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Optimization of irrigation water and nitrogen to cotton (*Gossypium Species*) through drip irrigation system

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ABSTRACT

A field experiment were carried out during 1993-94 and 1994-95 at Marathwada Agricultural University, Parbhani. In the trial effect of planting patterns and irrigation schedules through drip system was tested, and in the second trial nitrogen requirement of cotton (*Gossypium* sp.) through drip irrigation was studied on Vertisols. Seed cotton yield was not influenced significantly by the planting patterns during both the years. Irrigation at 0.8 and 1.0 ETC was at par and proved significantly superior to 0.4 and 0.6 ETC depth in influencing seed cotton yield. Application of 100 kg N/ha through drip recorded significantly higher seed cotton yield over rest of treatments including its soil application at the same rate. Higher N use efficiency was observed with drip than soil application methods.

Key words : Cotton, Planting pattern, Drip irrigation, Nitrogen

Heavy rains on Vertisols during early stage of cotton and recurrent dry spell prevailed at flowering or post-flowering period results drastic reduction in cotton yields. Productivity of cotton could be increased with irrigation at critical growth stage compared to rainfed situation (Mehetre, 1977). Surface irrigation on Vertisols leads to heavy incidence of pests and diseases besides impairing soil health. Drip irrigation to cotton maintains soil-water-plant relations at optimum conditions, lowers weed infestation and saves the irrigation water. However, in drip system initial cost involvement is very heavy especially on laterals and therefore field studies were conducted on drip irrigation under varying plant geometries for reducing cost on laterals along with N fertigation in cotton.

MATERIALS AND METHODS

Two sets of field experiments were conducted during 1993-94 and 1994-95 at Parbhani. The first set of experiments consisted of 8 treatment combinations involving 2 planting patterns and 5 irrigation schedules of drip (0.4, 0.6, 0.8 and 1.0 ETC) and 1 surface irrigation at 0.9 IW:CPE under alternate furrow irrigation (control). ETC was calculated as ETo × KC. where ETo = Potential evapotranspiration and KC = Crop coefficient. In the second set, N application @ 50, 75 and 100 kg/ha through drip and application of 100 kg N through soil as control was tried. The paired planting was (60/120

× 60 cm) was adopted for drip in the first set, whereas in the second set four treatments were tested under simple randomized block design with five replications.

Soil was medium deep clay, low in organic carbon (0.5%) and nitrogen (0.04%), medium in P_2O_5 (30 kg/ha) and rich in K_2O. The moisture contents at-33 Kpa and - 1,500 Kpa potentials were ranged over 35 to 36 and 16 to 17% respectively. Bulk density of soil was 1,320 kg/m^3. Under drip system 1 lateral was used for each row in normal planting, while in group planting 1 lateral was provided for paired row and 1 dripper for 1 hill (2 plants). Uniformity co-efficients of dripper was 95% and mean wetted diameter was 76 cm. Besides treatments all package of practices were followed as per recommendation uniformly to all the treatments in both the seasons.

RESULTS AND DISCUSSION

Planting pattern

Seed cotton yield was not influenced significantly by different planting patterns during both the years. Although higher productivity was recorded during 1993-94 compared to 1994-95 (Table 1). Narkhede *et al.* (1996) reported that pre-monsoon cotton planted under drip irrigation recorded significantly higher seed cotton and lint yield/ha.

Irrigation schedule

Irrigation schedule of 0.6. 0.8 and 1.0 ETC recorded significantly higher seed cotton yield than 0.4 ETC during 1993-94, while during 1994-95 0.8 and 1.0 ETC schedules being at par recorded significantly more seed cotton yield than 0.4 and 0.6 ETC.

Interaction

Interaction of planting pattern × irrigation schedule was absent during both the years (Table 1).

PLANTING PATTERNS

Irrigation schedule surface control

The seed cotton yield was significantly influenced by irrigation schedules through drip. Under paired planting pattern irrigation

Table 1. Seed cotton yield as influenced by planting pattern and irrigation schedules through drip

Treatments	Seed cotton yield (kg/ha)	
	1993-94	1994-95
Planting patterns		
P_1 -Normal planting (90 × 90 cm)	2,641	1,801
P_2 -Paired planting 60,120 × 60 cm	2,545	1,844
CD (P = 0.05)	NS	NS
Irrigation schedule through drip		
D_1-0.4 ETC	2,396	1,719
D_2-0.6 ETC	2,614	1,725
D_3-0.8 ETC	2,703	1,963
D_4-1.0 ETC	2,606	1,878
CD (P = 0.05)	152	116

Table 2. Seed cotton yield and water use components as influenced by different drip treatments and surface control (average of 2 years)

Particulars of treatments Planting ×	Irrigation schedules thourgh drip	Seed cotton yield (kg/ha)	Irrigation water applied (mm)	Consumptive use (mm)	WUE (kg seed cotton/ ha/cm)	Water saving over control	Per cent increase in yield over control
Normal	T_1 -(0.4 ETC)	1,916	81	706	27.1	55	5
Planting	T_2 -(0.6 ETC)	1,943	122	778	24.9	32	7
(90 × 90 cm)	T_3 -(0.8 ETC)	2,034	163	829	26.9	9	23
	T_4 -(1.0 ETC)	2,083	203	873	23.9		15
Group	T_5 -(0.4 ETC)	1,928	81	750	25.7	55	6
Planting	T_6 -(0.6 ETC)	2,039	122	761	26.8	32	12
(60 × 60 × 120 cm)	T_7 -(0.8 ETC)	2,141	163	795	26.9	9	18
	T_8 -(1.0 ETC)	2,071	203	853	24.3		14
Normal Planting alternate furrow Irri. at 0.9 IW/CPE	T_9 - Control	1,820	180	847	21.5		
CD. (P = 0.05)		172					
Mean		2,020	144	799	25.2	20	12

Table 3. Effect of different levels of nitrogen through surface and drip on the yield of cotton ('NHH44') (average of 2 years)

Treatments	Seed cotton yield (kg/ha)	Water applied (mm)	CU (mm)	Water use efficiency (kg/ha/cm)	Nitrogen use efficiency (kg seed cotton/kg N-ha)	Yield increase over control
N_1- 50 kg through drip	1,654	122	772	21.4	33.1	
N_2- 75 kg N through drip	1,897	122	783	24.2	25.3	4
N_3- 100 kg N through drip	2,108	122	813	25.9	21.1	16
N_4- 100 kg N/ha - conventional method of application and alternate furrow irrigation	1,825	180	860	21.2	18.2	
CD (P = 0.05)	139	102	92			
Mean	1,870	145	808	23.1	23.0	

at 0.6 ETC recorded significantly higher seed cotton yield over surface control and normal planting irrigation at 0.4 or 0.6 ETC was superior (Table 2). The increase in yield through over control was to the extent of 7% whereas water saving was 32%. The cost of dripper and lateral could be saved to the extent of 50% due to adoption of paired planting.

Nitrogen management in cotton through drip

Application of 100% recommended dose of N (100 kg/ha) through drip recorded significantly higher seed cotton yield over rest of the treatments including conventional method (100 kg N/ha through soil application) (Table 3). The yield realized with 75 kg N/ha through drip was comparable with 100 kg N/ha through conventional method. However, it was significantly superior to 50% of recommended dose through drip, thereby indicating saving of 25 kg N/ha through drip method.

Water-use-components

The data on water use components are presented in Table 2. This indicates that drip (0.4 to 0.8 ETC) has saved irrigation water ranging from 9 to 55 per cent over surface application (control). Increase in the seed cotton yield was also up to 23% with 0.8 ETC through drip compared to surface control.

Economic of drip unit system

Under paired planting of drip, cost on laterals and dripper was reduced to the extent of 50%. The cost involved in drip system under paired planting was Rs 50,642/ ha. However, this expenditure could be recovered within 4 years, as the benefit accrued in drip system over control was Rs

12,794/year. The payback period for drip unit was calculated as per the additional benefit due to drip treatment and additional area under irrigation.

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