

Effect of levels of irrigation and crop geometry on quality of sugarcane under drip irrigation

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Abstract

A field experiment was conducted in Gang Canal Command area at 3"O" Srikaranpur, Sriganganagar during 2005-06, 2006-07 and 2008-09 to find out optimum plant geometry of sugarcane through drip irrigation and to compare water use and water use efficiency in both the methods of irrigation. None of the quality parameters was influenced by different crop geometries in surface irrigation treatment. Only commercial cane sugar was significantly influenced by different crop geometries in drip irrigation. Single row planting at 75 cm & 90 cm gave significantly higher CCS (t/ha) than paired row planting at 120x60 cm but at par with paired row planting at 90x60 cm. Irrigation levels significantly influenced all the quality parameters except juice purity percent. The highest CCS in tones per hectare was recorded with drip irrigation at 100% PE which was at par with that obtained with drip irrigation at 80 % PE treatment but significantly higher than drip irrigation at 60% PE and surface irrigation treatments. The juice percentage was also highest with 100 % PE treatment but poll percentage; brix percentage and CCS (%) were highest with 80 per cent PE treatment. The mean data revealed that drip irrigation at 60, 80 & 100 % PE increased cane yield by 14.4, 26.4 & 44.6 per cent, respectively over the cane yield obtained with border strip irrigation. In addition to yield increase, the respective water saving was 32.9, 17.1 & 1.4 per cent. Drip irrigation also improved the quality of cane and the commercial cane sugar increased by 46.4, 35.8 and 15.1 per cent as a result of drip irrigation at 60, 80 and 100% PE, respectively over that obtained with conventional flood irrigation treatment.

Key words: Sugarcane, drip irrigation, crop geometry, quality

Introduction

India is one of the largest sugarcane producers in the world after Brazil. Sugarcane being an important cash crop, it ranks third in the list of most cultivated crops after paddy and wheat. Sugarcane is planted in both tropical and sub-tropical region of India with total production of 294.6 million tonnes and productivity of 66.8 tonnes per hectare (Singh *et al.*, 2013). About 80% percent of the total rainfall is received during three monsoon months (July-September) which too is highly unreliable and erratic. During rest of the period the crop performance is depend on irrigation. In irrigation northwest plain zone of Rajasthan sugarcane is a commercial crop. The most common practice of irrigation is border strip. Sugarcane requires 15-20 irrigation per annum for optimum growth and yield. Drip irrigation is high frequency irrigation method of supplying water directly to the root zone. The micro irrigation techniques have a major role to play in

mitigating the water scarcity situation by enhancing the productivity of water in sugarcane in effective and scientific way (Ridge *et. al.*, 2000; Shinde and Jadhav 2001). Through adoption of drip farmers can get higher yield by providing congenial environment to the plant through maintaining optimum moisture regime throughout the growing period.

Materials and Methods

A field experiment was conducted in Gang Canal Command area at 3 "O", Srikaranpur, Sriganganagar during 2005-06, 2006-07 and 2008-09 in randomized block design with 3 replications. The treatments comprising of 4 crop geometries (single row planting 75cm, single row planting 90cm, paired row planting 60 cm x 90 cm, paired row planting 60 cm x 120 cm) and 4 irrigation levels (60, 80 and 100% of PE by drip system on alternate day, and border strip irrigation at IW/CPE 1.0 & irrigation water depth 7.5 cm). The soil was sandy loam in texture, low in organic carbon (0.35%), medium in available P₂O₅ (42 kg/ha) and high in available K₂O (410 kg/ha). The pH (1:2) and EC

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(1:2) of the soil were 8.05 and 0.21 dS/m, respectively. A uniform basal dose of 50 kg N, 40 kg P₂O₅ and 40 kg K₂O/ha was applied at planting. Rest N (100 kg/ha) was applied in 2 splits, one half each in May and June as top dressing. Sugarcane cv. CO 6617 was selected as the test crop.

Results and Discussion

Crop quality

Crop geometry under surface irrigation:

Under surface irrigation crop quality was not significantly affected by crop geometry during 2005-06 and 2007-08 (Table 1 & 2). However, during 2006-07, poll %, brix % and CCS % were significantly influenced by crop geometry. The maximum values of these parameters were found at 75 cm row spacing which were at par with those obtained at 90 cm single row spacing and 90x60 cm paired row spacing but significantly higher than 120x60 cm paired row spacing (Table 3). The pooled results of three years revealed that none of the quality parameters was influenced by different crop geometries in surface irrigation treatment (Table 4).

Crop geometry under drip irrigation:

Only commercial cane sugar (CCS) was influenced significantly by crop geometry under drip irrigation during 2005-06 and 2006-07. The highest CCS of 11.57 t/ha during 2005-06 and 17.64 t/ha during 2006-07 was recorded with 75 cm and 90 cm row spacing, respectively. However, these treatments were at par with each other and 90 cm x60cm paired row

spacing but significantly superior to that obtained at 120x60 cm paired row spacing. It is pertinent to mention here that the highest cane yield was also recorded with 75cm and 90 cm single row spacing during 2005-06 and 2006-07, respectively and the impact of cane yield has reflected in terms of commercial cane sugar yield. During 2007-08, none of the parameters was influenced by different crop geometries in drip irrigation.

The pooled data of three years revealed that only commercial cane sugar was significantly influenced by different crop geometries in drip irrigation. Single row planting at 75 cm & 90 cm gave significantly higher CCS (t/ha) than paired row planting at 120x60 cm but at par with paired row planting at 90x60 cm (Table 4).
Irrigation levels:

Irrigation levels significantly influenced all the quality parameters except juice purity during 2005-06. Drip irrigation at 100% PE recorded the highest CCS of 12.42 t/ha followed by 80% (11.62 t/ha) and 60% PE (8.97 t/ha). The lowest CCS of 8.40 t/ha was recorded under surface irrigation treatment. Under drip system, decreasing levels of irrigation increased baggase percentage and decreased juice (%). CCS and poll percent were significantly highest with 80 % PE. The quality of juice was poorest under surface irrigation treatments.

Irrigation levels significantly influenced the poll %, CCS % and CCS in tones per hectare during 2006-07. Drip irrigation at 100% PE recorded the highest

Table 1: Effect of crop geometry and drip irrigation on cane quality parameters (2005-06)

Treatment	CCS (t/ha)	Juice (%)	Baggase (%)	Poll(%)	Brix(%)	CCS(%)	Juice purity(%)
Crop geometry (surface)							
75 cm row spacing	8.68	35.30	64.70	13.17	15.97	8.79	82.50
90 cm row spacing	8.37	35.06	64.93	13.23	15.40	8.88	83.22
90cm X 60 cm paired row	8.52	34.10	65.90	13.13	15.83	8.79	83.07
120cm X 60 cm paired row	8.06	34.23	65.77	13.03	15.77	8.69	82.24
S. Em. _±	0.51	0.49	0.49	0.29	0.36	0.32	2.59
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Crop geometry (drip)							
75 cm row spacing	11.57	37.81	62.19	13.14	16.07	8.79	82.84
90 cm row spacing	11.49	37.01	62.99	13.21	15.92	9.11	84.68
90cm X 60 cm paired row	10.77	37.67	62.32	13.93	15.99	8.97	83.49
120cm X 60 cm paired row	10.18	37.07	62.93	12.96	15.99	9.04	83.90
S. Em. _±	0.30	0.28	0.29	0.77	0.19	0.19	1.49
CD at 5%	0.86	NS	NS	NS	NS	NS	NS
Irrigation levels							
IW/CPE 1.0	8.40	34.67	65.32	13.14	15.89	8.74	82.76
100% PE (drip)	12.42	38.98	61.02	13.22	16.23	8.76	81.50
80% PE (drip)	11.62	37.16	62.83	13.93	16.49	9.42	84.58
60% PE (drip)	8.97	36.03	63.98	12.96	15.25	8.79	85.10
S. Em. _±	0.26	0.25	0.25	0.15	0.16	0.16	1.29
CD at 5%	0.74	0.71	0.71	0.42	0.46	0.47	NS

Table 2: Effect of crop geometry and drip irrigation on cane quality parameters (2006-07)

Treatment	CCS (t/ha)	Juice (%)	Baggase (%)	Poll(%)	Brix(%)	CCS(%)	Juice purity(%)
Crop geometry (surface)							
75 cm row spacing	13.13	37.83	62.17	16.72	17.72	12.20	94.54
90 cm row spacing	12.21	39.53	60.47	16.14	17.35	11.78	93.08
90cm X 60 cm paired row	12.03	41.05	58.95	15.67	16.87	11.44	92.97
120cm X 60 cm paired row	10.82	38.29	61.71	14.56	15.17	10.63	96.20
S. Em.±	1.46	2.04	2.04	0.63	0.79	0.46	1.96
CD at 5%	NS	NS	NS	1.82	2.27	1.33	NS
Crop geometry (drip)							
75 cm row spacing	17.21	38.22	61.77	16.46	17.64	12.02	93.44
90 cm row spacing	17.64	37.74	62.26	16.30	17.05	11.89	95.72
90 X 60 cm paired row	16.68	40.07	59.93	16.37	17.19	11.95	95.26
120 X 60 cm paired row	13.68	39.46	60.54	16.31	17.42	11.91	93.69
S. Em.±	0.84	1.18	1.18	0.36	0.45	0.27	1.13
CD at 5%	2.43	NS	NS	NS	NS	NS	NS
Irrigation levels							
IW/CPE 1.0	12.05	39.17	60.83	15.77	16.78	11.51	94.20
100% PE (drip)	18.00	38.23	61.77	16.25	16.92	11.86	96.08
80% PE (drip)	16.16	40.25	59.75	16.92	17.95	12.35	94.39
60% PE (drip)	14.74	38.15	61.85	15.90	17.10	11.61	93.10
S. Ed.	1.11	1.56	1.56	0.48	0.60	0.35	1.49
CD at 5%	2.27	NS	NS	0.98	NS	0.72	NS

Table 3: Effect of crop geometry and drip irrigation on cane quality parameters (2007-08)

Treatment	CCS (t/ha)	Juice (%)	Baggase (%)	Poll(%)	Brix(%)	CCS(%)	Juice purity(%)
Crop geometry (surface)							
75 cm row spacing	6.10	34.57	65.43	13.20	15.47	8.97	85.30
90 cm row spacing	6.11	34.18	65.82	12.76	14.93	8.68	86.13
90cm X 60 cm paired row	5.52	33.82	66.18	13.10	15.77	8.78	82.93
120cm X 60 cm paired row	5.43	33.82	66.18	12.82	15.27	8.64	83.87
S. Em.±	0.42	1.21	1.21	0.54	0.45	0.48	2.78
CD at 5%	A NS	NS	NS	NS	NS	NS	NS
Crop geometry (drip)							
75 cm row spacing	7.56	35.93	64.07	13.07	16.54	8.86	78.98
90 cm row spacing	7.65	36.65	63.35	13.77	17.04	9.09	80.83
90 X 60 cm paired	7.07	36.32	63.68	13.34	16.40	8.84	81.17
120 X 60 cm paired	7.52	37.07	62.93	13.69	17.11	8.98	79.99
S. Em.±	0.24	0.70	0.70	0.31	0.26	0.28	1.61
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Irrigation levels							
IW/CPE 1.0	5.79	34.10	65.90	12.97	15.36	8.77	84.56
100% PE (drip)	8.00	38.60	61.40	13.25	16.60	8.69	79.85
80% PE (drip)	7.86	36.53	63.47	13.93	17.10	9.48	81.36
60% PE (drip)	6.49	34.36	65.64	13.22	16.63	8.65	79.44
S. Ed.	0.32	0.93	0.93	0.41	0.35	0.37	2.13
CD at 5%	0.65	1.89	1.89	0.84	0.71	0.75	4.34

CCS of 18.00 t/ha followed by 80% (16.16 t/ha) and 60%PE (14.74 t/ha). The lowest CCS of 12.05 t/ha was recorded under surface irrigation. The highest poll percentage and CCS percentage were recorded with 80% PE treatment which were at par with that of

100% PE treatment but significantly superior over rest of the treatments.

During 2007-08, irrigation levels significantly influenced all the quality parameters. The highest juice percent and CCS in tones per hectare were recorded

Table 4: Effect of crop geometry and drip irrigation on cane quality parameters (Pooled data of three years)

Treatment	CCS (t/ha)	Juice (%)	Baggase (%)	Poll(%)	Brix(%)	CCS(%)	Juice purity(%)
Crop geometry (surface)							
75 cm row spacing	9.30	35.90	64.10	14.36	16.39	9.99	87.45
90 cm row spacing	8.90	36.26	63.74	14.04	15.89	9.78	87.48
90cm X 60 cm paired row	8.69	36.32	63.68	13.97	16.16	9.67	86.32
120cm X 60 cm paired row	8.10	35.45	64.55	13.47	15.40	9.32	87.44
S. Em. _±	0.80	1.25	1.25	0.49	0.53	0.42	2.44
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Crop geometry (drip)							
75 cm row spacing	12.11	37.32	62.68	14.22	16.75	9.89	85.09
90 cm row spacing	12.26	37.13	62.87	14.43	16.67	10.03	87.08
90 X 60 cm paired	11.51	38.02	61.98	14.55	16.53	9.92	86.64
120 X 60 cm paired	10.46	37.87	62.13	14.32	16.84	9.98	85.86
S. Em. _±	0.46	0.72	0.72	0.48	0.30	0.25	1.41
CD at 5%	1.33	NS	NS	NS	NS	NS	NS
Irrigation levels							
IW/CPE 1.0	8.75	35.98	64.02	13.96	16.01	9.67	87.17
100% PE (drip)	12.81	38.60	61.40	14.24	16.58	9.77	85.81
80% PE (drip)	11.88	37.98	62.02	14.93	17.18	10.42	86.78
60% PE (drip)	10.07	36.18	63.82	14.03	16.33	9.68	85.88
S. Ed	0.40	0.64	0.64	0.25	0.26	0.21	1.16
CD at 5%	1.22	1.93	1.93	0.75	0.80	0.65	NS

with drip irrigation at 100 % PE. The highest poll percent, brix percent and CCS percent were recorded with drip irrigation at 80% PE. The highest baggase percent and juice purity percent were recorded with surface irrigation treatment. The CCS in tones per hectare with drip irrigation at 100 % PE was at par with 80 % PE treatment but significantly superior over 60 % PE and surface irrigation treatment.

The pooled results of three years revealed that irrigation levels significantly influenced all the quality parameters except juice purity percent. The highest CCS in tones per hectare was recorded with drip irrigation at 100% PE which was at par with that obtained with drip irrigation at 80 % PE treatment but significantly higher than drip irrigation at 60% PE and surface irrigation treatments. The juice percentage was also highest with 100 % PE treatment but poll percentage, brix percentage and CCS (%) were

highest with 80 per cent PE treatment. In view of yield, quality and water saving, irrigation in sugarcane at 80% PE has been found optimum irrigation schedule

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