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Effect of Different Irrigation Levels on the Yield and Yield Components of Cotton (*Gossypium hirsutum*) under Two Sowing Methods

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Abstract: An experiment to study the effect of different irrigation levels on the yield of cotton (*Gossypium hirsutum*) under two sowing methods was conducted at the Agronomic Research Area, University of Agriculture Faisalabad. The treatments were consist of (A) two sowing methods viz. (I) flat sowing, (ii) ridge sowing and (B) six irrigation levels viz., irrigation during vegetative growth (1 irrigation; missing last 5 irrigations), irrigation during vegetative growth and flowering (3 irrigations; missing last 3 irrigations), irrigation up-to boll formation (4 irrigations; missing last 2 irrigations), irrigation from flowering till maturity (5 irrigations; missing first 1 irrigation), irrigation from boll formation till maturity (3 irrigations; missing first 3 irrigations), irrigation at all stages (Normal 6 irrigations). The experiment was laid out according to RCBD in split plot arrangement with three replications and net plot size was 2.25x6 m. Data on yield characteristics of the crop were collected using standard procedures and analyzed statistically by using Fisher's analysis of variance technique. Least significance difference (LSD) test at 0.05 levels was applied to compare the differences among significant treatment means. I_6 produced maximum (2406 kg ha^{-1}) seed cotton yield, which was significantly higher than all treatments. In treatment I_4 seed cotton yield (2217 kg ha^{-1}) was significantly higher than I_3 (2098 kg ha^{-1}) and I5 1362 kg ha^{-1}. The minimum yield (887 kg ha^{-1}) was recorded in I_1.

Key words: Cotton, yield and yield components, sowing method, flat sowing, ridge sowing

Introduction

Cotton (*Gossypium hirsutum*) is the most important cash crop and plays a significant role in the economic development of the country. The cotton crop not only meets the increasing demand of domestic agro-based industries but also fetches a substantial amount of foreign exchange (about 60%) through exportable surplus of cotton fiber and fiber made products (Anonymous, 2001). In addition cotton crop also provides livelihood to million of people that are engaged in the textile industry. Realizing the immense importance of cotton plant in building the economy of Pakistan, it has always been the object of extensive research to improve the yield potential of the crop under the local environmental conditions. Irrigation of cotton at various growth stages leads to differential behaviour of crop canopy development.

Low yield can be attributed to many factors such as use of poor quality seed resulting in poor germination, low seed rate, low plant population due to environmental stresses, poor management practices, conventional sowing methods, insect pest attack and water stress. Presently there is an acute need to use the available agricultural and agronomic resources for greater benefits. Owing to increasing population growth rate the demand for food and cloth is more than before. It indicates a tremendous scope for increasing the yield of seed cotton per ha taking care for yield constraints.

The irrigation water is the key factor in achieving higher yield because it is an important constituent of plants and plays a vital role in many metabolic processes. It increases leaf production, expansion rate and leaf area duration.

Materials and Methods

Investigations to study the yield characteristics of cotton at different irrigation levels and sowing methods were conducted at the Agronomic Research Area, University of Agriculture Faisalabad during the year 2001. The soil was sandy clay loam in texture Meteorological data was collected during the growing season of the crop from the Department of Crop Physiology, University of Agriculture, Faisalabad. The experiment was laid out in randomized complete block design (RCBD) with split plot arrangements using three replications, keeping the sowing methods in main plots and irrigation levels in subplots. The net plot size was 2.25 X 6 m. Experiment comprised of the following treatments. The sowing methods used were Flat sowing (S_1) and Ridge sowing (S_2) and six irrigation levels viz., irrigation during vegetative growth (1 irrigation; missing last 5 irrigations), irrigation during vegetative growth and flowering (3 irrigations; missing last 3 irrigations), irrigation up-to boll formation (4 irrigations; missing last 2 irrigations), irrigation from flowering till maturity (5 irrigations; missing first 1 irrigation), irrigation from boll formation till maturity (3 irrigations; missing first 3 irrigations), irrigation at all stages (Normal 6 irrigations) were used. Investigations were carried out to study the yield at different irrigation levels and sowing methods. Crop was sown in the first week of June 2001. Data recorded on different yield parameters were subjected to Fisher's analysis of variance technique and LSD at 0.05 level of probability was applied to compare the significant means (Steel and Torrie, 1984).

Results and Discussion

Number of flowers formed plant^{-1}

The number of flowers per plant as influenced by different irrigation levels and sowing methods is presented in Table 1. It is evident that irrigation levels had a significant effect on the number of flowers per plant. The figures in this table show that I_6 (irrigation at all stages) and I_3 (irrigation up to boll formation) bore significantly highest number of flowers per plant i.e. 111.8 and 111.8, respectively. These two treatments were at par with each other. It was followed by 102.5 and 100.8 flowers per plant for I_4 (irrigation from flowering till maturity) and I_2 (irrigation during vegetative growth and flowering), respectively; statistically I_4 and I_2 were also at par. Low number of flowers per plant was recorded in treatment I_5 (irrigation from boll formation till maturity), i.e. 64.17. It can be concluded that water stress at flowering stage is more harmful

Table 1: Effect of different irrigation level and sowing method on yield and yield components of cotton

Treatments	No. of bolls plant^{-1}	No. of flowers plant^{-1}	Seed cotton yield (kg ha^{-1})	Ginning out turn (GOT%)	100 Cotton Seed weight (g)
A. Sowing methods					
S_1	28.80	94.06	1683b	36.77	7.03
S_2	29.58	95.22	1729a	36.24	7.39
B. Irrigation levels					
I_1	15.65b	76.67c	887f	34.88c	6.59c
I_2	23.77c	100.8b	1266e	35.68bc	6.99bc
I_3	36.72b	111.8a	2098c	37.08ab	7.43ab
I_4	40.16a	102.5b	2217b	37.02ab	7.46ab
I_5	17.83d	64.17d	1362d	36.78ab	7.22ab
I_6	41.05a	111.8a	2406a	37.58a	7.58a

than at other stages. However, irrigation at all stages in all the conditions is more conducive to plant growth.

Sowing methods and their interaction with the different irrigation levels was non-significant. These results are in line with Unger ***et al.*** (1989) and Anac ***et al.*** (1999) who revealed that lowest flowering percentage (42%) in cotton resulted from sever and relatively late water stress.

Number of bolls formed plant^{-1}

Number of bolls formed per plant is an important yield-contributing component to final yield of a plant. Table 1 indicated that irrigation at different plant growth stages significantly lowered the number of bolls formed per plant as compared to that of I_6 (irrigation at all stages) i.e. 41.05 and I_4 (irrigation from flowering till maturity) i.e. 40.16 treatment, which remained at par with each other. The bolls formed per plant were significantly lower in I_1 (irrigation during vegetative growth), i.e. 15.65 and I_5 (irrigation from boll formation till maturity), i.e. 17.83 treatments, which were also at par. The increase in the number of bolls formed per plant in I_4 and I_6 could be attributed to the formation of more number of flowers and less drop of flowers in these treatments as compared to others.

The ridge-sown plots produced slightly higher number of bolls per plant than flat sown plots, but statistically the differences were non- significant. These results are supported by the findings of Guinn ***et al.*** (1981), Assadian (1987) and Vories ***et al.*** (1998) they reported that delaying the first irrigation reduced the number of bolls per plant.

Seed cotton yield (kg ha^{-1})

The final seed cotton yield is the function of combined effect of all the yield components under a particular set of environmental conditions. It is evident that two sowing methods differed from each other in seed cotton yield. Similarly the differences due to different irrigation levels were also highly significant. The interaction between irrigation levels and sowing methods was non-significant. The results show that I_6 (irrigation at all stages) produced maximum (2406 kg ha^{-1}) seed cotton yield which was significantly higher than all other treatments. In treatment I_4 (irrigation from boll formation till maturity) seed cotton yield (2217 kg ha^{-1}) was

significantly higher than I_3 (irrigation up to boll formation) 2098 kg ha^{-1} and I_5 (irrigation from boll formation till maturity) 1362 kg ha^{-1}.The significantly minimum seed cotton yield (887.8 kg ha^{-1}) was noted in I_1 (irrigation during vegetative growth).

The results indicate that there was a trend of reduction in yield with decreased amount of water used. The results further indicate that reduction in yield was more when irrigation was missed after vegetative stage and at flowering or boll formation stage. There was a significant progressive increase in seed cotton yield with each increase in irrigation level. Sowing methods also affected the seed cotton yield significantly. Ridge sowing (1729) produced significantly higher seed cotton yield than flat sowing (1683).

The highest seed cotton yield in case of I_6 treatment could be attributed to the increase in main yield component like number of mature bolls per plant and seed cotton weight per boll. These results are inline with the findings of Sarwar and Quershi (1999), Millhollon (2000) they reported that six irrigation produced the highest seed cotton yield.

100 Cotton seeds weight (g)

Among various parameters contributing to final seed cotton yield, 100 cotton seed weight is of great importance. The data showed that I_6 (irrigation at all stages) produced the heaviest maximum 100 cotton seed weight (7.58 g) over I_4 (irrigation from flowering till maturity) 7.46 g, I_3 (irrigation up to boll formation) 7.43 g and I_5 (irrigation from boll formation till maturity) 7.22 g. However, these all treatments are at par. I_4, $I_3$and I_5 did not differ significantly from I_2 (irrigation during vegetative growth and flowering). The lowest weight of 100-cotton seed was recorded in treatment I_1 (irrigation during vegetative growth), I_1 (6.59) and I_2 (6.99) were at par with each other. The effect of sowing methods and their interaction with irrigation levels were non-significant these results are supported by the findings of Boquet and Coco (1988) and Luz ***et al.*** (1998) they found that 100-cotton seed weight was reduced by water stress.

Ginning out turn (GOT) (%)

The ginning out turn was calculated to seed the effect of different irrigation levels and sowing methods on this yield parameter. It is evident from Table 1, that different irrigation regimes under study affect the ginning out turn% significantly. The highest ginning out turn percentage was recorded in treatment I_6 (irrigation at all stages), i.e. 37.58%, but the differences between I_6, I_5 (irrigation from boll formation till maturity), I_4 (irrigation from flowering till maturity)and I_3 (irrigation up to boll formation) were non-significant. The treatments I_5, I_4, $I_3$and I_2 (irrigation during vegetative growth and flowering) were at par. The lowest ginning out turn (34.88%) was recorded in I_1 (irrigation during vegetative growth). The results show that there is a trend towards the increase of ginning out turn percentage with frequent irrigations. These results are in line with Maruar (1991) and Chu ***et al.*** (1995) they reported that irrigation interval at five days increased lint yield by 5-11 (%) compared with irrigation interval of 10 days and 15 days.

Keeping in view the overall performance , it is concluded that I_6 (irrigation at all stages) and ridge sowing appeared to be the most suitable for obtaining higher seed cotton yield under Faisalabad conditions.

References

Anac, M.S., M.A. ul., I.H. Tuzel., D. Anoc, B. Okur and H. Hakerlerler, 1999. Optimum irrigation schedules for cotton under deficit irrigation conditions. Dord. Nethe. Klu. Acad. Pub., 7923-5299: 196-222.

Anonymous, 2001. Economic survey, Govt. of Pakistan, Finance Division, Eco. Advi. Wing, Isd.

Assadian, M.H., 1987. Upland cotton growth and canopy temperature as affected by deficit irrigation management. Diss. Abst. Inter., B. Sci. and Eng., 47: 3167.

Boquet, D.J. and A.B. Coco, 1988. Effect of irrigation and nitrogen rates on cotton grown on Sharkey clay. Ann. Prog. Rep. Louisiana Agri. Exp. Sta., pp: 24-30.

Chu, C.C., T.J. Hennberry and J.W. Radian, 1995. Effect of irrigation frequency on cotton yield in short season production systems. Crop. Sci., 35: 1069-1073.

Guinn, G., J.R. Mauney and K.E. Fry, 1981. Irrigation scheduling and plant population effect on growth, bloom rates, boll abscission and yield of cotton. Agron. J. Wes. Cott. Res. Lab., Phoenix, 73: 529-534.

Luz, M.J., J. Dase, R.C. Bezerra and A.N. Barreta, 1998. Fiber quality and agronomic characteristics of cotton cv. BR-1 subjected to water stress at different growth stages. Revista de oleage. e. Fibr, 2: 215-219.

Maruar, C.J., 1991. Comparison of net photosynthetic rate, stomatal resistance and yields of two cotton cultivars under water stress. Perquisa Agropecuaria Brasileria, 26:153-161.

Millhollon, E.P., D.R. Merville and R.A. Anderson, 2000. A 28 years study of cotton response to irrigation in northwest Louisiane. Red River Res. Sta., Lou. Univ. Agric. Center, 2: 1441-1443.

Sarwar, A. and A.S. Qureshi, 1999. Genetic response of cotton (***Gossypium hirsutum*** L.) to various irrigation regimes. Sarhad J. Agric., 15: 17-20.

Steel, R.G.D. and G.H. Torrie, 1984. Principles and procedures of statistics. Sec. Ed. McGraw Hill Book Co. Inc. Singapore, pp: 172-177.

Ungar, E.D., E. Kletter and A. Genizi, 1989. Early season development of floral buds in cotton. Agron. J., 81: 643-649.

Vories, E.D., N.P. Tugwell, J.S. McConnell and R.W. Turner, 1998. Irrigation management of cotton. Arkansas Agric. Exp. Sla. Sp. Rep., 188: 125-127.