# 1237 Performance of drip irrigation systems in cotton in relation to lateral patterns and irrigation levels

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Irrigation improves the consistency of cotton (*Gossypium hirsutum* L.) yield during the seasons with inadequate or poor rainfall distribution. Besides, high water use efficiency (WUE) can be obtained if irrigation is applied through drip system. Keeping this in view, an experiment was planned to evaluate the performance of drip system in cotton with different lateral patterns and irrigation levels at Punjab Agricultural University, Regional Station, Abohar, India during summer 2006. Growth of the cotton crop in terms of plant height and bolls per plant was maximum in plots where drip irrigation was supplied with laterals in each row at 1.0 ETc. and differed non-significantly with 0.8 and 1.0 ETc level in the drip system with lateral in paired rows. While comparing with flood system, both drip with lateral in each row and paired rows were significantly better at all the levels of irrigation. Seed cotton yield was maximum (4259 kg/ha) in drip system with lateral in each row at 1.0 ETc level followed by drip system with lateral in paired rows at 0.8 ETc level (4122 kg/ha). Considering the cost involved, drip system with laterals in paired rows can be more economical. WUE was higher at 0.6 ETc levels, where lowest amount of irrigation water was applied. WUE for drip systems with lateral in each row and with laterals in paired rows showed similar trend with different irrigation levels and had non-significant differences among themselves when compared at similar irrigation levels.

## Introduction

Cotton can tolerate water stress until first square formation; however yield is very sensitive to the irrigation regime. But later, during flowering and boll formation, water demand reaches the peak very fast. At that time, crop coefficient for cotton is 1-1.1. When most bolls of the first phase mature, water application can be reduced sharply. Shortage or standing water both are hazardous for the crop in determining its yield and the effects are even more harmful where the irrigation water is saline or of bad quality. Heavy water stress to the cotton crop will induce flower abscission and excess irrigation will initiate vegetative growth that will compete with boll formation. Drip irrigation is the efficient irrigation system which has found great use in orchards, value crops, etc. It is advantageous where shortage of irrigation water and poor quality of the water are the constraints in crop production. With drip irrigation water can be applied very precisely and frequently. It is an effective method to manipulate growth and production and record yields can be obtained. A subsurface drip irrigation system has the capability of applying sufficient water to meet the evaporative demand of the crop on a daily basis. This promotes maximum growth while minimizing any stress resulting from an inadequate supply of soil moisture. Although, the installation of drip irrigation systems is expensive, its advantages can help in the return of investment to some extent in terms of yield and quality of cotton. The objective of the present study was to study the performance of different planting methods in drip irrigation systems for yield and its components in American cotton (*Gossypium hirsutum* L.).

## Material and methods

The experiment was conducted at Punjab Agricultural University, Regional Station, Abohar during summer 2006 to study the impact of drip irrigation along with different planting patterns on seed cotton yield, its components and water use efficiency of the crop. The trial comprised of following 12 treatments:

1. Drip irrigation with lateral in each row and 0.6 ETc
2. Drip irrigation with lateral in each row and 0.8 ETc
3. Drip irrigation with lateral in each row and 1.0 ETc
4. Drip irrigation with lateral in paired rows and 0.6 ETc
5. Drip irrigation with lateral in paired rows and 0.8 ETc
6. Drip irrigation with lateral in paired rows and 1.0 ETc
7. Drip irrigation with lateral in paired rows and every third row missing; and 0.6 ETc
8. Drip irrigation with lateral in paired rows and every third row missing; and 0.8 ETc
9. Drip irrigation with lateral in paired rows and every third row missing; and 1.0 ETc
10. Flood irrigation at 0.6 ETc
11. Flood irrigation at 0.8 ETc
12. Flood irrigation at 1.0 ETc

Approved Bt cotton hybrid MRC 6304 was used in this experiment and was sown after applying pre-sown irrigation in the whole field in a split plot design with four replications on 12.5.06. Each treatment was accommodated in rows of m. Rows were kept apart by 67.5 cm while plant to plant distance was maintained at 75 cm. The recommended dose of fertilizer was applied. The plant population was maintained in all the plots. In the system, where every 3$^{rd}$ row was skipped, the plant population was maintained by increasing the number of plants in each row (decreasing the plant to plant population), so as to eliminate the factor of plant population in determining the seed cotton yield. The observations were recorded on plant height, number of bolls per plant, boll weight (g) seed index (g), seed cotton yield and ginning out turn. The standard statistical procedures were followed for analyzing the mean data.

## Results

The results of the experiment showed that the differences in plant stand for different treatments were non-significant as the sowing was done after applying pre-sown irrigation in all the plots uniformly. Growth of the cotton crop in terms of plant height were maximum in the plots where drip irrigation was supplied with lateral in each row at 1.0 ETc (160.5 cm) and was significantly better than all the irrigation levels in flood irrigation system (Table 1). It had non-significant differences when compared with lower irrigation levels in the same system and with 0.8 and 1.0 ETc levels of the drip irrigation system with lateral in paired rows. Amongst yield parameters, seed index (100-seed weight) and boll weight had non-significant differences for different treatments. While, bolls per plant were maximum in treatment with drip laterals in each row at 1.0 ETc level (53.7) and differed non-significantly with 0.8 ETc levels in same system and 0.8 and 1.0 ETc level in the drip system with lateral in paired rows. While comparing with flood system, both drip with lateral in each row and paired rows were significantly better at all the levels of irrigation water. Ginning out turn did not have significant differences for different treatments. The maximum seed cotton yield per plant was found in drip system with lateral in paired row at 1.0 ETc. However, seed cotton yield per plant at different levels of irrigation water levels within the same system were non-significant in all the drip systems, while in flood system there was significant increase in seed cotton yield per plant from 0.6 to 1.0 ETc level. This implies that even lower amount of

water in drip irrigation system can help in achieving similar yields. Seed cotton yield was found to be maximum (4259 kg/ha) in drip system with lateral in each row at 1.0 ETc level followed by drip system with lateral in paired rows at 0.8 ETc level (4122 kg/ha) and significantly lower yields were obtained in 0.6 ETc level in drip system with lateral in each row and paired row; 0.6 and 0.8 ETc levels in drip system where 3rd row was skipped and same levels in flood system. In other way, while comparing different drip systems at same irrigation levels, it was found that all the systems produced significantly similar seed cotton yield at 1.0 ETc level, while at 0.8 ETc level, seed cotton yield was significantly higher in drip with lateral in paired row and with lateral in each row. However, considering the economy of both the systems, drip system with lateral in paired rows can be more beneficial. Results of Mussaddak and George (2001) study revealed that fertigation of cotton improved seed cotton yield, dry matter yield, earliness and, in some cases, lint properties. They also found that under drip fertigation, between 35-55% of irrigation water was saved compared with surface-irrigated cotton grown under the same conditions. Seed cotton yield of the fertigated-cotton increased by more than 50% in some cases compared with that of the surface-irrigated cotton.

Water Use Efficiency (WUE), a parameter which determines the production of crop per hectare per mm of water applied, was significantly higher in drip system with lateral in each row and with lateral in paired rows at all levels of irrigation water than the flood irrigation system. WUE was higher at 0.6 ETc levels (Table 1), where lowest amount of irrigation water was applied, whereas at this level, seed cotton yield tended to decrease significantly as compared to 0.8 and 1.0 ETc levels in all the systems. While comparing WUE of 0.8 and 1.0 ETc levels of all the systems where yield levels were non-significant, WUE was significantly higher in 0.8 ETc levels. When drip systems with lateral in each row and with laterals in paired rows were compared, both showed similar trend in WUE with irrigation levels and had non-significant differences when compared at similar irrigation levels.

Therefore, the drip irrigation system with laterals in paired rows at 0.8 ETc levels can be used for maximizing yield without ignoring the water use efficiency of the system.

**References**

Mussaddak, Janat and George, Somi. 2001. Performance of cotton crop grown under surface irrigation and drip fertigation. I. Seed cotton yield, dry matter production, and lint properties. Communications in Soil Sci. Plant Anal. 32: 3045-3061;

**Table 1: Effect of different irrigation systems and irrigation levels on growth and yield parameters**

| Treatments | Plant stand | Plant height (cm) | Seed index (g) | Boll weight (g) | Bolls/ plant | Seed cotton yield/ plant | GOT (%) | Seed cotton yield (kg/ha) | Water use (mm) | WUE (kg/ha/mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 96.0 | 150.8 | 8.60 | 3.97 | 36.1 | 183.2 | 33.4 | 3595 | 176.5 | 20.37 |
| $T_2$ | 93.7 | 153.7 | 9.38 | 4.39 | 50.8 | 198.2 | 35.4 | 4029 | 235.4 | 17.11 |
| $T_3$ | 92.7 | 160.5 | 9.65 | 4.50 | 53.7 | 209.1 | 33.6 | 4259 | 294.2 | 14.48 |
| $T_4$ | 92.3 | 140.9 | 8.90 | 4.17 | 44.7 | 181.2 | 35.7 | 3570 | 176.5 | 20.23 |
| $T_5$ | 94.0 | 151.7 | 9.03 | 4.09 | 46.5 | 206.7 | 33.4 | 4122 | 235.4 | 17.51 |
| $T_6$ | 92.7 | 155.8 | 8.39 | 4.30 | 53.3 | 217.8 | 36.7 | 4033 | 294.2 | 13.71 |
| $T_7$ | 92.3 | 138.1 | 8.30 | 3.78 | 40.9 | 167.8 | 38.4 | 3449 | 176.5 | 19.54 |
| $T_8$ | 93.3 | 140.6 | 8.06 | 4.30 | 42.2 | 182.8 | 33.1 | 3555 | 235.4 | 15.10 |
| $T_9$ | 92.7 | 141.6 | 8.17 | 3.73 | 44.9 | 197.1 | 34.3 | 3821 | 294.2 | 12.99 |
| $T_{10}$ | 92.0 | 125.8 | 9.36 | 4.03 | 24.5 | 158.2 | 34.5 | 3261 | 197.5 | 16.51 |
| $T_{11}$ | 92.7 | 136.1 | 8.66 | 4.08 | 32.8 | 180.7 | 35.1 | 3539 | 263.4 | 13.44 |
| $T_{12}$ | 91.7 | 139.4 | 9.14 | 4.09 | 40.3 | 197.8 | 33.5 | 3906 | 329.2 | 11.87 |
| **CD (5%)** | **NS** | **10.4** | **NS** | **NS** | **11.2** | **31.0** | **NS** | **401** | **-** | **1.94** |
| **CV** | **4.16** | **4.24** | **11.18** | **8.96** | **15.58** | **9.63** | **6.46** | **6.29** | **-** | **7.14** |

T1: Drip irrigation with lateral in each row and 0.6 Etc; T2:Drip irrigation with lateral in each row and 0.8 ETc

T3: Drip irrigation with lateral in each row and 1.0 Etc; T4: Drip irrigation with lateral in paired rows and 0.6 Etc

T5: Drip irrigation with lateral in paired rows and 0.8 Etc; T6: Drip irrigation with lateral in paired rows and 1.0 ETc

T7: Drip irrigation with lateral in paired rows and every third row missing; and 0.6 Etc;

T8: Drip irrigation with lateral in paired rows and every third row missing; and 0.8 ETc

T9: Drip irrigation with lateral in paired rows and every third row missing; and 1.0 Etc; T10: Flood irrigation at 0.6 ETc

T11: Flood irrigation at 0.8 Etc; T12: Flood irrigation at 1.0 ETc