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Performance of Two Sesame Cultivars as Influenced by Supplemental Irrigation at Abu Naama

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Abstract: *Field experiments were conducted for four seasons to assess the influence of supplemental irrigation on two sesame varieties (Sesamum indicum L.) in a randomized factorial design with four replications. Treatments included three water moisture regimes (fully-irrigated, one supplemental irrigation and rain fed) and two sesame varieties (Khidir and Promo).*
The results revealed that there were statistically significant differences (p=0.01) between moisture regimes and plant height, number of capsules per plant, seed size and seed yield.
During the experimental period the highest seed yield of 832 Kgha^{-1} was obtained from fully-irrigated treatment in year 2002 whereas the lowest yield for both one supplemental irrigation and rain fed treatments were 280 Kgha^{-1} and 50 Kgha^{-1} respectively.
Correlation analysis indicated that weight per seed; number of pods per plant and plant height were significantly and positively correlated with yield. On the other hand number of pods per plant was positively and significantly associated with plant height suggesting that conditions favorable for better vegetative growth was reflected in production of more pods per plant and eventually, resulted in high yield.
Finally, this study suggested that the maximum number of supplemental irrigation for sesame crop in Abu Naama area is either two or three irrigations depending on severity of drought.

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I. Introduction

Sesame *(Sesamum indicum* L.) a tropical and subtropical crop is widely grown in countries like China, India, Turkey and Sudan.In Sudan, sesame is grown for its edible oil and other industrial products as well as for export. At present, commercial sesame production in the major producing areas in Sudan is under rain-fed conditions, in North Kordofan, Gadarif, Damazine, Sinnar, Kassala and Renk. (Betram,2004, Hala, 2011 and Julian, 2012).

The production of these areas fluctuates from one year to another when suboptimal environment prevails as a result of inadequate rainfall during the growing season.

Therefore, drought coupled with climate change pose a potential problem to sesame production under rain-fed conditions in Sudan as a result, it affects Sudan position in world trade and traditional markets.

To alleviate the problems associated with drought, have spurred interest in growing sesame under irrigation or supplemental irrigation, consequently, we will achieve our goal of improving sesame production.

A review of early work on sesame emphasizes the importance of supplemental irrigation of sesame in Abu Naama (Ageeb, 1969). Other in investigations revealed that at least a single irrigation in the season was necessary to give a reasonable economic yield (Farah, 1979).

Mahasin et al. (1988) in their study of four irrigation regimes on sesame in Gezira Research Station, reported a highest yield of 1114 kgha^{-1} ; whereas Ahmed (1998), in a separate study reported a high yield in the range of 750 kgha^{-1} to 1000 kgha^{-1}.

Furthermore, a review of the research work carried out in Kenana Research Station indicated that the yield of sesame crop in years of poor rainy season was generally below (238 kgha^{-1}). However, in a good rainy season the average was 409kgha^{-1}. Comparatively, the yield yields under full irrigation and supplemental irrigation were in the range of 528kgha^{-1}- 2071kgha^{-1} (Loggale, 2008).

A series of experiments were conducted from 1999 to 2002 for a more in-depth understanding of response of two newly released sesame varieties to supplemental irrigation.

II. Materials And Methods

In 1999, 2000, 2001, and 2002 supplemental irrigation experiments on two sesame varieties were conducted in Abu Naama Research Station, on a vertisol soil with 70% clay content and with an alkaline

reaction. However, Faisal and Farouk (1972) reported that Babiker detailed out the physical and chemical analysis of the top foot of soil at Kenana Research Station as shown in table 1.

The experiments were laid out in a completely randomized factorial design with four replications. The following irrigation treatments were imposed; (1) Rain-fed, (2) One- supplemental irrigation and (3) fully-irrigated. The irrigation water was applied during periods of drought when the soil started to crack. These irrigation treatments were carried out on two sesame varieties, namely: Khidir and Promo.

The fully-irrigated received only one- irrigation in 1999 whereas in 2000 it received two irrigations. In contrast, it received three irrigations in 2001 and 2002. Generally, the provision of irrigation water was either in the first half of pod-setting or in the second half of pod-setting and/or seed filling period.

In 1999 and 2000, planting was carried out in the first two weeks of July while in 2001 and 2002 it was done in the first week of August due to delay of onset of effective rainfall; weeding was carried out whenever necessary.The observations were recorded on plant height, number of capsules per plant, weight per seed and yield. Measurements of plant height and number of capsules/ plant were carried out on five plants randomly selected. At harvest, two rows were harvested each six meters long to determine the seed yield in $kgha^{-1}$.
Finally, statistical analysis was performed for separate seasons and pooled data of the four seasons.

Table 1: Some physical and chemical properties of soil at Abu Naama

Soil analysis	Soil test-value	
	Range	Mean
PH glass electrode (1:5)	5.8 – 9.6	9.1
Exch. Ca (mg/100gm)	9 - 30	21.0
Salts (%)	0.024-0.105	0.053
Na value	2-31	14.0
P_2O_5 (ppm, Trong)	30-400	116.0
N (ppm)	340-630	473.0
C (% Walkely Black)	0.31-0.67	0.41
Clay (%)	55-77	68.0
Nitrate in fresh soil (ppm)	1-11	3.4
Nitrate after 10 days incubation	1-16	3.3

Source: Faisal et al. Journal of Experimental Agriculture 1972.

III. Results And Discussions

The monthly rainfall data from the month April through November for the four seasons; 1999, 2000, 2001 and 2002 are presented in Table 2. The amount of rainfall during June and July for the four seasons is misleading; this is because the amount was not well distributed within the month and as a result the cracks in the soil were not filled timely in early July. Consequently, sowing of sesame crop was generally delayed.

It is very interesting to notice that there was a declining trend of rainfall during the four growing seasons. This declining trend resulted in provision of one- irrigation in 1999, two irrigations in 2000 and three irrigations in years 2001 and 2002, in the fully irrigated treatments.

These irrigation treatments occurred in the first week of October in 1999, 2000 and 2001, which coincided with the first half of pod-setting growth stage. However, in 2002 it was first applied in the third week of September at early stages of pod-setting.

Furthermore, it is also interesting to notice that in year 2002, the growing season was short with very little precipitation being received from April through November as compared to the other three years.

Table2: Climatological parameters data during 1999 – 2002 at Abu Naama

Month	Mean temperature (C^o)				Relative humidity (%)				Evaporation (mm)				Rainfall (mm)			
	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
January	26.3	26.7	25.3	24.9	42	34	36	34	12.0	12.0	11.9	12.0	0	0	0	0
February	28.5	28.7	28.0	30.9	32	31	28	31	14.8	14.7	14.4	14.2	0	0	0	0
March	29.5	30.5	31.1	31.3	33	26	28	22	17.8	16.7	17.1	17.2	0	0	0	0
April	33.1	33.8	34.5	34.0	26	31	30	20	19.6	17.3	12.9	21.8	2.6	-	-	0.2
May	32.9	33.5	30.9	34.1	48	47	45	29	16.2	15.5	11.8	20.5	19	19.4	50.5	11.2
June	31.1	31.3	30.5	29.6	61	60	64	53	13.6	13.3	12.2	14.4	102.9	92.7	81.8	13.3
July	27.9	28.3	28.3	30.0	78	76	78	70	6.6	7.6	7.5	6.9	93.3	160.2	167	162
August	26.2	26.7	26.9	27.9	87	82	84	80	3.3	7.0	5.1	6.6	270.2	218.7	155.9	105
Sept.	26.9	28.1	27.7	28.8	83	79	83	74	7.5	4.6	4.6	6.9	156.1	99.6	111.6	47.9
Oct.	27.5	29.1	29.5	29.5	78	59	63	57	4.2	8.3	7.6	10.5	31.8	5.3	2.0	26.7
Nov.	28.3	29.1	29.6	30.5	42	35	41	37	9.9	12.2	10.7	13.3	-	0.5	-	-
Dec.	28.1	26.7	28.3	25.8	39	35	40	35	10.3	12.0	12.1	12.9	-	-	-	-
Annual rainfall													879.3	596.4	568.8	367

Source: Abu Naama metrological station.

Table 3 shows the results of plant height in years 2000, 2001 and 2002. In years 2000, 2001 as well as combined effect of the years indicated that the response of sesame plant height to water regimes was highly significant (p= 0.01). Whereas in 2001 the treatments failed to show significant effect on plant height (p=0.05). The fully-irrigated treatment significantly (p= 0.01) recorded the highest plant height (110 cm) as compared to other moisture regimes when the data of the three seasons were combined. In the year 2002 where there was severe water deficit, the plant height of rain-fed treatment recorded the lowest plant height as compared to the plant heights in years 2000 and 2001. On the other hand, the two varieties; Khidir and Promo failed to show any significant differences (p= 0.05) in plant height between them for the period of the four seasons.

Table 3: Effect of three water regimes on plant height (cm) of two newly released sesame varieties

Variety	Water regime			Mean
	Fully-irrigated	One supplemental irrigation	Rain-fed	
Season 2000 - 2001				
Promo	109	101	91	100
Khidir	101	99	91	97
Mean	105	100	91	99
S.E. ±	Variety(var.) mean = 2.364	Water regime (Wr) = 2.895	Wrxvar = 4.094	
Season 2001 - 2002				
Promo	117	114	110	114
Khidir	113	110	106	110
Mean	115	112	108	112
S.E. ±	Var mean = 5.642	Wr = 6.91	Wr x var = 9.772	
Season 2002 - 2003				
Promo	110	83	48	80
Khidir	109	81	48	79
Mean	110	82	48	80
S.E. ±	Var mean = 2.719	Wr = 3.33	Wr x var = 4.709	
Combined data 2000 - 2003				
Promo	112	99	83	98
Khidir	108	95	82	95
Mean	110	97	83	97
S.E. ±	Var mean = 2.004	Wr = 2.455 Season = 2.455 season x treatment = 6.013	Wr x var = 3.471	

The results in Table 4, obtained from field experiments in year 2002 and pooled data revealed that the water regimes had a highly significant effect on number of pods per plant (p= 0.01), in which fully-irrigated influenced the sesame crop to produce more capsules than in the other two water regimes. Conversely, rain-fed had less number of capsules per plant than fully-irrigated or once irrigated treatments. However, in year 2000 and 2001 the results were inconsistent. The trend of inconsistent results of number of pods per plant for the two sesame varieties over the three water regimes for the three years was also found.

Table 4: Effect of three water regimes on number of capsules per plant of two newly released sesame varieties

Variety	Water regime			Mean
	Fully-irrigated	One supplemental irrigation	Rain-fed	
Season 2000 - 2001				
Promo	63	59	49	57
Khidir	62	53	43	53
Mean	63	56	46	55
S.E. ±	Var mean = 2.372	wr = 2.905	wr x var = 4.108	
Season 2001 - 2002				
Promo	59	49	47	52
Khidir	58	48	45	50
Mean	59	49	46	51
S.E. ±	Var mean = 3.602	wr = 4.412	wr x var = 6.24	
Season 2002 - 2003				
Promo	74	42	27	48
Khidir	66	43	12	40
Mean	70	43	29	44
S.E. ±	Var mean = 1.92	wr = 2.352	wr x var = 3.326	
Combined data 2000 - 2003				
Promo	65	50	41	52
Khidir	62	48	33	48

Mean	64	49	37	50
S.E. ±	Var mean = 2.466	wr = 3.02	wr x var = 4.27	
	Season = 3.02	season x treatment = 7.4		

Results obtained from weight per seed for the four years of study were conflicting (Table 5). In 1999 and 2000 there was a significant effect (p= 0.05) of water regimes on weight per seed of the sesame crop. However, in year 2001 and 2002, significant of water regimes on seed weight was not detected. On the other hand, the pooled data showed a highly significant differences (p= 0.01) between water regimes, in which there was a marked difference between fully-irrigated and rain-fed treatments.

Among the water regimes, fully-irrigated treatment increased seed yield consistently throughout experimental seasons as compared to rain-fed treatment (Table 6), this might be attributed to avoidance of water deficit. Depression of sesame seed yield by rain-fed treatment was considerably greater in year 2002, as a result of inadequate rainfall which resulted in waterstress occurring as early as the crop starts pod-setting. Consequently, it led to highly significant differences (P=0.01) in seed yield between the water regimes. Furthermore, fully-irrigated treatment gave significant high seed yield than one supplemental irrigation and rain-fed treatments. On the other hand, one supplemental irrigation had significantly high seed yield than rain-fed treatment (p=0.01). However, in 1999, 2000 and 2001 the fully-irrigated and one supplementalirrigation had similar seed yield but significantly different from rain-fed seed yield.

Table 5: Effect of three water regimes on weight per seed (mg) of two newly released sesame varieties

Variety	Water regime			Mean
	Fully-irrigated	One supplemental irrigation	Rain-fed	
Season 1999 - 2000				
Promo	3.53	3.36	2.84	3.24
Khidir	3.99	3.83	3.10	3.64
Mean	3.76	3.60	2.97	3.44
S.E. ±	Var mean = 0.244	Wr = 0.299	Wr x var = 0.423	
Season 2000 - 2001				
Promo	3.73	3.47	3.32	3.51
Khidir	3.79	3.77	3.41	3.66
Mean	3.76	3.62	3.37	3.59
S.E. ±	Var mean = 0.102	Wr = 0.299	Wr x var = 0.176	
Season 2001 - 2002				
Promo	3.87	3.68	3.48	3.67
Khidir	3.95	3.76	3.71	3.81
Mean	3.91	3.72	3.60	3.74
S.E. ±	Var mean = 0.322	Wr = 0.185	Wr x var = 0.262	
Season 2002 - 2003				
Promo	3.51	3.26	3.26	3.34
Khidir	4.01	3.51	3.26	3.59
Mean	3.76	3.39	3.26	3.47
S.E. ±	Var = 0.254	Wr = 0.311	Wr x var = 0.439	
Combined data 1999 - 2003				
Promo	3.72	3.44	3.22	3.46
Khidir	3.93	3.72	3.37	3.67
Mean	3.82	3.58	3.29	3.56
S.E. ±	Var mean 0.088	Wr = o.108 Season = 0.016 season x treatment = 0.305	Wr x var = 0.153	

Table 6: Effect of three water regimes on seed yield (kgha^{-1}) of two newly released sesame varieties

Variety	Water regime			Mean
	Fully-irrigated	One supplemental irrigation	Rain-fed	
Season 1999 - 2000				
Promo	512	476	332	440
Khidir	487	461	303	417
Mean	499	468	317	428
S.E. ±	Var mean = 10.408	wr = 12.747	wr x var = 18.027	
Season 2000 - 2001				
Promo	696	590	500	595
Khidir	592	571	494	552

Mean	644	580	497	574
S.E. ±	Var mean = 19.509	wr = 23.894	wr x var = 33.791	
Season 2001 -2002				
Promo	403	382	204	330
Khidir	377	357	200	312
Mean	390	370	202	321
S.E. ±	Var mean = 56.558	wr = 69.27	wr x var = 97.962	
Season 2002 - 2003				
Promo	852	281	56	396
Khidir	812	280	44	376
Mean	832	280	50	387
S.E. ±	Var mean = 25.37	wr = 31.072	wr x var = 43.943	
Combined data 1999 - 2003				
Promo	615	426	278	440
Khidir	567	417	260	415
Mean	591	422	269	427
S.E. ±	Var mean = 17.354	Wr = 21.254 Season = 24.542 Season x treatment = 30.058	Wr x var = 30.058	

Generally, water is essential for growth and development of the crop, hence water deficit of varying degrees may affect all these processes through the effect on physiological processes of the crop, which may result in reduction in leaf area index and reduced photosynthates which can be translocated to other plant parts and economic yield. These effects of moisture deficit were evident in rain-fed treatment which resulted in reduction of plant height in all the years except 2001. Reduction in weight per seed occurred in years 1999 and 2000. However, number of pods per plant was reduced in all the years for rain-fed treatment. Consequently, the seed yield of rain-fed treatment for all the years was reduced significantly as compared to fully-irrigated treatment.

The highest seed yield was produced in year 2002 by the fully-irrigated treatment (832 $kgha^{-1}$)as compared to other years [1999 (499 $kgha^{-1}$), 2000 (644 $kgha^{-1}$) and 2001 (390 $kgha^{-1}$)]. The reason for this situation was because in 2002 the crop was dependent on irrigation for most of its growth period.

In Table 7, agronomic variables significantly and positively correlated with seed yield, where correlation coefficient for weight per seed was (r = 0.844 at p= 0.05), number of pods per plant (r = 0.984 at p= 0.01) and plant height (r = 0.994 at p= 0.01). Similar results were also obtained by Khidir and Osman (1970), in which they also indicated that association between yield components mentioned above and yield warrants use of these yield determinants in breeding program to improve yield.

In our study, we found that the number of pods per plant was positively and highly significantly correlated with plant height. This suggests that favorable conditions for vigorous vegetative growth contributed significantly to more pods per plant. In other words vigorous growth results in increasing leaf area index which would improve assimilate supply and hence greater number of pods per plant and higher yields. Similarly, this can explain the positive association of plant height and yield.

Table 7: Correlation between plant characters and yield of two sesame varieties

Plant characters	Yield ($kgha^{-1}$)
	r values
Plant height (cm)	+ 0.994**
Number of pods per plant	+ 0.984**
Weight per seed (mg)	+ 0.844*

*significant at 5% level **significant at 1% level

IV. Conclusion

The pooled data clearly demonstrated that the seed yield data and the other plant characters including plant height, number of capsules per plant and weight per seed were significantly influenced by the moisture regimes. The fully-irrigated treatment had significantly increased seed yield as well as the other plant parameters as compared to supplemental irrigation and rain-fed treatments. Similarly, one supplemental irrigation treatment was better than rain-fed treatment.

Reduction of sesame seed yield by both one supplemental irrigation and rain-fed treatments in year 2002 was exceptionally greater, which was attributed to inadequate rainfall, resulting in water stress occurring in early growth stages of sesame crop.

This research study showed that irrigation is essential to obtain reasonably high yield which is evident in year 2002, where the crop under fully-irrigated was dependent on irrigation for most of its growth period.

This is in agreement with early findings [Ageeb (1969), Farah (1979)]. However, it is clear also from this study that the two varieties were not influenced differently by the water regimes.

Correlation analysis showed that the yield was found to be positively associated with plant height, weight per seed and number of pods per plant.

Lastly, and based on the data of this study being supported by the earlier studies, we can recommend that the maximum number of supplemental irrigation required by sesame crop in Abu Naama area, and based on severity of drought, are two to three irrigations, applied during the period from the start of pod-setting to grain filling period

References

[1]. Ahmed, M. H. (1998). Release of cultivar Khidir for production in high rainfall areas, (Southern Gadarif and Damazine) Sudan Journal of Agric. Research, Vol. 1, No. 1 page: 89.
[2]. Ageeb, O. A. A. (1969). Kenana Res. Sta. Ann. Report.
[3]. Betram John Kuol (2004). Breeding for drought tolerance in sesame, (Sesamum indicum L.) in SudanBonn University Dissertation
[4]. Faisal, M. A., Farouk, A. S. (1972). Effects of N, P and K on yield of grain sorghum in the Central Rain- lands of Sudan, Experimental Agriculture, Vol. 8, No. 2: 151 – 154.
[5]. Farah, S. M. (1973). Kenana Res. Sta. Ann. Report.
[6]. Hala, A. E. (2011). Sudan trade point management of promotion and investment department of studies. Report No. 18.
[7]. Julian, G., Catherine K., Sebastian I. M., Ines S. (2012). The untapped potential of sesame. American University
[8]. Khidir, M. O., Osman, H. E. (1970). Correlation studies of some agronomic characters in sesame. Experimental Agriculture, Vol. 6, No. 1: 27 – 31.
[9]. Loggale, L. B. (2003). Summary of sesame research findings and achievements at Kenana Research Station, Abu Naama, Sudan
[10]. Mahasin,, A. M., Saeed, M. F. and Ahmed, A. S. (1988). Effect of four- irrigation regimes on sesameLand and Water Research Centre, Annual Report

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