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Effect of Competition and Seed Rate on Productivity of Haemanthus Multifloras Plant in Central Darfur State, Sudan

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ABSTRACT

The study was conducted during the period 2016- 2017 at the experimental field of Agricultural Research Corporation (Nertiti Station), Western Jebel Marra Locality (WJML) Central Darfur State, Sudan. The aim objective was to determine the effect of weeds reduction and seed rates on growth and other yield attributes of Haemanthus multiflorus plant. A split plot design was used with four replications. The main plot included weed reduction (Weeded) and no weeding (un-weeded). Weeding was done via hand mowing. Three seed rates (4, 8 and 12 kg/ha) were also applied as sub-plot. Data were analyzed by STATISTIX9. The study revealed that; weeded ×12 kg/ha seed rate treatment demonstrated significant differences from un-weeded ×8 kg/ha seed rate and un-weeded ×12 kg/ha seed rate treatments in season (2016) which reach (7.78, 5.38 and 5.03 tillers per plant respectively). This may be attributed to hand weed control more than seed rates. Also weeded ×8 kg/ha seed rate treatment had a positive effect on number of leaves per plant more than other treatments in season (2016), which showed significant between this treatment and weeded ×4 kg/ha, un-weeded×4 kg/ha, un-weeded×8 kg/ha and un-weeded×12 kg/ha seed rates respectively (187.53, 122.25, 93.25, 96.65 and 77.1 leaves per plant respectively). As well as weeded ×12 kg/ha seed rate treatment have shown superior results on dry matter production than other treatments which caused differences among this treatment and un-weeded ×4 kg/ha and un-weeded ×12 kg /ha seed rates treatments in the first season which reached 846.3, 371.5 and 328.5 kg DM/ha respectively. In the second season the same treatment (Weeded ×12 kg/ha) obtained superiority on forage productivity yield and revealed highly significant effect between it and un-weeded ×4 kg/ha treatment. There were also significant differences among this treatment and un-weeded ×8 kg/ha and un-weeded ×12 kg/ha seed rates treatments which reach 1537.3, 881.3, 1119.2 and 1128.0 kg DM/ha respectively. Subsequently weeded ×12 kg/ha treatment was recommended for Haemanthus multifolorus establishment in (WJML).

Introduction

Weeds compete with crops when they remove a portion of a resource from a shared resource pool, leaving the crop with less of the resource than is needed for optimum growth [1-3]. Competition may occur for water, creating or exacerbating water stress. It may occur for nutrients such as nitrogen, leading to chlorosis, leaf senescence and reduced yields. These concepts also resemble those believed by Wortmann, et al. [4,5] who reported that the effect of seeding rate on yield in sorghum have been inconsistent, where higher seeding rates have been shown to increase dry matter productivity in some instances, and to have no effect on yield in others. Until recently weeds have been controlled by ploughing and disking prior to crop sowing and repeated hand weeding operations carried out by casual labour, the farmer and his family. Sowing and weeding significantly affected number of leaves per plant of Blepharis linariifolia after from 30 days from sowing [6]. In Fairhope site (USDA-ARS / UNL Faculty) plant height increased with increasing seeding rate Snider, et al. [7]. Seeding rate did not affect any of the seed yield and yield components measured Yunhua Han, et al. [8]. Higher plant densities can sometimes stimulate increases in plant height due to inter-node elongation Snider, et al. [7]. In the United States, average crop yields were depressed by 12% due to weeds USBC [9]; these results were similar to those achieved by who stated that there were more tillers per plant in the 6 and 12 kg/ha treatments than the other treatments (18 and 24 kg/ha), but mean tiller weight was similar for all treatments.

Materials and Methods

The Study Area

The study was carried out at the experimental field of Agricultural Research Corporation (Nertiti station) –over two seasons (July-October 2016 andJuly-October2017) in (WJML) Central Darfur State, Sudan. The area is located in the western part of Jebel Marra massive and extends between latitudes 12°57´ and 13° 00´ N and longitudes 24° 02´and24°04´ E. The altitude at Nertiti is 600 m above sea level (m.a.s.l.) DRCO [10]. Due to the influence of elevation, Jebel Marra climatic conditions resemble those of the Mediterranean region. Rainfall in the western slopes ranges between 420 mm/annum at Golol, Murtagello and Nertiti (1000 m.a.s.l.), and 1200 mm / annum at the upper slopes (2500 – 3000 m.a.s.l.). The minimum temperature ranges between 6°Cand 10°C FAO [10] Figure 1.

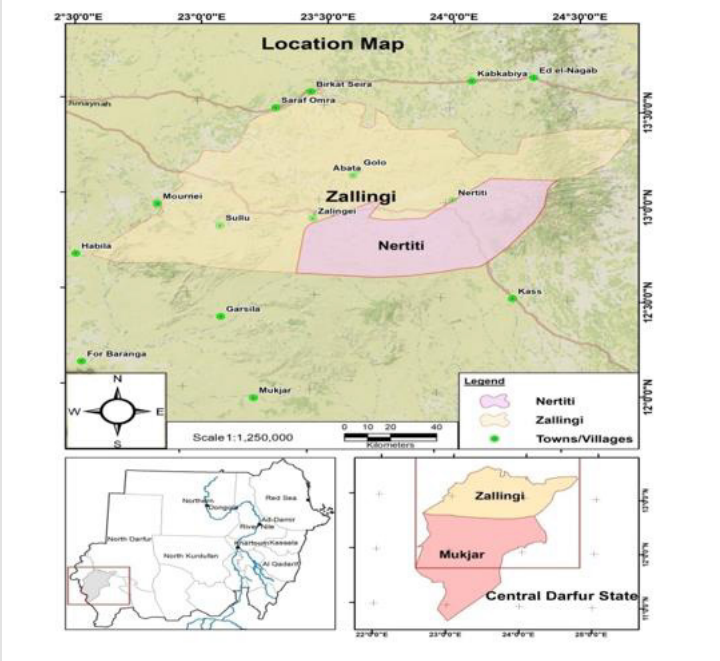

Figure 1: Central Darfur State Map in Republic of Sudan- Nertiti is the head quarter of WJML.

Land Preparation

The land was disc ploughed and then followed by harrowing and leveling. The area of the experiment was divided into 24 plots 2 × 2 meter each.

Competition and Reseeding Experiment

The experimental layout was a split plot arrangement with four replications. Weeds control was the main plot, while seed rates represented the sub-plot. Weeds control was practised via hand weeding and carried out through the experiment whenever necessary to evaluate the effect of competition reduction on growth attributes, where mowing method was used for that process. Un-weeded plots were left un-touched. Seeds were broadcasted under rain fed irrigation, three seed rates were used 4, 8 and 12kg/ha. Method of sowing was broadcasting seeds on flat and then covering by rake at a depth of about one (cm). The parameters investigated were plant height(m), number of tillers /plants, number of leaves / plant and dry matter production (kg DM/ha) (Tables 1 & 2).

Table 1: Temperature (°C) and Rainfall (mm) during 2013- 2017 in WJML.

Year	Max tem (°C)	Min tem (°C)	Mean tem (°C)	Highest monthly tem (°C)	Lowest monthly tem (°C)	Rainfall (mm)
2013	36.6	9.3	23	40	4	1035.5
2014	35.8	9.8	22.8	39.9	4.5	829.4
2015	35.6	15.6	25.6	39.4	8.5	691.8
2016	37.4	15.2	26.3	39.4	9.4	846.5
2017	35.5	11.3	23.4	38.5	8.2	780.4

Note: Source: Jebel Marra Rural Development Project Meteorological Section (2018).

Table 2: Rainfall (mm) distribution during 2013- 2017 in WJML.

Year	Months							
	April	May	June	July	August	September	October	Total
2013	**-**	**11.7**	**81.5**	**287**	**534**	**121.3**	**-**	**1035.5**
2014	**0.9**	**22.6**	**30.3**	**153.7**	**441.4**	**179.8**	**0.7**	**829.4**
2015	**-**	**1.2**	**16.6**	**118.7**	**387.1**	**103.4**	**64.8**	**691.8**
2016	**-**	**8.7**	**96.8**	**229.1**	**419.9**	**85.3**	**6.7**	**846.5**
2017	**2.7**	**15.4**	**100.6**	**118.7**	**440.1**	**102.9**	**-**	**780.4**

Note: Source: Jebel Marra Rural Development Project Meteorological Section (2018).

Data Analysis

Data were analyzed using statistix program version 9.0 and mean comparisons were made using the F-protected least significant difference for separation at 5% level of significance [11].

Results and Discussion

Effect of Competition on Growth and Yield Attributes of Haemanthus Multiflorus

No significant effect for hand weed control on Haemanthus multiflorus plant height during the two seasons, while differences were found in number of tillers, number of leaves per plant and dry matter yield (Table 3). Hand mowing of weeds had a positive effect on number of plant tillers or branches per plant and also on number of leaves per plant in 2016 which reflect significant differences among weeded and un-weeded treatments, since these parameters were higher in weeds controlling treatment. These results resemble those achieved by [6] who stated that sowing and weeding significantly affected number of leaves per plant of Blepharis linariifolia after from 30 days from sowing. No statistical differences were found between weeded and un-weeded treatments on the same parameters in 2017 (Tables 4-6). Forage yield (kg DM/ha) was greater in weeded pattern than un-weeded treatment in 2017, which reached1449 and 1042 kg DM/ha respectively resulting in significant differences. This finding is in line with Walter, et al. [5]. Who reported that until recently weeds have been controlled by ploughing and disking prior to crop sowing and repeated hand weeding operations carried out by casual labour, the farmer and his family?

Table 3: Competition and Seed rates experiment layout for one replication.

Species	Main plot UW	Sub-plot UW×Sr1	Sub-plot W×Sr3	Sub-plot W×Sr2
	Main plot W	Sub-plot W×Sr1	Sub-plot UW×Sr2	Sub-plot UW×Sr3

Note: UW= un-weeded, W= mow weeded, Sr1= seed rate1 (4 kg/ha), Sr2= seed rate2 (8 kg/ha) and Sr3= seed rate3 (12 kg/ha).

Table 4: Effect of competition on growth and yield attributes of Haemanthus multiflorus during seasons 2016 and 2017.

Treatments	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Forage yield (kg DM/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017
W	0.58Ns	0.59Ns	7.28	12.81Ns	152.7	159.30Ns	568.2Ns	1449.3
UW	0.55Ns	0.62Ns	5.55*	9.58Ns	89.0*	117.80Ns	363.6Ns	1042.8*
Mean	0.57	0.61	6.42	11.20	120.9	138.55	465.9	1246.1
SL	Ns	Ns	*	Ns	*	Ns	Ns	*

Note: S.L= significant level, Ns= not significant at P> 0.05, * = significant differences at P ≤0.05.

Table 5: Effect of seed rates on growth and yield attributes of Haemanthus multiflorus during seasons 2016 and 2017.

Treatments	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Forage yield (kg DM/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017
Sr1	0.53*	0.69 Ns	6.43 Ns	11.61 Ns	107.8 Ns	143.89 Ns	414.6 Ns	1145.9 Ns
Sr2	0.53*	0.54 Ns	6.40 Ns	11.71 Ns	142.1 Ns	146.09 Ns	395.6 Ns	1259.8 Ns
Sr3	0.64	0.59 Ns	6.40 Ns	10.25 Ns	112.7 Ns	125.68 Ns	587.4 Ns	1332.6 Ns
Mean	0.57	0.61	6.41	11.19	120.9	138.55	465.9	1246.1
SL	*	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Note: S.L= significant level, Ns= not significant at P> 0.05, * = significant differences at P ≤0.05.

Table 6: Effect of competition and seed rates on growth and yield attributes of Haemanthis multifolorus during seasons 2016 and 2017.

Treatments	Plant height (m)		Tillers/plant		Leaves /plant		Forage yield (kg DM/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017
W ×Sr1	0.56Ns	0.64Ns	6.63Ns	14.1Ns	122.25*	181.58Ns	457.8Ns	1410.5Ns
W ×Sr2	0.55Ns	0.55Ns	7.43Ns	13.4Ns	187.53Ns	160.35Ns	400.5Ns	1400.2Ns
W ×Sr3	0.64Ns	0.58Ns	7.78Ns	10.9Ns	148.33Ns	135.98Ns	846.3Ns	1537.3Ns
UW ×Sr1	0.49Ns	0.74Ns	6.25Ns	9.2Ns	93.25**	106.20Ns	371.5*	881.3**
UW ×Sr2	0.50Ns	0.53*	5.38*	10.0Ns	96.65**	131.83Ns	390.8Ns	1119.2*
UW ×Sr3	0.65Ns	0.60Ns	5.03**	9.6Ns	77.1**	115.37Ns	328.5*	1128.0*
Mean	0.57	0.61	6.42	11.19	120.85	138.55	465.9	1246.1
CV	23.8	18.52	23.8	32.31	24.7	38.83	25.2	16.10
SL	Ns	*	**	Ns	**	Ns	*	**
SE±	0.1	0.08	0.8	2.10	21.0	30.24	20.0	29.26

Note: Ns= not significant at P> 0.05, * = significant at P <0.05, **= high significant at P <0.01

Effect of Seed Rates on Growth and Yield Attributes of Haemanthus Multiflorus

Seed rates treatments had an influence just on plant height in season 2016 while no effect was found in season 2017. On the other hand, no significant differences were found on tillers/plant or number of leaves per plant according to different seed rates treatments over two seasons. Also seed rates did not affect forage productivity (Table 4). The hypothesis that plant height is increased at high seeding rates was confirmed in season 2016. These findings are consistent with Snider, et al. [7], who reported that in Fairhope site (USDA-ARS / UNL Faculty) plant height increased with increasing seeding rate. In this study seed rates had no effect on number of tillers, number of leaves per plant and dry matter production over the two seasons of the study. These results agree with Yunhua Han, et al. [8] who stated that seeding rate did not affect any of the seed yield and yield components measured.

Effect of Competition and Seed Rates on Growth and Yield Attributes of Haemanthis Multifolorus

The interaction between the different treatments namely: hand weeds control, un-weeded and seed rates had no effect on Haemanthis multifolorus height in the first season (2016) while significant differences were found among un-weeded ×4kg/ha seed rate and un-weeded ×8kg/ha seed rates treatment on plant height in season (2017). Also, significant differences were found between treatments on number of tillers per plant (Table 5). Moreover, significant differences were found on number of leaves per plant and forage productivity due to effect of treatments. The study revealed that none of the treatments had an effect on plant height in season (2016), while un-weeded involved 4 kg/ha seed rate had a significant effect on plant height in season (2017) which caused differences among it and un-weeded with 8 kg/ha seed rates treatment (0.74 and 0.53m respectively). This result differed from that obtained by Snider, et al. [7] who reported that higher plant densities can sometimes stimulate increases in plant height due to inter-node elongation. Regarding number of tillers or branches per plant; weeded ×12 kg/ha seed rate treatment demonstrated significant differences from un-weeded ×8 kg/ha seed rate and un-weeded ×12 kg/ha seed rate treatments in season (2016) which reach (7.78, 5.38 and 5.03 tillers per plant respectively). This may be attributed to hand weed control more than seed rates. This finding is in line with USBC [9] who reported that in the United States, average crop yields were depressed by 12% due to weeds. Also, these results were similar to those achieved by (Julia M Lee, et al.) who stated that there were more tillers per plant in the 6 and 12 kg/ha treatments than the other treatments (18 and 24 kg/ha), but mean tiller weight was similar for all treatments. On the other hand, no effect was found for all treatments on tillers number in the second season (2017).

Weeded ×8 kg/ha seed rate treatment had a positive effect on number of leaves per plant more than other treatments in season (2016), which showed significant between this treatment and weeded ×4 kg/ha, un-weeded×4 kg/ha, un-weeded×8 kg/ha and un-weeded×12 kg/ha seed rates respectively (187.53, 122.25, 93.25, 96.65 and 77.1 leaves per plant respectively). These results agree with [6] who stated that sowing and weeding significantly affected number of leaves per plant of Blelpharislinarifolia30 days after sowing. No statistically significant effect was found among all treatments on number of leavesS per plant in second season (2017). Weeded ×12 kg/ha seed rate treatment have shown superior results on productivity than other treatments which caused differences among this treatment and un-weeded ×4 kg/ha and un-weeded ×12 kg/ha seed rates treatments in the first season which reached 846.3, 371.5 and 328.5 kg DM/ha respectively. In the second season the same treatment (Weeded ×12 kg/ha) obtained superiority on forage yield and revealed highly significant effect between it and un-weeded ×4 kg/ha treatment. There were also significant differences among this treatment and un-weeded ×8 kg/ha and un-weeded ×12 kg/ha seed rates treatments which reach 1537.3, 881.3, 1119.2 and 1128.0 kg DM/ha respectively. These results resembled those achieved by [1-3].

Who stated that weeds compete with crops when they remove a portion of a resource from a shared resource pool, leaving the crop with less of the resource than is needed for optimum growth? Competition may occur for water, creating or exacerbating water stress. It may occur for nutrients such as nitrogen, leading to chlorosis, leaf senescence and reduced yields. These results also resemble those achieved by Wortmann. et al. [4,5] who reported that the effect of seeding rate on yield in sorghum have been inconsistent, where higher seeding rates have been shown to increase dry matter productivity in some instances, and to have no effect on yield in others [12].

Conclusion

This study concluded that weeded ×12 kg/ha seed rate treatment demonstrated significant differences; since it increased number of tillers per plant in season (2016) as well as it was shown superior results on forage production for Haemanthus multiflorus

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