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Original Research Article

Effects of sowing date on sunflower (*Helianthis annuus* L.) yield and yield components under rainfed conditions in Blue Nile State, Sudan

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Abstract

A field trial was conducted for two consecutive seasons (2014/15 and 2015/16) at Al-Damazin Agricultural Research Station Farm, Damazin, Sudan, located at longitude 34°22' E, latitude 11°47' N and altitude 470 m. The objective of this study is to determine the optimum sowing date for sunflower under rainfed conditions in Blue Nile State, Sudan. The experimental materials consisted of one sunflower hybrid (Sirena cultivar) and four sowing dates late-July (22 and 24 July), early August (1 and 3 August), mid-August (11 and 13 August) and late August (21 and 23 August). The experiment started grown on 22.7.2014 and 24. 7. 2015 as the first sowing date with interval period of 10 days between each sowing date to other. A randomized complete block design with three replications was used. Data collected and parameters measured included days to 50% flowering, days to maturity, plant height (m), head diameter (cm), 100 – seed weight (g), % of filled seed and seed yield ton/ha. Statistical analysis revealed highly significant differences (P≤ 0.001and P≤ 0.05) among all traits measured in both seasons. Seed yield recorded the highest value (2.8ton/ha) in season one by the late July (21-23) sowing date. The combine analysis for seed yield over the two seasons revealed that the early August (1-3) sowing date out-yielded (2.6tons/ha) the rest tested sowing dates.

Keywords: Sowing date, Seed weight, Sunflower, Yield components

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an annual crop that is the source of one of the most important edible oils on a global scale. In season 2015/2016, sunflower was grown on 23.06 million hectares worldwide with a total production of 39.19 million metric tons, and an average productivity of 1.7 metric tons/ha. The major sunflower producing countries are Ukraine, Russia, European Union, Argentina and China (USDA, 2016). Sunflower is a promising oilseed crop in Sudan. The seed of sunflower have a high oil content (40-50%) and 30% digestible protein and can be used as a source of food for humans or as a poultry feed. Sunflower cake can also be used as an animal feed. Sunflower is adaptable to a wide range of climatic conditions and is well suited for Sudanese conditions. It can be a suitable winter oil crop in irrigated conditions. Sunflower seed, which are a raw material for the oil industry, can increase the capacity of the local crushers, and the extra raw material can be exported to the Arab countries. Extensive commercial production of sunflower was initiated in Sudan in the late 1980's and the early 1990's with the introduction of hybrids such as Hysun-33 from Australia and PAN-7351 from South Africa (El Ahamdi, 2003; Nour *et al*., 2005). The production was established mainly in rainfed areas of the country and, to a lesser extent in irrigated conditions. At about the same time, early maturing accessions of two

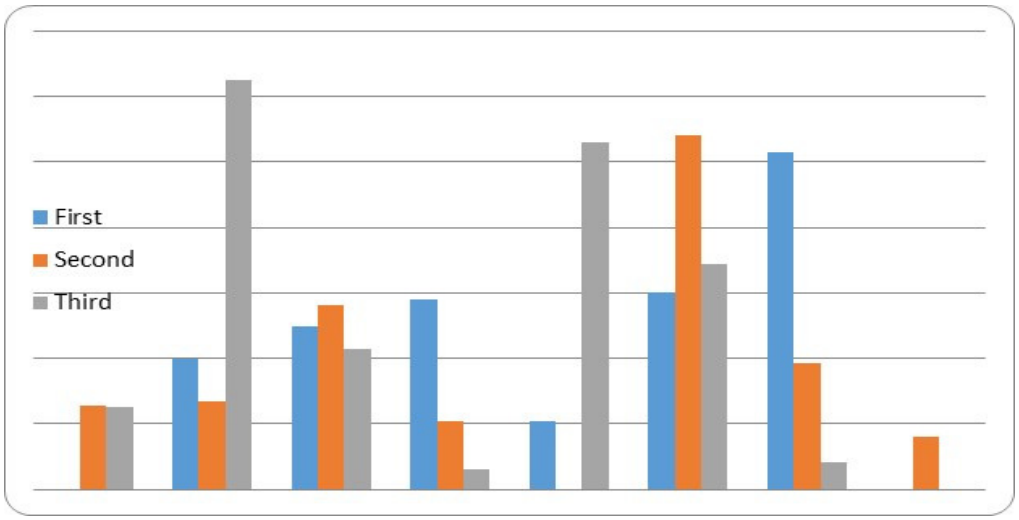

Figure 1. Rainfall data (mm) as 10 days total at Damazin Research Station Farm during seasons 2014/15 and 2015/16

open-pollinated sunflower varieties, Rodio and Bolereo, were released under the names Damazin-1 and Damazin-2, respectively (Adam and Osman, 1989). In the two decades since then, nevertheless, sunflower has failed to expand significantly in the country in total area and seed production, which could be attributed mainly to production constraints. There are many production constraints that are responsible for the fluctuation in area and productivity. These include frequent dry spells, erratic distribution of rainfall, lack of advanced technologies such as hybrid seeds, poor cultural practices, problems with empty seeds, low use of fertilizers, and faulty policies on funding, processing and marketing. Still, the lack of improved sunflower hybrids developed locally has emerged as the main limiting factor. Sunflower hybrid seed are introduced from abroad and are bought with hard currency at a price that farmers can hardly afford. There is also the problem of hybrid seed not being available at optimum planting time.

In the recent time due to climate change phenomenon in the whole world and because of the new heightening of Russers Dam on the Blue Nile River which affected particularly on Blue Nile State climate (extended rainfed areas) in different ways as unnatural rainfall averages (high or low), disparity distributions, temperature, occasional drought and irregular starting time of the rainy season every year. These constrains involve a new research to update or to generate appropriate new technologies to solve these problems. Because of these climate constrains, the objective of this study is to determine the optimum sowing date for sun-flower under rainfed conditions in Blue Nile State, Sudan.

MATERIALS AND METHODS

A field trial was conducted for two consecutive seasons (2014/15 and 2015/16) at Al- Damazin Agricultural Research Station Farm, Damazin, Sudan, located at longitude 34°22' E, latitude 11°47' N and altitude 470 m. Soil is classified as typic chromusterts, fine, smectitic and isohyperthermic (Soil Survey staff, 1976). The chemical analysis result of the top soil (0 – 20) and the sub soil (20 – 40 cm) of the site was described in table 1. Experimental materials consisted of one sunflower hybrid (Sirena cultivar) and four sowing dates, late-July (22 and 24 July), early August (1 and 3 August), mid-August (11 and 13 August) and late August (21 and 23 August). The experiment started grown on 22.7.2014 and 24. 7. 2015 as the first sowing date with an interval period of 10 days between each sowing date to other. A randomized complete block design with three replications was used. Seeds were sown in ridges 80cm apart and 30cm within ridges. A total plot size was 16m^2 (4rows x 5m long x 0.8m apart) with net harvested area of 4.8m^2. The soil was disc ploughed, harrowed and ridged. Three seed per hole thinned to one plant after two weeks of germination, hand weeding was done twice using hoes. Fertilizers, herbicides and pesticides were not used. Data collected and parameters measured included days to 50% flowering, days to maturity, plant height (m), head diameter (cm), 100 – seed weight (g), % of filled seed and seed yield ton/ha. The summary of the weather data for the study period is presented in Figure 1.

RESULTS

Means of parameters measured and combine analysis were presented in tables 2, 3, 4 and 5. Statistical analysis revealed highly significant differences among all traits measured in the study in both seasons. Days to 50% flowering, day to maturity, Plant height and head

Table1. The soil chemical analysis result of Damazin Research Station Farm

Analysis result	Value
pH (1:5 H_2O)	7.0 – 7.3
Total N	0.042 – 0.044 %
Available P	3.9 – 3.9 mg/kg
Exchangeable K	0.63 – 0.59 cmol/kg
O.C.	0.593 – 0.598 %
C/N ratio	14 -13, respectively

Table 2. Effect of sowing date on days to 50% flowering and days to maturity of sunflower (Sirena cultivar) in two seasons at Damazin Research Station Farm

Sowing date	Days to50% flowering		Days to maturity	
	Season one	Season two	Season one	Season two
Late-July (22-24)	63.3	65.0	131.7	106.7
Early Aug. (1-3)	67.7	61.0	125.7	99.3
Mid-Aug. (11-13)	61.0	59.0	114.0	98.7
Late Aug.(21-23)	58.3	59.3	106.7	92.3
Mean	62.6	61.1	119.5	99.3
Statistics				
Prop.	***	***	***	***
SE±	1	0.8	1.1	0.7
CV%	2.9	2.4	3.2	2.4

***Highly significant difference

Table 3. Effect of sowing date on plant height (m) and head diameter (cm) of sunflower (Sirena cultivar) on two seasons at Damazin Research Station Farm

Sowing date	Plant height (m)		Head daimeter (cm)	
	Season one	Season two	Season one	Season two
Late-July (22-24)	1.2	1.6	15.3	17.0
Early Aug. (1-3)	1.3	1.5	14.7	17.3
Mid-Aug. (11-13)	1.2	1.5	14.0	15.0
Late Aug.(21-23)	1.3	1.6	18.7	17.0
Mean	1.3	1.6	15.7	16.6
Statistics				
Prop.	***	***	*	***
SE±	0.01	0.01	0.8	0.4
CV%	2	3	9.2	4.4

***Highly significant difference, * significant difference.

Table 4. Effect of sowing date on 100-seed weight (g) and % filled seed of sunflower (Sirena cultivar) in two seasons at Damazin Research Station Farm

Sowing date	100-seeds weight		% filled Seeds	
	Season one	Season two	Season one	Season two
Late-July (22-24)	7.6	6.1	96.0	95.4
Early Aug. (1-3)	6.8	6.1	97.6	92.5
Mid-Aug. (11-13)	6.9	5.7	97.2	93.6
Late Aug.(21-23)	7.1	5.4	97.9	96.0
Mean	7.1	5.8	97.2	94.4
Statistics				
Prop.	***	*	*	*
SE±	0.12	0.1	0.6	0.9
CV%	3	6.1	1.2	2

***Highly significant difference. *Significant difference

Table 5. Effect of sowing date on seed yield (tons/ ha) of sunflower (Sirena cultivar) in two seasons and Combine analysis at Damazin Research Station Farm

Sowing date	Season one	Season two	Combine analysis
Late-July (22-24)	2.8	2.0	2.4
Early Aug. (1-3)	2.7	2.5	2.6
Mid-Aug. (11-13)	1.9	2.2	2.0
Late Aug.(21-23)	2.6	2.1	2.3
Season mean	**2.5**	**2.2**	**2.3**
Statistics			
Prop.	***	***	***
SE±	0.05	0.01	0.02
CV%	3.3	1.1	2.6

***Highly significant difference.

diameter recorded highly significant differences (P≤ 0.001) in both seasons, where 100 – seed weight recorded significant differences in the season one. However significant differences (P≤ 0.05) were observed for % of filled seed over the two seasons, while 100-seed weight in the season one.

Days to 50% flowering registered (67 days) in the season one as the highest value by the early August (1-3) sowing date. In other side days to maturity noted (131 days) in season one as the highest value by the late July (22-24) sowing date. The late July (22-24) sowing date and the late August (21-23) sowing date were given the highest values (1.6m) of Plant height in season two. Whereas the late August (21-23) sowing date recorded the highest value (18.7cm) of head diameter in season one, while 100 seed-weight gave the highest value (7.6g) in season one by the late July (22-24) sowing date. % of filled seed scored the highest value (97.9%) in season one by the late August (21-23) sowing date. Seed yield recorded the highest value (2.8ton/ha) in season one by the late July (21-23) sowing date. The combine analysis for seed yield over the two seasons revealed that the early August (1-3) sowing date out-yielded (2.6tons/ha) the rest tested sowing dates.

CONCLUSION

From the results of the study, the combine analysis revealed that the early August (1-3) sowing date recorded (2.6tons/ha) as the highest seed yield followed by late July (2.4 tons/ha), late August (2.3 tons/ha) and mid-August (2.0 tons/ha). Hence we recommended that the early August (1-3) sowing date as the optimum sowing date in Blue Nile State for rainfed sector. Under critical environment conditions and if not possible to grow under rainfed conditions in above recommended sowing date, farmers in Blue Nile State could use mid-August (11-13) or late August (21-23) as alternative sowing date that could give reasonable seed productivity.

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