

EFFECT OF DRIP AND SPRINKLER IRRIGATION SYSTEM ON GROWTH AND YIELD OF AMERICAN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT : A field experiment was conducted to compare the performance of drip and sprinkler irrigation system on the growth and yield related parameters of American cotton (*Gossypium hirsutum* L.) cv. L-846 at research farm of Punjab Agricultural University, Ludhiana. There were two levels of irrigation (i.e., low and high having IW/CPE ratio as 0.75 and 1.00); and two methods of fertilizer application in drip (i.e., manual application and fertigation). The result shows that the plant height was found maximum in sprinkler system (159.10 cm) as compared with drip system (158.90 cm) having treatment of low level of irrigation using fertigation. Number of bolls per plant was found maximum in drip system (22.96) with low level of irrigation and in sprinkler system (22.20) having treatment of fertigation, respectively. There was no significant difference between all treatments in quality traits (i.e., fibre length, micronaire, fibre maturity coefficient, fibre bundle strength and oil content). Maximum yield (31.10 q/ha) was found in drip system with low level of irrigation followed by sprinkler system (28.60 q/ha) with high level of irrigation. Water Use Efficiency (0.47 q/ha-cm) and Nitrogen Use Efficiency (41.47 q/ha-kg) was found more in drip system as compared to sprinkler system.

Key Words : Drip and sprinkler irrigation system, yield, American cotton.

Cotton is one of the main crops in south-west Punjab. In this area the main source of irrigation is canal water. Since the supply of canal water is inadequate, the general tendency of farmers is to flood their fields without considering the characteristics of soil, climate and crop requirement. This has resulted into inefficient and injudicious use of canal water and which has caused water logging and salinity problems in that area. Intensive canal networking impaired with conventional irrigation system like; check basin, border and furrow irrigation methods are responsible for the present burning problem of this area of Punjab. Punjab is not only facing the problem of water logging but declining of water table is also a great problem. Water table is lowering mainly due to over exploitation of groundwater for irrigation and other purposes.

To nullify these problems, one have to use

available water resources judiciously for irrigation and other purposes. Drip and sprinkler systems of irrigation are the suitable option to the farmers because, their efficiency is very high (Sivanappan, 1985). The drip and sprinkler irrigation system is also improving water use efficiency (Chauhan and Shukla, 1990). By using drip irrigation system water can be saved upto 70 per cent (Rao and Dixit, 1994). The objective of this study carried out the effect of drip irrigation method over sprinkler irrigation on growth and yield.

MATERIALS AND METHODS

The study was conducted at Soil and Water Engineering Department, Punjab Agricultural University, Ludhiana on sandy loam soil of alluvial origin of great depth. The study carried out to determine the effect of drip irrigation method over sprinkler irrigation method over sprinkler irrigation system using

two levels of irrigation, (low level IW/CPE=0.75 and high level IW/CPE=1.00). The experimental design was split-split. American cotton cv. LH-846 was sown. Fertilizers were applied at the rate of 75 kg N/ha and 30 kg P₂O₅/ha (as per recommendation of Package of Practices of kharif crops, PAU, Ludhiana, 1996). Treatment details are given in Table-1.

In sprinkler irrigation and drip irrigation system each plot size was 12.0 m x 4.05 m and 4 m x 2.7 m. respectively. There were two fertilizer application methods, manual fertilizer application and fertigation. In sprinkler irrigation system half of the fertilizer (N and P₂O₅) was applied as basal dose and remaining half of the fertilizer was applied at blooming stage. In drip irrigation system half of the plots received fertilizer as in the case of sprinkler system, but in the remaining half of the plots fertilizer as in the case of sprinkler system, but in the remaining half of the plots fertilizer was applied at blooming stage. In drip irrigation system half of the plots received fertilizer as in the case of sprinkler system, but in the remaining half of the plots fertilizer were applied as fertigation in split doses. For providing suitable soil moisture condition for better germination a common irrigation was applied to all the plots as surface irrigation. In drip irrigation system, plots were irrigated daily on the basis of previous day's evaporation. The operations like intercultural practices were carried out uniformly in all the plots. For different treatments data were recorded from time to time on different plant and yield related parameters (Biwalkar, 1998).

RESULTS AND DISCUSSION

Plant parameters

Plant related parameters were influenced by different treatments. Plant height was recorded maximum in sprinkler irrigation system as compared to drip irrigation system (Table-2). In drip (158.9 cm) and sprinkler (159.1 cm) irrigation system plant height was found to be higher in IW/CPE=1.00 as compared with IW/CPE = 0.75. In this fact that there was more vegetative growth in IW/CPE=1.00 due to

more availability of water in the root zone, but in the case of IW/CPE=0.75. The plant growth (height) was affected by water availability for the use of plant in the root zone and the height of the plant got affected.

The average number of boll per plant was recorded maximum in drip irrigation system compared with sprinkler irrigation system (Table-3). In IW/CPE = 0.75 average number of boll per plant was more in drip irrigation system (22.10) followed by sprinkler irrigation system (22.20) at IW/CPE=1.0. In drip irrigation system there was less number of bolls per plant were recorded in IW/CPE ratio = 1.00. It can be contributed to the fact that at the time of squaring and boll formation there was a continuous vegetative growth occurred in IW/CPE=1.00 and due to prolonged vegetative growth flowering got affected.

Yield and Quality parameters

The data on yield under different treatments are given in Table-3. The table shows that the average seed-cotton yield was found to be higher in drip irrigation as compared to sprinkler irrigation system. In drip irrigation system the average seed-cotton yield was found to maximum (31.10 q/ha) in IW/CPE = 0.75 as compared to IW/CPE = 1.00 (30.32 q/ha). In sprinkler irrigation system seed-cotton yield was found to be maximum in (28.60 q/ha) in IW/CPE = 1.00 followed by IW/CPE = 0.75 (28.57 q/ha). There was no significant difference found among all IW/CPE ratios.

Water Use Efficiency (WUE) and Nitrogen Use Efficiency (NUE)

The water applied to the crop under different treatments is given in Table-4. Table shows the amount of water, which was given to the cotton crop as differential irrigation. Effective rainfall was calculated by using USDA (SCS) method and it was 36.14 cm. during crop season. The data on WUE are given in Table-5. Water use efficiency showed a close relationship with yield. WUE was found to be maximum (0.47 q/ha-cm) in drip system having IW/CPE = 0.75 as compared to sprinkler system (0.39 q/ha-

Table-1 : Treatment identification of various treatments.

S.No.	Treatment	Treatment identification
Drip irrigation system		
1.	LF	Low level, fertigation
2.	LMa	Low level, manual fertilizer application
3.	HF	High level, fertigation
4.	HMa	High level, manual fertilizer application
Sprinkler irrigation system		
1.	L	Low level
2.	HS	High level

Table-2 : Effect of different treatments on final plant height (in cm) under drip and sprinkler irrigation systems.

Treatment	Drip	Sprinkler
Level of irrigation		
IW/CPE = 0.75	135.80	140.60
IW/CPE=1.00	158.90	159.10
Average	138.46	149.85
C.D. (5%)	3.46	7.21
Method of N application in drip method		
Manual	139.50	--
Fertigation	137.40	--
Average	138.45	--
C.D (5%)	1.33	--

Table-3 : Effect of different treatments on average number of bolls/plant under drip and sprinkler irrigation systems.

Treatment	Drip	Sprinkler
Level of irrigation		
IW/CPE = 0.75	22.10	20.3
IW/CPE=1.00	19.80	22.2
Average	22.96	21.2
C.D. (5%)	1.37	0.63
Method of N application in drip method		
Manual	22.20	--
Fertigation	23.70	--
Average	22.95	--
C.D (5%)	0.46	--

Table-4 : Effect of different treatments on yield (Seed-cotton) (q/ha) under drip and sprinkler irrigation systems.

Treatment	Drip	Sprinkler
Level of irrigation		
IW/CPE = 0.75	31.10	28.57
IW/CPE=1.00	30.32	28.60
Average	31.49	28.58
C.D. (5%)	NS	NS
Method of N application in drip method		
Manual	30.99	-
Fertigation	31.99	-
Average	31.49	-
C.D (5%)	NS	-

Table-5 : Effect of irrigation water applied (cm) to different treatments under drip and sprinkler irrigation systems.

Treatment	Drip*	Sprinkler*
Level of irrigation		
IW/CPE = 0.75	11.30	11.30
IW/CPE=1.00	15.00	15.00
Method of N application in drip method		
Manual	11.40	-
Fertigation	11.40	-

* The effective rainfall is not included. It's differential Irrigation given to cotton crop.

Table-6: Effect of different treatments on water use efficiency (q/ha-cm) under drip and sprinkler irrigation systems.

Treatment	Drip*	Sprinkler
Level of irrigation		
IW/CPE = 0.75	0.47	0.39
IW/CPE=1.00	0.42	0.37
Average	0.47	0.38
Method of N application in drip method		
Manual	0.47	-
Fertigation	0.49	-
Average	0.48	-

* Water use efficiency is calculated on the basis of seasonal water used by cotton crop

Table-7 : Effect of different treatments on Nitrogen use efficiency (q/kg) under drip and sprinkler irrigation systems.

Treatment	Drip*	Sprinkler*
Level of irrigation		
IW/CPE = 0.75	41.47	38.10
IW/CPE=1.00	39.67	38.13
Average	41.77	38.11
Method of N application in drip method		
Manual	40.82	-
Fertigation	42.65	-
Average	41.73	-

*Nitrogen use efficiency is calculated on the basis of seasonal water used by cotton crop.

cm) at the same level of irrigation. In drip irrigation system WUE of fertigation was higher (0.49 q/ha-cm) as compared to manual fertilizer application (0.47 q/ha-cm). The effect of different irrigation systems and various treatments on NUE is given in Table-7. It reveals that the NUE was found to be maximum (41.47 q/kg) in the plots having treatment of low level of irrigation in drip irrigation system and was found to be higher (38.13 q/kg) in IW/CPE = 1.00 in sprinkler irrigation system.

From above study conclusion can be drawn as—

- Drip system of irrigation showed superiority over sprinkler irrigation system in plant and yield related parameters.
- Since there were no significant difference found among three IW/CPE ratios, IW/CPE = 0.75 is the best level of irrigation to irrigate Cotton crop in south west district of Punjab.
- Since the water use efficiency of the drip system is more than of the sprinkler system, it can be concluded that the drip irrigation system is most suitable system over sprinkler system to irrigate cotton crop in south-western Punjab to nullifying the

effect of water-logging and salinity problems.

- In saline soils Ammonium fertilizer application is a problem for farmers, so fertilizer application become easier by using drip system as "fertigation".

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