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COTTON YIELD AND YIELD COMPONENTS CAN BE MAXIMIZED BY IRRIGATION INTERVALS AND CHISELING IN SANDY LOAM SOILS

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ABSTRACT

Establishment of indeterminate growth parameters and reproductive aspects is of crucial importance during field conditions. Cotton plant has particular aspects in many ways regarding its growth and development, vegetative and reproductive as well as yield components and field management. Although it is perennial in its nature, it is much respondent to climate, environment, field, soil and field preparatory practices adopted at field level for maximum potential yield. Two year field study was designed to carry out at the research area of CCRI, Multan to investigate the effect of soil preparatory technique i.e. chiseling and crop irrigation intervals in cotton field for soil moisture holding capacity, yield of seed cotton and its components. Cotton cultivar CIM-499 was manually dibbled on silt loam soil in last week of May with bed and furrow planting method duringthe both cropping years. Split plot design was applied comprising inter culturing chiseling and interculturing no chiseling were in main plots and irrigation intervals (8 and days) treatments were kept in sub plots. Results indicated that inter culturing + chiseling produced the highest significant seed cotton production (17.8%) more bolls plant^{-1} (14.3%) and water intake (17.7%) than no chiseling with inter culturing. However, irrigation interval after eight days produced the maximum yield of seed cotton (14.2%), more 14.3%bolls plant^{-1}and water retention (35.6%) than 12 days irrigation interval.

Keywords: chiseling, g*ossypium hirsutum*, inter-culturing, irrigation intervals, seed cotton yield, yield components.

INTRODUCTION

Water plays a vital role for healthy cotton plant growth and development in many ways. Water itself is a source of plant nutrients, namely, hydrogen and oxygen. All plant nutrients derived from the breakdown of soil minerals and organic matter present in the soil are obtained from applied fertilizers and manures which are first dissolved in soil water. These nutrients are absorbed by plant roots and transported to different parts of the plant in solution. Water thus serves as a carrier of plant nutrients into complex organic substances like starch, sugars, proteins, fats and soils, vitamins etc takes place in the presence of water. Moreover water keeps plants turgid and thus moderates the effects of temperature differences drought, frost, etc. Unlike most other crops, root growth in cotton is more sensitive to oxygen in the soil rather than to the CO_2 level. Standing water in cotton fields due to rain or over irrigation lowers the oxygen content in the soil thus suffocating the root system and causing the plants to wilt, if the effect is prolonged plants die.

Without an adequate supply of water either through rainfall or where this is not sufficient through supplemental irrigation, the above biological processes will not take place to desired extent. This will result in poor plant growth and reduced crop yields. Meeting the water requirement of cotton by irrigation is a major management consideration and production cost in the arid and semi-arid regions of the country. Increasing demand for water, decline water table in the tracts with sweet aquifer and increasing energy costs for pumping emphasize the need for conserving water in irrigated agriculture. Irrigation for maximum cultivars of cotton could potentially decrease water requirements. However to produce acceptable yields in a shorter time the plants must fruit early and rapidly. Delays and interruptions in boll productions would either reduce yields or lengthen the item required to produce the crop.

The purpose of irrigation is to keep the soil supplied with readily available moisture for plant growth and development. In areas where the total rainfall normally exceeds the amount necessary for optimum crop production the purpose of irrigation can be limited to correcting differences in soil moisture caused by poor distribution of rainfall, excessively high temperatures and poor moisture intake and storage condition within the soil. The water requirement of cotton depends on the variety of cotton, type of soil, the length of the growing season, temperature, hours of sunshine, the amount and distribution soil. During the early growth stages (seedling) less amount of water is consumed by the cotton plants and by transportation and evaporation a lot of amount is lost. As plants grown the need of water increases, as soon asit reached to its peak and cotton crop plant have many bolls, while decline in water consumption started. The irrigation schedule should be such that it supplied these needs. Proper timing is necessary for maximum production. Heilman 1988 concluded that in row chiseling increased plant height, rooting depth and cotton lint yields as compared to non-chisel treatment.

Abdel Qadir (2000) reported significant decrease in cotton yields after two, three and four week intervals of irrigation. While yield differences produced by two and three week irrigation intervals were not significant statistically. Schomberg *et al* (2003) compared different tillage types and frequencies for cotton and noted 15-20% greater lint yields with annual in row chisel than with conventional disk tillage. Abdelatif *et al.,* (2009) reported no clear differences in yield and quality between the two

shorter watering intervals, 7 and (4 days However, larger irrigation interval of 21 days decreased the yield by 16 % and 22% for Barac (67) B and Barakat cultivars, respectively. Chisel plough is an ideal implement to increases soil fertility as more enough sunlight, moisture and air circulation is provided by the deep tillage. It also helps in maintaining the soil moisture content for longer period in the soil. Cotton plant vegetative growth and development is regulated by water. Seed cotton yield is adversely affected by the bothmore irrigation than required and deficient water stress. In crop production, water is a significant and vital input. Therefore, the present studies were carried out consecutively during the crop seasons of 2011-2012 to investigate the effect of irrigation intervals and chiseling effect on seed cotton yield under Southern Punjab climatic conditions.

MATERIALS AND METHODS

Chiseling and irrigation interval effects on cotton plant yield and yield components were studied, at Central Cotton Research Institute Multan during 2012 and 2013on silt loam soil. The treatments consisted of (a) [3 inter-culturing plus chiseling, 3 inter-culturing plus no chiseling] (b) [8-day and 12-day irrigation intervals]. Field trail was carried out in a split plot design with four repeats having chiseling in main plot and irrigation interval in the sub plot. CIM-499 cultivar was sownin the fourth week of May. The bed furrow were made on well prepared soil with 75 cm apart rows from each other by tractor driven implement followed by bed shaping and spray of Pendimethalin 33% @ 2.5 lit. The seeds were planted manually by dibbling method at 22.5cm plant to plant distance within the rows. Thinning was done 20 days after sowing by making single plant per hill.

Irrigation water was applied in measured quantity by installing a Cut Throat Flume (CTF) in water channel and irrigation water discharge was measured by reading the height of water passing through Cut Throat Flume from the inlet side. The height column then was read from a given chart of specified Cut Throat Flume measurement into cusecs. Then it was converted into the required unit (mm). Soil samples for soil moisture content up to a depth of 90 cm were taken from field area before all the irrigations. Soil samples were oven dried at 120 C for 24 hours. The difference of the wet and dry soil measured in percentage. The cotton crop was protected from the attack of insect pests with insecticidal sprays as and when required. Standard crop production practices were followed during the season. The data for the seed cotton yield and its components were recorded at crop maturity. The significant differences and analysis of variance among the treatments was analyzed by the LSD at 5 % level (Steel and Torrie, 1980).

RESULTS AND DISCUSSIONS

The results on seed cotton yield and its components, irrigation water addition and soil moisture content are given in Tables 1 to 6. Chiseling and irrigation interval treatments indicated significant results for seed cotton yield and cotton boll weight (g). These results are supported by several scientists including Heilman (1988) and Schomberg *et al.,* (2003) who reported an increase in cotton lint yields with in row chiseling application. Inter culturing plus chiseling with 8-day irrigation interval with irrigation water of 833 mm/ha produced the highest seed cotton yield of 1960 kg ha^{-1}. These results are in accordance with that of Mirjat, *et al.,* (2000), Abdel Gadir (2000) and Ahmad *et al.,* (1997) who reported that larger irrigation intervals result decrease in seed cotton yield. Averaged across the irrigation interval, inter-culturing plus chiseling gave 281 kg ha^{-1} higher seed cotton yield than inter culturing plus no chiseling. Averaged across the chiseling, 8-day irrigation gave 228 kg ha^{-1} seed cotton yield than 12-day irrigation interval. Seed cotton yield increased due to increase in cotton bolls $plant^{-1}$ and average boll weight (g). (Table 1-4) there were 10.4 % more irrigation water addition in furrow followed

Table-1. Chiseling and irrigation interval effect on irrigation water ha^{-1} (mm) applied in soil.

Treatments	Irrigation interval	Total water applied	Water applied before chiseling	Water applied before chiseling	Average soil moisture (%)
Inter-culturing +Chiseling	8-day	833.3	298.1	535.2	15.0
	12-day	693.0	298.1	394.9	13.9
Inter-culturing +No Chiseling	8-day	752.9	298.1	454.8	12.4
	12-day	630.1	298.1	332.0	11.2

Table-2. Chiseling, inter-culturing and irrigation interval effect plant height, seed cotton yield (kg ha^{-1}), bolls plant^{-1} and cotton boll weight (g).

Treatments	Irrigation intervals	Plant height (cm)	Seed cotton yield	Bolls plant^{-1}	Cotton boll weight (g)
Inter-culturing +Chiseling	8-day	116.0	1960	25	2.76
	12-day	110.2	1758	22	2.60
Inter-culturing +No Chiseling	8-day	106.9	1705	22	2.56
	12-day	104.5	1451	19	2.46
Sub effects					
Treatments	**Plant height** (cm)	**Seed cotton yield**	**Bolls plant^{-1}**	**Cotton boll weight** (g)	
Chiseling	113.1	1859	24	2.68	
No Chiseling	105.7	1578	21	2.51	

Table-3. Effect of irrigation interval on plant height, seed cotton yield (kg ha^{-1}), bolls plant^{-1} and boll weight (g).

Irrigation interval	Plant height (cm)	Seed cotton yield	Bolls plant^{-1}	Cotton boll weight (g)
8-Day	111.5	1833	24	2.66
12-Day	107.4	1605	21	2.53
C.D 5 %				
Treatment (T)	7.13	199.59	N.S	0.02
Irrigation (I)	3.19	187.81	2.87	0.05
T x I	N.S	N.S	N.S	N.S

Table-4. Chiseling effect on water applied and on soil moisture content.

Treatment	Total water applied ha^{-1} (mm)	Water applied before chiseling ha^{-1}(mm)	Water applied after chiseling ha^{-1} (mm)	Average soil moisture (%)
Chiseling	763.2	298.1	465.1	14.5
No Chiseling	691.5	298.1	393.4	11.8
8-Day Irrigation Interval	793.1	298.1	495.0	13.7
12-Day Irrigation Interval	661.6	298.1	363.5	12.6

Table-5. Economic analysis hec^{-1}(chiseling v/s zero chiseling).

Increased yield over zero chiseling (kg ha^{-1})	More water applied (Hr ha$^{-1)}$	Total cost ha^{-1}	Increased income ha^{-1}	Net income ha^{-1}	Cost benefit ratio
281	2.99	2730	8170	5440	1:1.99
Economic analysis (8day v/s 12-day) 9 irrigation intervals					
228	4.48	1859	6629	4770	1:2.57

Table-6. Basis of calculation.

a	Seed cotton	1163 rupees /40Kg
b	Cotton Picking Dues	2.25 rupees kg^{-1}
c	Water charges (Tube well)	200 rupees hrs
d	Cost of chiseling (3times)	500 rupees/ ha/ chiseling
e	Irrigation applications	150 rupees, Man/day (3 irrigations)

by three times chiseling than no chiseling. Similarly the 8-day irrigation interval had 20 % more irrigation water addition in soil than 12 day irrigation interval. These results are supported by those of Bhatti and Soomro (1996) that also reported that cotton crop needs more irrigation water for better crop yields. On the basis of average, the soil moisture in chiseling treatment per 30 cm depth remained high (14.5%) through the crop season as compared no chiseling treatment (11.8%) (Table 5-6). The analysis of cost benefit ratio of irrigation interval 1:2.57 and chiseling was 1:1.99 (Tables 5-6)

CONCLUSIONS

a) Inter-culturing plus chiseling with 8-day irrigation interval is useful in maintaining soil moisture content in the soil and obtaining better seed cotton yields.
b) Inter culturing plus chiseling treatment produced increased (17.81% seed cotton yield) against zero chiseling treatment.
c) The 8-day irrigation interval gave 14.21% more seed cotton production than irrigation interval of 12-days.
d) Soil moisture content in chiseling treatment remained high 2.70% as compared no chiseling treatment.

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