Response of roselle to plant spacing under flood irrigation in the Gash Delta

Mohamed ELNaseeh M. Osaman1

Abstract

Roselle was evaluated for yield of dry calyx at different plant spacing in six locations and for five seasons in the Gash Delta. Two of these seasons were considered as demonstrations under extreme soil moisture conditions. Seeds of a mixed landrace (ELRahad) were sown at in–row spacing of 40, 60, 80, 100 and 120 cm along furrows 80 or 100 cm wide in seasons 1986-87 (2 locations), 1992-93 and 1993-94. Demonstrations were executed in seasons 1988-89 and 1990-91. The flood irrigation periods were different in the 4 locations, viz. 10, 20, 25 and 30 days. The highest yield of dry calyx was recorded at the spacing of 60 x 80 cm and 80 x 80 cm, although the effects of in–row spacing on yield was not significant. When the flood period was 20– 30 days, the highest calyx yields were obtained at the closer in-row spacing of 40 and 60 cm; while in shorter flood periods of 10 days the yield was higher at 80 cm. The overall mean yield at the low flood irrigation of 4 or 10 days was 306 and 439 kg/ha, while at 20 days the yields were 550 and 703 kg/ha. The highest yield of 1067 kg/ha was recorded at flood period of 25–30 days.

Introduction

Roselle is a traditional crop in the Gash Delta grown in small strips and as guard rows around sorghum or watermelon. The crop is well adapted to the flood irrigation system by virtue of its deep root system and tolerance to moisture stress. Although it is vulnerable to many pests and diseases such as flea beatles, whitefly, aphids, and powdery mildew, only flea beatles can be serious at the seedling stage. It was grown as a commercial crop in 150 feddan in Degain block by a Sudanese investor in season 1985-86 with a reasonable success. The crop was established in 1–6 October 1985, picking started in January, and continued fruiting till the third week of May 1986, i.e. it stayed in the field for 7-8 months. In spite of infestation by whitefly and aphids, no apparent damage was inflicted. Also the crop tolerated powdery mildew.

The main problems facing the investment were the high cost of picking and peeling calyx, and the low market price at that time, (Osman and Saeed 1986). But, the crop seems to have good potentials as a processing and export crop. In the Gash Delta, the crop may fit very well in areas of low soil moisture, or in strips around other crops.

Materials and methods

The experiment was conducted in five seasons during the period 1986 to 1994 in four locations(Table1) varying in type of soil (silty loam, silty clay loam, clay loam, clayey) and duration of flood irrigation (4, 10, 20, 25 and 30 days) (Table 1). Seeds of the famous landrace ELRahad were treated and sown at the rate of 5–6 seeds/hole with a foot–pressed selluka either in flat harrowed beds, or flat unploughed beds or along the bottom of furrows opened with a 2–plate disc plough. Sowing dates were either in September or October depending on time of flooding. Treatments tested were two between–row spacing 80 and 100 cm and four in–row spacing 40, 60, 80,

[1] Agricultural Research Corporation, Shambat Research Station

100 and 120 cm. They were entered in a randomized complete block design with 4 replicates. The experimental plots in 1988-89 and in 1990-91 were executed and used as demonstration plots with extreme soil moisture conditions. Seedlings were thinned to 2 plants/hole 10–14 days after sowing. Pests and diseases were recorded as shown in table 1. Picking of fruits started 77, 86, 94 or 110 days after planting according to growing conditions. One, two or three picks were made. Fruits were left over night, then pealed, and calyx were sun dried for 3–4 days.

Results

Yield of dry calyx

Difference in–row spacings tested in two locations in season 1986-87 was not significant in terms yield of dry calyx (Table 2). In location A in basin Degain 36, where the flooding period was 10 days, the highest yield of dry calyx was recorded at 80x80 cm spacing, and the lowest at the wider spacing of 120x80 cm. Location B in basin Degain 37 was flooded for 20 days produced higher yields than location A, and the maximum was recorded at the closer spacing of 60x80 cm. The difference between the combined yields of the 2 locations was not significant. The effects of the closer in–row spacings of 60x80 and 80x80 produced similar yields that were 26.6 % and 27.6 % higher than the wider spacing of 120x80 cm.

Similar results were obtained in seasons 1992-93 and 1993-94. When in–row spacings of 40, 60 and 80 cm were tested at the two between row spacings 80 and 100 cm, still no significant differences were found between treatments, except in the between row spacings, where the difference was statistically significant ($P = 0.05$) (Table 3). The closer between row spacing of 80 cm out yielded 100 cm by 7.3%. In–row spacings of 40 and 60 cm produced similar high yields that were 4.1% and 5.7% higher than that from 80 cm. Considering the joint effect of spacings, the highest yields of dry calyx were produced at 60x80 and 80x80 cm.

Demonstrations at extreme soil moisture conditions

The experiment was conducted under extreme soil moisture condition in 1988-89 in Rabakasa 1 basin which was flooded for 2 and 4 days, with a wider between row spacing of 100 cm because of moisture stress. Very low yields were recorded. The highest was 400 kg/ha at in-row spacing of 60 cm. When excuted in Tendilai pilot basins where a basin of 10 feddans was flooded under control with 700 ml in 4 days, very high yields were recorded at all in-row spacings. The highest 1326 kg/ha was obtained at the very close spacing of 40x80 cm. The overall mean yield at Tendilai was 4 times that of Rabakasa 1 (Table 4).

Discussion

Roselle is usually rain-grown in the Sudan and in many parts of the world, e.g. West Africa and India. It is grown at wide spacing of 120x90 cm (Purseglove, 1982). As plant density should be adjusted to the prevailing or available soil moisture, plant spacing is expected to be closer when irrigated. In the Gash Delta where crops are grown by flood irrigation, the soil moisture varies widely depending on the duration of flooding. When the flood period was long ie $\geq$ 25 days, the closer in–row spacings of 40 and 60 cm gave the highest calyx yield. At shorter flood periods of 10 days, the best yield was recorded at 80 cm in-row spacing. Between row spacing of 80 cm gave significantly higher yield than 100 cm.

Since roselle is characterized with a strong tap root and tolerates moisture stress, it is expected to fit efficiently in areas of limited flood irrigation or peripheries of the basins where other crops may not succeed in the Gash Delta.

Recommendations

Based on the performance of roselle in the Gash Delta at different flooding periods, it is recommended to grow it at closer intarow spacings of 40-60 cm in adequate soil moisture, and at wider spacing (80 cm) in limited moisture of low flood. Between row spacing of 80 cm is to be recommended under adequate soil moisture and 100 cm under limited soil moisture.

References

Osman, M. N. and Saeed, O. (1986). Karkadeh production in the Gash Delta. Evaluation report for a commercial investment in 1985-86. Kassala Research Station, ARC.

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Table 1. Details of Roselle spacing experiments

Details	1986-87		1992-93	1993-94
	L A	L A		
Site	Degain 36	Degain 37	Tugrar 14	Tuqrar 9
Soil	Silty clay loam	Silty clay loam	Silty loam	Clayey
Flood irrigation	10 days	20 days	25 days	20 days
Between rows	80 cm	80 cm	80 – 100	80, 100
In–row	60, 80, 100, 120	60, 80, 100, 120	40, 60, 80	40, 60, 80
Design and Reps	RCB / 4 reps	RCB / 4 reps	RCB / 4 reps	RCB / 4 reps
Variety	Rahad	Rahad	Rahad	Rahad
Seed bed	Furrows	Furrows	Flat	Flat harrowed
Sowing date	15. 9.1986	12.10.1986	29.9.1992	2.9.1993
Seeds/hole	5– 6	5– 6	5– 6	5– 6
After thinning	2 plants/hole	2 plants/hole	2 plants	2 plants
Pest and diseases:	Flea beetles	Flea beetles White fly	Flea beetles Powdery mildew	Flea beetles White fly
Harvest	3 picks	2 picks	1 pick(109 days)	1 pick (105days)

Table 2. Response of Roselle to in-row spacing in the Gash Delta.

Spacing cm.	Dry sepals (kg/ha)		Means kg/ha	% Change
	1986-87 L A	1986-87 L B		
60 x 80	455	625	540	+27
80 x 80	489	600	544	+28
100 x 80	416	514	465	+9.0
120 x 80	394	459	427	,
S.E ±	46	51	34	
C.V. (%)	21	18	20	
Location means:				
L A	437			
L B	550			
S.E ±	35.25			
C.V (%)	19.56			

Table 3. Response of Roselle to plant spacing in the Gash Delta.

Spacing (cm)	Dry sepals (kg/ha) 1992-93	Dry sepals (kg/ha) 1993-94	Means kg/ha	Change %
40x80	1119	614	867	+10.5
60x80	1197	708	953	+21.5
80x80	1067	791	929	+18.5
40x100	1067	771	919	+17.1
60x100	989	730	859	+9.7
80x100	963	606	784	
Significance	Ns	Ns	Ns	
S.E. ±	44	84	67	
Means:				
Between row:				
80	1128	705	916	+7.3
100	1007	702	854	
Significance	*	Ns	Ns	
S.E±	26	48		
In–rows :				
40	1093	692	893	+4.1
60	1093	719	906	+5.7
80	1015	699	857	
Significance	Ns	Ns	Ns	
S.E ±	31	59	47	
C.V (%)	8	24	15	
Season means:				
1992/93	1067			
1993/94	703			
Significance	**			
***S.E.*±**	34			
C.V (%)	15			

Table 4. Performance of Roselle under extreme soil moisture condition in the Gash Delta demonstration plots.

Spacing (cm)	Dry sepals (kg/ha) 1988-89 (4 flood days)	Spacing (cm)	Dry sepals 1990/91 (700 ml)
40x100	331	40x80	1326
60x100	400	60x80	1223
80x100	256	80x80	1300
100x100	236	100x80	1250
Season means	306		1275