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Effect of Drip Fertigation on Growth, Yield Attributes and Yield of Cotton

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A field experiment was conducted at Agricultural College and Research Institute, Madurai, during rabi 2010 - 2011 to study the effect of drip fertigation on growth, yield attributes and yield of cotton. In this study, growth parameters such as plant height, leaf area index (LAI), sympodial branches, dry mater production, root length, root dry weight were found to be enhanced by drip irrigation at 100 per cent Pan Evaporation (PE) along with 100 per cent drip fertigation (Recommended Dose of Fertilizer(RDF) as Water Soluble Fertilizer (WSF)). This combination of drip irrigation 100 per cent PE with drip fertigation 100 per cent RDF as WSF also increased yield attributes such as number of bolls plant $^{-1}$, boll weight and seed cotton yield.

Key words: Cotton, D rip fertigation, Growth, Yield attributes, Yield.

Cotton, the king of fibers, occupies a prominent position as a commercial crop both in the developed and developing countries. India ranks first in cotton area and has enough potential to increase the productivity through management practices. According to CAB(2013) report cotton has been grown in an area of 119.78 lakh ha with a total production of 365 lakh bales and the average productivity was 518 kg/ha. Irrigation and fertilizers are the most important management factors which influence growth, plant development, yield and lint quality. Drip fertigation is a proven technology with the potential for increasing the crop productivity and conservation of resources. The yield increase in drip irrigation compared to conventional irrigation method varies from 20 to 100 per cent, whereas, saving in water ranges from 40 to 70 per cent, besides 50 to 60 per cent saving in labour (Sivanappan, 2004). Water saving includes irrigation of a smaller portion of the soil volume, decreased surface evaporation, reduced runoff from the drip field and controlled deep percolation loses below the crop root zone. Drip irrigation at 50 per cent of PE throughout the crop growth periods could save 50 per cent irrigation water and increase cotton productivity (Sankaranarayanan *et al*., 2010). Application of water soluble fertilizers (WSF) through drip irrigation system is gaining importance in present day agriculture to boost productivity of various crops (Yosef, 1999).

Materials and Methods

A field experiment was conducted at Agricultural College and Research Institute, Madurai during rabi 2010-2011 on drip fertigation in cotton with two irrigation regimes and six fertigation levels in split plot design with three replications. For testing cotton hybrid RCH -2 (BG II) was used. The main plot treatments consisted of two drip irrigation regimes *viz*., 75 per cent Pan Evaporation (PE) (I_1) and 100 per cent PE (I_2). The subplot treatments consisted of six fertigation levels *viz*., 75 per cent Recommended Dose of Fertilizer (RDF) as commercial fertilizers (F_1), 100 per cent RDF as commercial fertilizers (F_2), 125 per cent RDF as commercial fertilizers (F_3), 50 per cent RDF as WSF (F_4), 75 per cent RDF as WSF (F_5) and 100 per cent RDF as WSF (F_6). The RDF level was 150:75:75 kg NPK/ha. The growth parameters, yield attributes and yield were recorded and statistically analyzed.

Soil physic-chemical characteristics of the experimental field

Particulars	
Textural composition (Per cent on moisture free basis) (Piper,1966)	
Clay (%)	11.92
Silt (%)	11.93
Fine sand (%)	31.50
Coarse sand (%)	42.65
Textural class	Sandy clay Loam
Physical properties	
Bulk density (g cc $^{-1}$)	1.38
Chemical properties	
Available N (kg ha^{-1}) (Subbiah and Asija, 1956)	232.00
Available P (kg ha^{-1}) (Olsen *et al*.,1954)	14.80
Available K (kg ha^{-1}) (Stanford and English, 1949)	297.00
Organic carbon (%) (Walkley and Black,1934)	0.46
pH (1 : 2 soil water suspension) (Jackson, 1973)	7.5
EC(dSm^{-1}) (1:2 soil water suspension) (Jackson, 1973)	0.23

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Results and Discussion

Growth parameters

Growth parameters such as plant height, leaf area index, leaf water content, and dry matter production were influenced by irrigation regimes and fertigation levels (Table 1).

The plant height recorded under drip irrigation at 100 per cent PE with drip fertigation of 100 per cent RDF as WSF (I_2F_6) was 92.6 cm at 120 DAS. The increased plant height under this treatment was mainly due to the continuous availability of the required quantity of water along with the required nutrients. This was in conformity with the findings of Sankar *et al*. (2007).

Table 1. Effect of drip irrigation regimes and fertigation levels on growth parameters of Cotton

Treatment	Plant height at 120 DAS (cm)				Leaf Area Index at 120 DAS (cm)				RLWC (%) at 90 DAS				Dry matter production (kg ha^{-1}) at harvest			
	I_1	I_2	Mean		I_1	I_2	Mean		I_1	I_2	Mean		I_1	I_2	Mean	
F_1	69.0	73.0	71.0		2.84	2.89	2.86		73.1	77.9	75.5		3194	3314	3254	
F_2	77.2	82.0	79.6		2.90	2.99	2.94		74.9	82.7	78.8		3788	3952	3870	
F_3	87.7	89.2	88.4		2.93	3.02	2.97		77.3	82.8	80.1		4154	4536	4345	
F_4	68.0	81.0	74.5		2.85	2.92	2.88		72.4	81.8	77.1		3184	3525	3354	
F_5	78.5	93.0	85.8		2.98	3.21	3.09		76.8	85.5	81.1		3730	4212	3971	
F_6	92.6	92.6	98.4		3.1	3.5	3.3		79.3	88.0	83.6		4477	5089	4783	
Mean	78.8	87.0			2.9	3.0			75.6	83.1			3754	4104		
SEd	I	F	IXF	FXI	I	F	IXF	FXI	I	F	IXF	FXI	I	F	IXF	FXI
	1.7	1.7	2.9	2.5	0.1	0.1	0.1	0.1	0.2	0.6	0.8	0.8	61	79	120	113
CD(= 0.05)	7.6	3.7	8.5	5.2	0.1	0.1	0.2	0.1	1.2	1.2	1.9	1.7	266	166	321	235

The treatment combination of drip irrigation at 100 per cent PE with drip fertigation of 100 per cent RDF as WSF (I_2F_6) was more effective in increasing the LAI (3.51 at 60 DAS). Increased proliferation of roots resulting in quick canopy growth might have enhanced higher production and translocation of photosynthates from source to sink (Veeraputhiran, 2000). The same treatment combination has also registered higher RLWC of 88.0 per cent at 90 DAS. Drip irrigation, because of favourable moisture supply, recorded the higher value of stomata conductance and transpiration rates, which led to increase in LAI (Sammis and Wilkam, 1986).

The higher dry matter production was recorded under drip fertigation of 100 per cent PE with drip fertigation of 100 per cent RDF as WSF (I_2F_6) (5089 kg at harvest). Fertilizers applied through drip irrigation as water soluble fertilizers in desired split doses throughout the crop growing period, according to its requirements, might have enhanced availability of nutrients by the continuous supply of nutrients up to 120 DAS. This might have reflected on the plant growth rate and higher DMP. These results are also in agreement with the findings of Shanmugam *et al*. (2007).

Yield attributes

Yield attributes such as number of sympodial branches, number of bolls and boll weight were influenced by irrigation regimes and fertigation levels (Table 2).

Table 2. Effect of drip irrigation regimes and fertigation levels on yield attributes and yield of Cotton

Treatment	Sympodial branches plant^{-1} at harvest				Boll number $^{-1}$ plant				Boll Weight (g)				Seed cotton yield (kg ha^{-1})			
	I_1	I_2	Mean		I_1	I_2	Mean		I_1	I_2	Mean		I_1	I_2	Mean	
F_1	22.3	25.3	23.8		29.0	32.0	30.5		3.3	3.8	3.5		1602	1688	1645	
F_2	28.3	29.5	28.9		32.5	34.5	33.5		3.7	4.3	4.0		1816	1901	1823	
F_3	30.5	32.3	31.4		34.5	36.2	35.3		4.1	4.6	4.3		1941	1982	1961	
F_4	22.5	27.0	24.8		30.2	32.5	31.4		3.5	4.1	3.8		1632	1764	1698	
F_5	28.0	31.0	29.5		34.6	36.2	35.4		4.3	5.0	4.7		1900	2078	1989	
F_6	33.0	36.0	34.5		36.8	40.0	38.4		5.1	6.0	5.5		2172	2381	2276	
Mean	27.5	30.2			32.9	35.2			4.0	4.6			1843	1965		
SEd	I	F	IXF	FXI	I	F	IXF	FXI	I	F	IXF	FXI	I	F	IXF	FXI
	0.4	0.3	0.6	0.5	0.2	0.2	0.4	0.3	0.1	0.1	0.1	0.1	20	24	37	34
CD (= 0.05)	2.0	0.8	2.0	1.1	1.1	0.4	1.2	0.7	0.2	0.1	0.2	0.1	87	50	101	70

Higher number of sympodial branches were recorded under drip irrigation of 100 per cent PE with 100 per cent RDF as WSF through drip fertigation (I_2F_6) (36.0 at harvest). The higher number of bolls were recorded under drip irrigation at 100 per cent PE with drip fertigation of 100 per cent RDF as WSF (I_2F_6) which recorded 40.0 bolls plant $^{-1}$.

The higher boll weight of 6.0 g was recorded under drip irrigation at 100 per cent PE with drip

fertigation of 100 per cent RDF as WSF. This might be due to the fact that the adequate nutrients supplied from these treatments had created more conducive environment for the roots to absorb the nutrients more effectively, when compared to drip fertigation of 100 per cent RDF as commercial fertilizers. The growth parameters were also higher under this treatment, which might have contributed to higher yield. This might also be due to more photosynthesis, ultimately increase in dry matter with an increase in the amount of fertilizer level. This sort of favourable effect of higher NPK dose on yield attributes was also noted by Halemani *et al*. (2004). Thind *et al.* (2011) reported that application of drip irrigation resulted in an average increase of 5 per cent in seed cotton yield as compared to check-basin.

Seed cotton yield

Combined effect of drip irrigation at 100 per cent PE with 100 per cent RDF as WSF (I_2F_6) registered higher seed cotton yield of 2381 kg ha $^{-1}$. This was followed by drip irrigation at 75 per cent PE with 100 per cent RDF as WSF (I_1F_6), which recorded 2172 kg ha^{-1}of seed cotton yield. (Table 2).

The increase in cotton yield with drip irrigation at 100 per cent PE were mainly attributed to greater and consistent availability of soil moisture and nutrients, resulting in better crop growth, yield components which ultimately, reflected on the seed cotton yield. Increased yield might be due to application of water soluble fertilizer, which favoured uptake of nutrients associated with increased growth and yield attributes. Similar results were expressed by Janat and Somi (2001).

Conclusion

Among the irrigation regimes, drip irrigation at 100 per cent PE recorded higher growth rate and yield attributes. Drip fertigation of 100 per cent RDF as WSF (I_2F_6) recorded higher yield and yield attributes. Hence, based on this study, it could be concluded that drip irrigation of 100 per cent PE with fertigation of 100 per cent RDF as WSF (I_2F_6) would be an ideal practice to achieve higher productivity in hybrid cotton.

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