Indian J. Agron. **41** (1) : 127–131 (March 1996)

Effect of plant density and drip irrigation on pre-monsoon cotton (*Gossypium hirsutum*)

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Received: February 1994

ABSTRACT

A field experiment was conducted during the pre-monsoon season of 1989 and 1990 to study the effect of plant densities and drip irrigation on yield, quality and economics of pre-monsoon cotton (*Gossypium hirsutum* L.). Plants @ 2/hill recorded significantly higher mean seed-cotton yield, lint, cotton-seed and oil yield/ha than 1 plant/hill at 1.5 m x 1.0 m spacing and the respective increase recorded was 31.99, 36.49, 34.23 and 35.33%. The fibre-maturity coefficient recorded by 2 plants/hill was significantly better than 4 plants/hill at 1.5 m x 2.0 m spacing system during both the seasons. The fibre-bundle strength and 2.5% span length were significantly better with 1 plant/hill than 2 plants/hill at 1.5 m x 1.5 m spacing system. Two plants/hill at 1.5 m x 1.0 m spacing recorded the maximum mean gross monetary return (Rs 17,332/ha) and net returns (Rs 8,893/ha).

Establishment of hybrid cotton (*Gossypium* sp.) with application of 1 litre water/day during pre-monsoon period is effective in increasing yield substantially (Kharche and Deshpande 1991). In practice, maintaining available soil moisture at higher range throughout the growing season as well as imposing calculated stress conditions for beneficial results in term of economic yield very well be achieved with drip-irrigation system on any soil type. Application of water @ 1.0 litre/day with drip emitters results in higher yield than spot application on even very shallow soil. Considering the easy availability of precise emitters and laterals in recent years, the present investigation was undertaken to study the effect of plant densities and drip irrigation on yield, quality and economics of pre-monsoon cotton (*G. hirsutum* L.)

MATERIALS AND METHODS

Pre-monsoon cotton crop was sown on 26 May 1989 and 17 May 1990 at Watershed Management Research Unit, PKV, Akola. The treatments comprising 6 plant geometries and 3 irrigation levels were laidout in strip plot design with four replications. The treatments tested were 1 plant/hill at 1.5 m x 1.0 m (P_1), 2 plants/hill at 1.5 m x 1.0 m (P_2), 1 plant/hill at 1.5 m x 1.5 m (P_3), 2 plants/hill at 1.5 m x 1.5 m (P_4), 2 plants/hill at 1.5 m x 2.0 m (P_5), 4 plants/hill at 1.5 m x 2.0 m spacing (P_6). The

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A part of Ph. D. Thesis of the first author

plants/hill were spaced at 15 cm distance vertically and horizontally as per treatment. Three irrigation schedules, viz. application of water @ 1.5, 1.0 and 0.5 litres/day/hill at I_1, I_2 and I_3 treatments up to 26 July were followed. Application rate of irrigation water was 3.0, 2.0 and 1.0 litres/day/hill at I_1, I_2 and I_3 irrigation levels up to 15 August respectively. Thereafter water application rates were 4.5 (I_1), 3.0 (I_2) and 1.5 (I_3) litres/day/hill up to 10 November. The soil was shallow with sandy clay-loam deficient in nitrogen (total 0.049%), medium in available P_2O_5 (40.90 kg/ha) and rich in available K_2O (492.8 kg/ha). The field capacity, permanent wilting point, bulk density, pH and electrical conductivity were 30.28%, 15.34%, 1.29 g/cc, 8.0 and 0.25 mm hos/cm at 25°C respectively. 'AHH 468' cotton variety was used with a common fertilizer dose of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O/ha. Laterals of 13 mm diameter with 1 turbo key dripper (4 litres/hr)/hill were used.

RESULTS AND DISCUSSION

Effect of spacing

Number of bolls picked/plant recorded by 1 plant/hill was significantly superior to 2 plants/hill at 1.5 m x 1.0 m and 1.5 m x 1.5 m spacing systems during both the seasons (Table 1). Two plants/hill were significantly superior to 4 plants/hill at 1.5 m x 2.0 m spacing. Kalsey *et al.* (1978) found reduction in mean number of bolls/plant at 60 cm x 30 cm compared with 60 cm x 60 cm spacing. Boll weight recorded by 2 plants/hill was significantly superior to 4 plants/hill at 1.5 m x 2.0 m spacing. However, the differences recorded by 1 plant/hill and 2 plants/hill at 1.5 m x 1.0 m and 1.5 m x 1.5 m spacing were not significant during both the seasons. These findings are in conformity with the finding of Nandwate and Upadhaya (1978).

At 1.5 m x 1.0 m spacing system 2 plants/hill recorded significantly higher seed cotton, lint, cotton-seed and oil yield than 1 plant/hill and the increase recorded was 31.99, 36.49, 34.23 and 35.33% respectively (Table 1). Two plants and four plants/hill at 1.5 m x 2.0 m spacing system did not significantly affect the seed cotton, lint, cotton seed and oil yield. The higher seed-cotton yield obtained with low plant density/hill at 1.5 m x 1.0 m or 1.5 m x 1.5 m spacing might be due to optimum population and plant architecture, resulting in good growth in terms of plant height, leaf-area index and yield-contributing characters. Although yield attributes (boll number and boll weight) were seen to be better with 1 plant/hill than 2 plants/hill, increase in yield attributes could not compensate the yield expressed per unit area mainly because of change in plant population/unit area which ultimately decide yield/ha. Similar results were reported by Bavale (1982).

Results indicated negative relationship between spacing and fibre length. An increase in plant spacing from 1.0 to 2.0 m resulted in decrease in fibre length (Table 2). Similar results were reported by Hawkins and Peacock (1970). During 1990, the fibre-uniformity ratio recorded by 1 plant/hill was significantly superior to 2 plants/hill at 1.5 m x 1.5 m spacing. The fineness of cotton fibre at 1.5 m x 1.5 m spacing system with 1 plant/hill was significantly superior to 2 plants/hill during 1989. Similarly, 4 plants/hill at 1.5 m x 2.0 m spacing was significantly better to 2 plants/hill. Fibre-maturity coefficient at 1.5 m x 2.0 m spacing, 2 plants/hill was significantly better than four plants/hill. At 1.5 m x 1.0 m and 1.5 m x 1.5 m spacing system fibre-maturity coefficient value remained unaffected due to

Table 1. Effect of plant densities, row spacing and irrigation level on yield attributes and yield of cotton

Treatment	Bolls picked/plant		Boll weight (g)		Seed-cotton yield (q/ha)			Lint yield (q/ha)			Cotton seed (q/ha)			Cotton seed oil (q/ha)		
	1989	1990	1989	1990	1989	1990	Pooled	1989	1990	Pooled	1989	1990	Pooled	1989	1990	Pooled
Spacing																
P_1	73.01	60.03	3.04	3.83	14.42	14.96	14.69	5.79	5.38	5.59	8.62	9.08	8.75	1.39	1.61	1.50
P_2	54.31	46.87	2.98	3.67	16.85	21.94	19.39	6.72	8.54	7.63	10.13	13.39	11.76	1.71	2.35	2.03
P_3	88.40	74.34	3.02	4.18	11.03	15.15	13.09	4.41	5.59	5.00	6.62	9.56	8.09	1.11	1.55	1.33
P_4	56.31	52.08	2.97	3.70	13.50	16.63	15.07	5.34	6.70	6.02	8.08	9.92	9.00	1.37	1.64	1.51
P_5	69.88	60.24	3.05	3.94	13.27	15.04	14.16	5.07	6.19	5.63	8.19	8.88	8.54	1.33	1.55	1.44
P_6	42.83	40.70	2.31	2.98	12.13	15.99	14.06	4.70	6.18	5.44	7.42	9.75	8.58	1.33	1.62	1.47
CD (P = 0.05)	13.72	9.05	0.50	0.59	1.70	1.78	1.22	0.44	0.55	0.51	0.79	0.89	0.86	0.27	0.33	0.20
Irrigation																
I_1	64.37	55.59	3.46	3.80	13.09	17.19	15.14	5.15	5.57	5.86	8.07	10.61	9.34	1.39	1.77	1.58
I_2	65.48	57.20	3.72	3.80	13.50	16.58	15.04	5.37	6.33	5.85	8.08	10.25	9.17	1.32	1.74	1.53
I_3	62.51	54.31	3.41	3.71	14.00	16.04	15.02	5.50	6.40	5.95	8.50	9.03	9.07	1.42	1.66	1.54
CD (P = 0.05)	NS	NS	NS	NS	NS	0.50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Details of treatments are given in text

Table 2. Effect of plant densities andirrigation levels on quality parameters of cotton

Treatment	2.5% span length		Uniformity ratio		Fineness (10^{-6} g/cm)		Maturity coefficient		Bundle strength Lb/mg	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
Spacing										
P_1	28.92	27.73	55.00	49.33	3.52	4.37	0.69	0.71	8.27	7.97
P_2	28.36	26.29	55.50	50.33	3.55	4.43	0.69	0.72	8.23	7.85
P_3	27.23	26.12	53.75	51.41	3.58	4.23	0.70	0.70	8.56	8.35
P_4	27.81	26.17	55.25	49.83	3.86	4.33	0.73	0.69	8.94	8.20
P_5	27.71	26.00	55.50	49.50	3.88	4.20	0.72	0.71	8.88	8.24
P_6	28.02	26.18	54.50	49.75	3.45	4.28	0.68	0.69	8.05	8.01
CD (P = 0.05)	0.53	NS	NS	1.20	0.18	0.13	0.03	0.01	0.13	0.27
Irrigation										
I_1	28.39	26.21	53.91	50.45	3.58	4.26	0.70	0.70	8.54	8.14
I_2	28.88	25.90	55.16	49.70	3.59	4.33	0.70	0.71	8.46	8.12
I_3	27.90	26.13	55.66	49.91	3.74	4.33	0.72	0.70	8.61	8.05
CD (P = 0.05)	NS	NS	0.74	0.29	0.10	NS	NS	NS	NS	NS

plants density/hill during both the seasons. At 1.5 m x 1.5 m and 1.5 m x 2.0 m spacing system increase in density of plants/hill from 1 to 2 or 2 to 4 resulted in decrease bundle-strength values.

At 1.5 m x 1.0 m spacing system 2 plants/ hill recorded significantly higher gross and net monetary returns (Rs 17,332 and Rs 8,893) over 1 plant/hill (Table 3). The increase in gross monetary and net return recorded 2 plants/hill was 33.48 and 82.23% over 1 plant/hill at 1.5 m x 1.0 m spacing. Similarly, 2 plants/hill at 1.5 m x 1.5 m spacing system recorded increase in gross and net monetary return up to 12.71 and 39.19% over 1 plant/hill. Two plants/ hill at 1.5 m x 1.0 m spacing recorded maximum/rupee return (Rs 2.04), followed by 2 plants/hill at 1.5 m x 1.5 m spacing. The lowest/rupee return was recorded by 1 plant/hill at 1.5 m x 1.5 m spacing system.

Effect of irrigation

Mean number of bolls picked/plant, boll weight, mean seed-cotton yield, lint, cotton seed, oil yield were not significantly influenced due to various irrigation levels. The fibre uniformity ratio and fineness were significantly influenced by irrigation treatments. During 1989 fibre-uniformity ratio at medium irrigation levels was significantly superior to high irrigation level. However, fibre fineness at high irrigation level was significantly better than low irrigation level during 1989. Other quality parameters remained unaffected due to different irrigation levels. Mean maximum gross, net return and net return/rupee were obtained at high irrigation level and the lowest gross, net and per rupee return were recorded at low irrigation levels.

Table 3. Effect of plant densities, row spacing and irrigation level on monetary economics of hybrid cotton

Treatment	Gross monetary return (Rs/ha)		Net return (Rs/ha)		Net return/rupee	
	1989	1990	1989	1990	1989	1990
Spacing						
P_1	11,936	14,033	3,878	5,882	1.48	1.72
P_2	14,215	20,450	5,932	11,855	1.71	2.37
P_3	9,239	14,109	1,815	6,430	1.24	1.83
P_4	11,205	15,545	3,759	7,718	1.50	1.98
P_5	10,951	14,026	3,611	6,533	1.49	1.87
P_6	10,233	14,957	2,829	7,295	1.38	1.95
CD (P = 0.05)	1,272	1,646	1,213	1,647		
Irrigation						
I_1	10,935	16,085	3,352	8,159	1.44	2.02
I_2	11,337	15,537	3,651	7,637	1.47	1.96
I_3	11,617	14,938	3,909	7,062	1.50	1.89
CD (P = 0.05)	NS	492	349	497		

Details of treatments are given in text

On the basis of 2-year data it was concluded that for drip irrigation system, 2 plants/hill at 1.5 m x 1.0 m spacing system (13,333 plants/ha) recorded the maximum seed-cotton yield as well as net monetary return/ha.

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