant in the first, second, third and fifth measurements of the second season. On the other hand, broadcast on ridges increased plant height in the first measurement and significant in second measurement of the first season (Table1). These results agreed with those obtained by Hong *et al.* (1987) and Ibrahim *et al*.(2006).

Also Table (1) showed that Fine cut outscored reclaimer cultivar in plant height in seven out of ten measurements during both seasons. These differences reached the significant level

for the second, third and fifth measurements of the first season. Result obtained agreed with those reported by Yousif and Ibrahim (2013).

Table (1) : Effect of sowing methods on plant height of Rhodes grass cultivars during (2017 - 2019) seasons:

sowing methods										
season	1st					2nd				
measure / Treatment	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
FB	10.42	26.60^{ab}	51.42	46.95	46.22	27.02^{a}	53.50^{a}	98.25^{a}	84.17	103.95^{a}
RB	10.80	27.90^{a}	53.30	43.96	38.70	23.97^{ab}	49.70^{ab}	83.07^{b}	83.75	100.50^{ab}
FL	9.85	22.87^{b}	54.30	43.80	42.92	20.40^{bc}	44.42^{bc}	85.45^{ab}	79.90	94.10^{c}
RL	10.00	23.92^{ab}	51.07	37.95	33.95	18.05^{c}	37.35^{c}	68.40^{c}	82.12	96.90b^{c}
Mean	10.26	25.32	52.52	43.16	40.45	22.36	46.26	83.79	82.48	98.86
LSD	NS	4.49	NS	NS	NS	5.35	8.07	14.18	NS	5.39
Cultivars										
I	10.63	27.45^{a}	54.73^{a}	42.53	48.12^{a}	23.03	46.62	87.27	82.07	98.21
E	9.90	23.20^{b}	50.31^{b}	43.80	42.76^{b}	21.58	45.91	80.31	82.90	99.51
LSD	NS	2.01	3.84	NS	5.17	NS	NS	NS	NS	NS
C.V	21.04	15.77	14.53	14.77	25.41	16.85	16.30	14.18	6.67	6.47

Means flowed by the same letter (s)in a given column are not significantly different p = 0.05

FB Sowing broadcast on flat. RB Sowing broadcast on ridges. FL Sowing in line(row) on flat. RL Sowing in line on ridges. I Fine cut cultivar. E Reclaimer cultivar. NS Not significant.

Leaf area (cm^2):

Broadcast sowing on flat produced higher leaf area in three out of six cuts during both seasons, while broadcast sowing on ridges increased leaf area in the first and second cuts of the first season. Furthermore, broadcast sowing on flat significantly increased leaf area in the third count of the second season (Table 2). This result agreed with those reported by Springer and Gillen (2007).

Fine cut outnumberd reclaimer cultivar in leaf area in all cuts of both seasons. This increase in leaf area was significantly obtained in the first and second cuts of the first season (Table 2). Result obtained agreed with those reported by Mirza *et al* (2002).

Table(2) : Effect of sowing methods on leaf area of Rhodes grass cultivars during two seasons (2017 - 2019):

	sowing method					
Season	1st			2nd		
Cut / Treatment	1st	2nd	3rd	1st	2nd	3rd
FB	16.10	12.98	9.39	19.64	20.71	11.62[a]
RB	18.08	14.95	7.47	19.84	15.66	10.75[ab]
FL	15.90	13.37	8.85	20.81	16.41	11.08[ab]
RL	16.27	13.13	7.66	16.48	16.53	8.78[b]
Mean	16.59	13.61	8.34	19.19	17.33	10.56
LSD	NS	NS	NS	NS	NS	2.66
Cultivars						
I	17.24[a]	14.41[a]	8.61	19.27	18.41	10.95
E	15.93[b]	12.80[b]	8.07	19.12	16.24	10.17
LSD	1.06	1.11	NS	NS	NS	NS
C.V	12.74	16.25	22.29	11.87	22.44	28.24

Number of spikes per plant:

Differences between sowing methods with respect to number of spikes per plant were not significant during both seasons, while broadcast on flat and on ridges slightly increased number of spikes per plant in the first and second seasons, respectively (Table 3). Similar observation was made by Elkarouri and Mansi (1980).

1000 seed weight (g):

Differences between 1000 seed weight as a result of sowing methods were not significant in both seasons. However, broadcast sowing on ridges and sowing in line on flat increased 1000 seed weight in the first and second seasons, respectively (Table 4). Similar result was reported by Ishiaku *et al*.(2016).

Table (3 and 4) showed that number of spikes per plant and 1000 seed weight did not differ greatly for both cultivars and the differences were not big enough to reach the significant level. On the other hand, reclaimer cultivar had the higher mean number of spikes per plant and the highest mean of 1000 - seed weight during both seasons compared with fine cut cultivar. This may be due the highest number of tillers/plant which was reflected in lower 1000 - seed weight. This result was similar to the observation of Ali *et al* (2001).

Table (3): Effect of sowing methods on number of spikes per plant of Rhodes grass cultivars during two seasons (2017 - 2019):

sowing methods		
Season / Treatment	1st	2nd
FB	11.35	8.55
RB	9.90	8.67
FL	10.85	8.57
RL	11.17	8.57
Mean	10.81	8.61
L.S.D	NS	NS
Cultivars		
I	10.77	9.07
E	10.86	9.15
L.S.D	NS	NS
C.V	15.91	18.34

Table (4): Effect of sowing methods on 1000 seed weight of Rhodes grass cultivars during two seasons (2017 - 2019):

sowing methods		
Season / Treatment	1st	2nd
FB	0.33	0.37
RB	0.41	0.38
FL	0.33	0.42
RL	0.32	0.40
Mean	0.35	0.39
L.S.D	NS	NS
Cultivars		
I	0.31	0.35
E	0.39	0.43
L.S.D	NS	NS
C.V	21.79	18.98

Seed yield (kg/ha):

Sowing on flat (broadcast and in line) produced higher seed yield compared to sowing on ridges (broadcast and in line) during both seasons (Table 5). However, the differences were not big enough to reach the significant level. The increase in seed yield as a result of flat sowing could be explained on the basis that all growth and yield component parameters measured in this experiment (plant height, leaf area, number of spikes per plant and 1000 seed weight) were favored by flat sowing and this was reflected in higher seed yield. Similar result interpretations were also reported by Suliman (2018) and Mihessi (2017).

Reclaimer cultivar out yielded fine cut cultivar in seed yield and gave slight increase during both seasons. This differences were not big enough to reach the significant level (Table 5). This might be explained by the fact that reclaimer cultivar had greater number of spikes per plant and higher 1000 - seed weight. Similar result was reported by Abusuwar and Abdella (2001) who reported that the increase in final seed yield of clitoria could be a result of the increase in 1000 – seed weight.

Table (5) : Effect of sowing methods on seed yield of Rhodes grass cultivars during two seasons (2017 - 2019):

sowing methods		
Season / Treatment	1st	2nd
FB	2.99	7.17
RB	2.37	8.22
FL	2.10	8.42
RL	1.31	7.23
Mean	2.19	7.76
L.S.D	NS	NS
Cultivars		
I	1.99	7.54
E	2.39	7.98
L.S.D	NS	NS
C.V	24.49	20.32

Conclusion

It can be concluded from the results of this study, that under high terraces soil reclaimer cultivar produced higher seed yield. Moreover, sowing on flat (broadcast or in line) increased seed yield of the crop.

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