

Sunflower: A proposed new crop for the Gash Delta

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Abstract

Sunflower was suggested as one of the new cash crops in the Gash delta. This study was intended to evaluate adaptability of the crop through the performance of some hybrids and open-pollinated (OP) cultivars under the flood irrigation system of the Gash delta. A set of cultivars were tested in four locations of different irrigation levels of 7-30 days flood periods, and varying soils of silty, clay loam during the seasons 1989-90 and 1990-91. The hybrid Hysun 33 and the two open pollinated (OP) cultivars Rodio (Damazin 1) and Egnazai were considered as standard cultivars and hence evaluated for the crop performance. Results have shown that Hysun 33 produced a higher yield of 2220, while Rodio and Egnazia recorded lower yields of 1900 and 1760 kg/ha, respectively.

The yields recorded at the Gash delta were higher than the yields of the same cultivars reported from all other locations in Sudan. Rodio recorded a high oil content of 48% in Gash delta which was higher than the 45% of the Rodio when grown under rain only or supplementary irrigation. The crop did not require chemical pest control in all test locations. Hence, sunflower may be recommended as one of the new cash crops for the Gash delta crop rotation to be planted as a late flood crop.

Introduction

The origin of the sunflower is South–West of the United States. It was first introduced in Europe as an ornamental, but was established in eastern Europe and Russia as an oilseed crop. Russian cultivars had immense impact on the development of sunflower as a commercial crop in Europe and in Americas. At present, sunflower is considered the second most important oilseed crop, after soybean, in world production. Sunflower is adapted to a wide range of climatic conditions (temperate, subtropical and tropical) and is not sensitive to day length. In the tropics it is grown in rotation with maize, sorghum, groundnut and millet.

It is tolerant to heat and drought like sorghum and millet. In temperate countries seed yield exceeds 2000 kg/ha, whereas in tropical Africa is as low as 350 kg/ha. European countries import 85% of the crop entering the world trade, and Asian countries about 15% (Pursglove 1982).

Sunflower has a tap root system well branched and extends laterally for several meters and makes good use of available moisture in the upper soil profile (Litzenberger 1978).

Although experimentation of sunflower in Sudan started as early as the 1940s, real concern with it is commercial production started late mainly as rainfed crop. The cultivated area in 1990-1991 reached 293000 feddans mainly in the rainfed area with average yield of 99 kg/feddan.

Recently, high yielding hybrids were introduced and grown under irrigation (Ali, 1995; Burhan 1998). After the exclusion of castor as a cash crop from the Gash delta in 1987, sunflower was suggested among other cash crops for the Gash delta. It was expected to have a good chance of adaptation in the flood irrigation system because of its well–branched tap root system, wide ecological adaptation, and

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tolerance to drought. This experiment was part of the new cash crops program for the Gash delta.

Materials and method

A set of cultivars and hybrids were first introduced in the Gash delta in 1989-90 and grown in three different locations in Kassla and digain blocks with different type of soil ranging from heavily silted to silty clay loam. The three locations received flood irrigation water for 30, 20 or 7 days representing normal irrigation periods in the Gash delta (Table 1). The cultivars were entered in a randomized complete block design with three replicates, and similarly executed in the three locations, except in location 1 where planting was made in flat beds as shown in Table 1 because of the difficulty of opening furrows due to heavy siltation and prolonged wetting. Sowing dates were different depending on the flooding time of the site. The seedlings were thinned to one plant/hole. Discs were harvested when completely dry.

The experiment was repeated four time in season 1990-91 in the pilot irrigation basins in Tendelai Block where heavy irrigation was applied for 4 days (Table 1). Treated seeds were sown on 26 Sep 1990. Dry discs were harvested on 20 Jan 1991.

The set of cultivars included the three standard cultivars selected for the evaluation of the performance of sunflower in the Gash delta. These were Hysun 33, and two OP Radio and Egnazia.

Parameters recorded were plant height, disc diameter and seed yield. Chemical analysis for oil and protein content was done in ARC laboratories at Wad Madani. Observations on pests and diseases were made by the department of plant protection of Kassla.

Results

Seed yield

Differences between cultivars in seed yield although very large but were not statistically significant due to high coefficient of variability in both seasons in locations of good flood irrigation of 20 and 30 days. Yield differences were comparatively small and not significant when the cultivars were grown under limited soil moisture of 7 floods days (Table 2a). Among the selected 3 cultivars, Hysun 33 recorded the highest yield of 2888 kg/ha when grown in 20 flood days. Rodio and Egnazia also produced high yield, in the location of the 20 flood days. The effect of the location (flood period) on seed yield was statistically highly significant ($P = 0.01$). Yields at 7 flood days were reduced by 59% and 54% compared to yields from 20 and 30 flood days, respectively. The overall mean seed yield of the Hysun 33 in loction of good flood irrigation across the two seasons was 2220 kg/ha, while that of Rodio was 1900 and Eganzia 1764 kg/ha (Table 2b).

The heavily flooded loctions of 30 days in season 1989-90 and the basins in 1990-91 produced yield lower than the 20 days flooded location (Table 2a).

Oil content

Rodio cultivar had the highest oil content of 48%, with 985 kg/ha yied of oil. Hysun 33 had an oil content of 42%, producing 1055 kg/ha of oil, while Eganzia had low oil content of 39% with oil yield of 720 kg/ha (Table 3).

Oil characteristics

The iodine number refer to the degree of saturation while the acid value refers to the free fatty acids both were low in the cultivar Rodio and relatively high in the cultivar Eganzia (Table 3).

Carbohydrate

Total carbohydrates constituted 7.7% of the sunflower seed, 6.3% of this is insoluble carbohydrate. The three cultivars showed high value of insoluble carbohydrate of 6.5%-7.5%. The major components of soluble carbohydrate are non-reducing sugar (Table 3).

Protein content

The range of protein content of the evaluated varieties was 25%-22%. The highest in total protein content were, Hysun 33 and Rodio, both with 24.7% (Table 3).

Plant height

The cultivar Hysun 33 and Rodio recorded similar plant height of 168 and 163 cm, respectively, while Eganazia attained a height of 142 cm under adequate soil moisture conditions of 20 flood days (Table 4).

Disc Diameter

Hysun 33 and Egnazia produced discs with similar diameter of 21 cm, while Rodio had larger heads (24 cm) under adequate soil moisture as in locations 1 and 2. Smaller discs (12-13 cm) were produced under limited flood irrigation of 7 days as in location 3. However the largest heads were produced at the irrigation level of 20 days as in location 2 (Table 5).

Signs of maturity

Permanent disc bending, disc browning, and disc drying were taken as indicators of seed maturity and drying. The varieties Hysun 33 and Egnazia reached complete maturity in 118 days, while Rodio in 125 days under conditions of adequate soil moisture (Table 6).

Economic evaluation

Although the estimated production cost of sunflower was higher than that of sorghum in the Gash delta, mainly because of the high seed cost of sunflower, the net returns obtained from sunflower were higher than sorghum net benefits (Table 7). Although sunflower had no crop residues or straw for farmers livestock, the high seed yield and good market price of sunflower as a processing and/or export crop make it economically attractive as a cash crop. Hence, sunflower crop can be one of the possible new cash crops to intensify and diversify the existing mono-cropping system of sorghum.

Discussion

The sunflower cultivars tested under the flood irrigation system and the silty clay loam soils of the Gash delta produced yields higher than all reported yields from other locations in Sudan whether under irrigation, or rainfed, or rainfed with supplementary irrigation. The overall mean yield of the three cultivars in two seasons and three locations of adequate soil moisture was 2000 kg/ha. Adam and Osman (1989) reported that in the rainfed locations with supplementary irrigation at Abu Naama the open-pollinated Rodio (Damazin 1) recorded 835 kg/ha, which represented 44% of its Gash delta yield. The highest yield of 1195 kg/ha recorded at El Faisal Scheme by Rodio (Damazin1) was still less than the over all mean yield in the Gash delta. The same goes for Egnazia which recorded yields in the Gash delta higher by 48% than in Abu Naama, and by 34% than that recorded at El Faisal Scheme.

In Gezira, and under regular irrigation, Ali (1989) reported the highest mean yield of 2010 kg/ha from 5 hybrids (G 100, G 101, G 202 and 2 Pioneer hybrids)

grown in summer season. This was lower than the mean yield of Hysun 33 in the Gash delta. The highest yield of 1259 kg/ha in the Gezira produced by the OP Egnazia was far less than its yield in the Gash delta. Hence, the hybrid and OP cultivars produced higher yields in Gash delta compared to the Gezira and the rainfed or rainfed supplemented with irrigation. Large scale commercial production of sunflower with Hysun 33 in the Gash delta by the SMA OIL CO in 1992/93 and Wadi Agig CO. in 1994-95 produced 1190 kg/ha and 1700 kg/ha respectively, compared to commercial levels of 715 kg/ha in the Damazin area (Osman 1995). The percent of oil content of the Egnazia in Gash delta or in Abu Naama was similar (39% and 41%) but the cultivar Rodio gave 48% in Gash delta and 45% in Abu Naama which was the highest in both sites.

The cultivar Radio produced taller plants with larger heads in the Gash delta as compared to its performance in both the Gezira and Abu Namma. The crop was monitored by the Plant Protection Department of Kassala, which did not report any pests requiring chemical control. This gives the crop an environmental advantage besides its economic value.

Recommendations

Based on the seed and oil yield and the absence of economic damage by pests and diseases, and the good net returns when compared to sorghum, sunflower is recommended as a new crop in the Gash delta to intensify and diversify the mono-cropping system of sorghum.

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Table 1. Details of the Experiments

Details	1989-90	1989-90	1989-90	1990-91
	L 1*	L 2	L 3	
Location	Tugrar 13	Tugrar 9	Degain 38	Tendelai 10
Soil	Silt	Clay loam	Silty clay loam	Silty clay loam
FloodIrrigation	30 days	20 days	7 days	700 mm
Varieties	14	14	14	12
Design	RCB	RCB	RCB	RCB
Replicates	3	3	3	3
Subplot size	8X4	8X4	8X4	6X2
Seed bed	Flat	Furrow	Furrow	Furrow
Sowing date	19/9/89	16/10/89	9/10/89	26/9/90
Spacing	80X30	80X30	80X30	80X30
Seeds/hole	3	3	3	2
Seedling/hole	1	1	1	1
Gap filling	10 days	14 days	14 days	10 days
Harvest date	8/1-1/2	5/2-10/2	11/213/2	20/1/91

*L1 = Location, L2 = Location 2, L3 = Location 3

Table 2a. Evaluation of sunflower cultivars for seed yield in the Gash delta

Variety	Total seed yield kg/ha					Means kg/ha
	1989-90 L 1	1989-90 L 2	1989-90 L 3	1989/99	1989-90	
Hysun 33	2193	2888	1115	2065	1905	1985
Rodio	2059	2055	883	1666	1741	1703
Egnazia	1747	1944	1021	1571	1674	1622
S.E (±)	213	319	201	144	250	
C.V (%)	17	22	35	23	22	
			Location means:			
			L 1	2000	1773	1770
			L 2	2295		
			L 3	1006		
			Significant	* *		
			S.E (±)	75		

N.B. The above results are part of a set of cultivars in the Gash delta and therefore the level of significance is for the whole data.

**Table 2b. Evaluation of sunflower cultivars for seed yield in the Gash delta
Under good irrigation conditions**

Variety	Seed yield kg/ha				
	1989-90 L 1	1989-90 L 2	Mean of Locations	1990-91	Mean of years
Hysun 33	2193	2887	2540	1905	2222
Rodio	2059	2054	2057	1740	1899
Egnazia	1746	1943	1854	1674	1764
S.E \pm	213	319		250	
C.V. (%)	17	22		22	
Means	2000	2295	2147	1773	1960

Table 3. Oil and protein content of sunflower varieties grown under adequate soil moisture at the Gash delta (1989-90)

Variety	Seed yield kg/ha	Oil content		Protein content %	Iodine number	Acid value	Insol. Carbohyd. %
		%	kg/ha				
Hysun 33	2540	41.6	1056	24.7	29	36	6.5
Rodio	2057	47.9	985	24.7	23	25	7.3
Egnazia	1845	39.1	721	22.2	37	89	7.5
Means	2147	42.9	921	23.9			

Table 4. Evaluation of sunflower varieties under flood irrigation of 20 days at the Gash delta

Variety	Seed yield (kg/ha)	Plant height (cm)	Disc diameter (cm)
Hysun 33	3332	167	25
Rodio	2332	163	29
Egnazia	2124	141	25
S.E (\pm)			
C.V. (%)			

Table 5. Disc diameter (cm) of sunflower varieties in the Gash delta

Variety	1989-90				1989-90
	L 1	L 2	Locations means	L 3	
Hysun 33	16	25	21	12	18
Rodio	18	29	24	11	19
Egnazia	16	25	20	12	17
Significance	*			**	
S.E (±)	1.3			1	
C.V. (%)	12			14	

Table 6. Signs of maturity 13 weeks after sowing

Variety	Permanent bending (%)	Disc browning (%)	Dry plants (%)	Date of harvest	Days to complete maturity
Hysun 33	87	37	32	18 Jan	118
Egnazia	93	45	29	18 Jan	118
Rodio	70	13	23	25 Jan	125

Sowing date: 19 Sep. 1989, irrigation: 30 flood days, Harvest: Discs completely dry

Table 7. Estimated production costs and benefits

Operation	Cost/Benefit (SD/ha)	
	Sunflower	Sorghum
<u>Cost:</u>		
Land preparation	4760	3570
Planting	3570	2380
Resowing	1150	1190
Weed control	9520	9520
Seed dressing	2380	2380
Harvesting	14280	14280
Straw collection	-	8330
Seeds	6000	1428
Water rate	7140	7140
Sacks	2000	1900
Guards	6000	6000
Transport to local market	6000	3800
Subtotal cost	62800	53588
Interest (10% of subtotal)	6280	4287
Total cost	69080	57875
<u>Benefits: (Returns):</u>		
Average yield (tons/ha) seed	2.0	1.9
Average price (SD/ton)	65000	30000
Benefits from seeds (SD/ha)	130000	57000
Benefits from hay/strow (SD/ton)	-	47600
Gross benefits	130000	104600
<u>Deductions:</u>		
Zakat (5% of returns)	6500	5230
Actual gross benefits (SD/ha)	123500	99370
Net benefits (SD/ha)	54420	41495
Net benefit/cost (%)	78.8%	71.7%