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Effect of Irrigation on Chickpea Varieties Sown on Different Dates on Irrigated Fields of Lakki Marwat, Khyber Pakhtunkhwa, Pakistan

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Abstract
In the study area (Lakki Marwat) there is a lot of scope of growing irrigated chickpea because the farming community is growing this crop for centuries due to very huge demand in the region. This study was conducted to examine the impact of irrigation on chickpea yield, to select a variety/ varieties best suited for irrigated farming in irrigated region and to standardize the production technology package of irrigated chickpea. The experiment was conducted at ARS, Serai Nauarang, Lakki Marwat, in Randomized Complete Block Design with split plot arrangement having three replications. Irrigations (No irrigation, pre-sowing irrigation and irrigation at flowering stage) were allotted to the main plots while varieties (Karak-1, Karak-2, Sheenghar and KC-98) and sowing dates (Oct. 1st, Oct. 15, Nov, 1, and Nov, 15) were kept in the sub plots. The sub plot size was 4 m by 1.8 m with row to row distance of 30 cm and plant to plant distance of 10 cm. Plant height and pods plant^{-1}, biological and grain yields were significantly affected by different varieties and sowing dates at Lakki Marwat. The effect of irrigation was significant on plant height and branches plant^{-1} at Lakki. Pre-sowing irrigation resulted in taller plants as compared to no irrigation and irrigation at flowering at Lakki. Delay in plating consistently decreased plant height at Lakki. Chickpea variety Karak-I attained long stature plants at Lakki, while short stature plants were noted for KC-98 variety. Delay in planting resulted decline in number of pods plant^{-1}. Karak-I produced higher number of pods plant^{-1}, whereas variety KC-98 resulted in lower number of pods plant^{-1} at Lakki. Similarly delaying plating from 1st October to 15th November, biological yield of chickpea also decreased at Lakki. Variety Karak-I was higher in biological yield at Lakki. Grain yield considerably decreased with delay in planting Lakki. At Lakki, chickpea variety Karak-I resulted in higher yield, followed by Karak-II while, KC-98 produced lower grain yield. It is concluded from the above experiments that planting dates significantly affected grain yield and its components and higher grain yield was produced in early planting (1st October) and decline with delay in planting at Lakki. Chickpea cultivar Karak-I produced higher grain yield followed by Karak-II and proved to be higher yielding cultivars than Sheenghar and KC-98.
Keywords: Irrigation regimes, Chickpea, Varieties, Irrigated fields

Introduction

Traditionally, chickpea is grown on marginal lands in semi arid regions on remnant monsoon preserved moisture. It is the second largest rabi crop after wheat sown in the light textured soils of southern parts of Khyber Pakhtunkhwa, especially in Karak, Bannu, Lakki Marwat, D.I.Khan and Tank districts. In this region, crop husbandry is always at risk because of biotic and abiotic calamities. Availability of proper and timely moisture remains the major threat throughout the crop period. Other associated problems include aschochyta blight, fusarium complex, damage due to Heliocoverpa insects and heat and cold stresses.

At present, in Khyber Pakhtunkhwa, about 50 thousand hectares of land is planted on desi type chickpea with average production of 15-18 thousand tons (0.3 to 0.36 tons ha^{-1}). This produce is much lower and insufficient to meet local requirements (65 thousand tons). It is imported from other provinces, especially from Punjab to meet the local requirements. Chickpea is predominantly consumed in the form of whole grains or daal. However, a sizeable portion of its grains are converted into flour and is used in the preparation of a variety of snack foods (especially Pakora), sweets and condiments. Whole or broken chickpea grains serve as a protein rich diet for cart animals. Chickpea is relatively free from anti-nutritional factors, has a high protein digestibility, and is rich in phosphorous and calcium compared to other pulses.

In dry land farming especially in sandy soils, farmers harvest hardly 350 kg grains per hectare whereas at research stations and extension farms maximum yield of 1000 kg ha^{-1} has been obtained in dry land culture. This huge yield gap is due to timely preservation of moisture in monsoon season and proper weed control at research stations. However, chickpea has given higher yields in D.I. Khan District when planted on clay soils. The results collected at A.R.I D.I. Khan indicate that average yield of up to 2500 kg/ha is possible with one

irrigation before planting. On the contrary, in dry land farming, there is a general feeling that excessive moisture during vegetative phase of chickpea causes undesired vegetative growth which promotes lodging and reduces grain yield considerably.

Chickpea crop has special physiology. Soon after emergence, the crop grows rapidly and develops well-established canopy, however, the growth rate is reduced considerably due to low temperature in winter. In spring, with the rise in temperature, the growth rate is boosted again and plants start flowering and pods in a very short period. Farmers of the area prefer to plant chickpea in the last week of September to get maximum benefit of the monsoon preserved moisture and thus plants attain sizeable size and canopy in October-November. Such plants have tendency to grow more vigorously if the soil moisture is replenished by one or two rain showers. Thus the crop faces excessive vegetative growth and is liable to lodge. On the other hand, in D.I. Khan region where this crop is emerging as more economical than wheat, sowing is delayed till last week of October-first week of November, on irrigated fields particularly after rice. Because the soil profile is filled with sufficient amount of moisture, farmers encourage grazing and excessive nipping when the crop shows tendency towards over growth. It ensures maximum grain yield at the end.

In the projected area (Lakki Marwat), there is a lot of scope of growing irrigated chickpea because the farming community is growing this crop for centuries and is already an established crop of the region. Once established, this practice will bring considerably higher returns which will ultimately raise the living standards of the farming community and will thus help in poverty alleviation and making agriculture sustainable in the region.

As Chickpea is one of the important crops of that area which has a great impact on the lives of the farmers of the area therefore, the findings of the research project will be shared with the Extension Personnel of the area so that they may be conveyed to the farmers of the project area which will definitely increase the income and ultimately improve the living standard of them.

Chickpea (*Cicer arietinum* L.) is the third most important food legume grown on 11 million ha with 9 million tons production. It is grown in over 45 countries in all continents of the world. It provides a high quality protein to the people in developing countries. People in the developed countries consider it as a healthy food. Green leaves/twigs of chickpea are used in preparing a nutritious vegetable in countries of South Asia. These are also used as high protein fodder mixed with cereal leaves. Chickpea stover is fed to the cattle/goats as a nutrient-rich supplement to their major cereal fodder in the lean season. Two main types are recognized. Desi type with small and brown seed accounts for nearly 90% and kabuli type with bold and cream-colored seed is grown on around 10% area. Nearly 90% of the crop is cultivated rain-fed mostly on receding soil moisture and on marginal lands. If managed well, the crop could bring high returns to the farmers in addition to enhancing sustainability of agricultural systems.

Khan et al., (2004) reported that twenty-two genetically diverse chickpea genotypes were studied for their physiological efficiency to select the most desirable genotype/genotypes for breeding program on chickpea. Genotype "CM7-1" was found physiologically efficient stain with maximum harvest index (37.33%) followed by genotype "CM 1571-1-A" with harvest index of 35.73%. Genotype "90206" produced maximum biological yield (7463 kg ha-1) followed by genotypes "CM31-1" and "E 2034" with biological yield of 7352 and 7167 kg ha-1, respectively. Harvest index and economic yield showed significant positive correlation value of (r = +0.595), while negative correlation value of (r = -0.435) was observed between harvest index and biological yield. Chickpea is the major pulse crop of Pakistan, cultivated on 70% of the total area under food legumes (Bashir and Malik, 1988).

Chickpea is the principal pulse and provides a major source of protein in the diet of the predominantly vegetarian population. It is traditionally cultivated in arid sandy areas of Khyber Pakhtunkhwa but recently its production has declined as chickpea have been displaced by the rapid expension of irrigated areas and the introduction of modern cultivars of wheat. In Pakistan during 2001, chickpea was grown on an area of 905 thousand ha with a production of 397 thousand tons. Punjab and Sindh are leaders in chickpea production (Anonymous, 2001).

Experimental Procedures

Research experiment on varieties and sowing dates was conducted under three (3) water regimes i.e., no-irrigation, pre-sown irrigation and one irrigation at flowering stage at Agricultural Research Station (ARS), Lakki Marwat. Phosphorus and nitrogen were applied at the rate of 90 and 25 kg ha^{-1}, respectively. Nitrogen at the low rate was applied as a starter dose. However the fertilizers rates were adjusted according to the nutrient status of the soil after soil analysis.

The experiment was conducted at ARS, Lakki Marwat in Randomized Complete Block Design with split plot arrangement having three replications during rabi 2008-09. Irrigations (No irrigation, pre-sowing irrigation and irrigation at flowering stage) were allotted to the main plots while varieties (Karak-1, Karak-2, Sheenghar and KC-98) and sowing dates (Oct. 1st, Oct. 15, Nov, 1, and Nov, 15) were kept in the sub plots. The

sub plot size was 4 m by 1.8 m with row to row distance of 30 cm and plant to plant distance of 10 cm.

Data were collected on the following parameters:

1. Number of productive branches/plant
2. Number of pods/plant
3. Plant height at harvest maturity
4. Biomass (kg/ha)
5. Grain yield (kg/ha)

Statistical Analysis

The data were statistically analyzed according to procedure appropriate for RCB design with split plot arrangement. Means were separated using LSD test at 5% level of probability (Steel and Torrie, 1984).

Results

Plant height

Statistical analysis of the data showed that plant height was significantly affected by irrigation, different varieties and sowing dates. None of the interactions was significant for plant height. Pre-sowing irrigation resulted in taller plants (49.66 cm) as compared to no irrigation (48.38) and irrigation at flowering (46.71 cm). Delay in plating consistently decreased plant height and taller plants (50. 39 cm) were recorded in plots sown on Ist October, followed by planting on 15th October (49.23 cm), whereas short stature plants (45.35 cm) were recorded in plots sown on 15th November. Plants of chickpea variety Karak-I attained higher height (50.91 cm), followed by Karak-II (49.60 cm), while short stature plants (45.30 cm) were produced by KC-98.

Branches plant^{-1}

Statistical analysis of the data indicated that branches plant^{-1} were significantly affected by irrigation, sowing dates and varieties. Interaction between irrigation and planting dates for branches plant^{-1} was significant, whereas all other interactions were not significant. Higher number of braches per plant (7.47) was recorded in plots where no irrigation was applied as compared to pre-sowing irrigation plots (7.31) and irrigation at flowering (5.97). Number of branches per plant decreased with delay in planting from early to last planting and more branches plant^{-1} (7.74) was recorded in plots sown on 1st October, followed by 15th October (7.25) and lesser branches plant^{-1} (5.81) were noted in plants sown on 15th November. In case of varieties, higher number of branches plant^{-1} (7.94) was recorded by Karak-I, followed by Karak-II (7.32), which were at par with each other. Lower number of branches plant^{-1} (5.87) was produced by KC-98.

Pods plant^{-1}

Pods plant^{-1} was significantly affected by sowing dates and varieties, whereas effect of irrigation was not significant. All interactions were not significant except irrigation and sowing dates. Likewise with delay in planting, pods plant^{-1} also decreased consistently and more pods plant^{-1} (26.99) were produced in early sown plots (1st October), followed by plots sown on 15th October (25.76). Karak-I resulted in higher number of pods plant^{-1} (27.37), followed by Karak-II (26.77), which were at par with each other, however KC-98 resulted in lower number of pods plant^{-1} (20.59).

Biological yield

Biological yield was significantly affected by sowing dates and different varieties, whereas the effect of irrigation was not significant. Interaction between irrigation and sowing dates and varieties and sowing dates were significant for biological yield. Similarly delay in plating from 1st October to 1st November, also decreased biological yield of chickpea. Higher biological yield (3101 kg ha^{-1}) was produced in early sown plots (1st October), followed by 15th October plots (3028 kg ha^{-1}), whereas lower biological yield (2943 kg ha^{-1}) was recorded in plots sown on 1st November. Karak-1 was higher in biological yield (3431 kg ha^{-1}), followed by Karak-II (3119 kg ha^{-1}), whereas lower biological yield was recorded for variety KC-98 (2603 kg ha^{-1}).

Grain yield

Effect of sowing dates and varieties was significant on grain yield, whereas irrigation did not affect grain yield of chickpea. Interaction between irrigation and sowing dates and planting dates and varieties were significant, whereas other interactions were non-significant. Grain yield considerably decreased with delay in planting and greater grain yield (966 kg ha^{-1}) was produced in plots sown on 1st October, followed by 15th October (915 kgha^{-1}). Lower grain yield (781 kg ha^{-1}) was produced in plots sown on 15th November. Karak-I was proved to be high yielding variety (1055 kg ha^{-1}), followed by Karak-II (929 kgha^{-1}), whereas plants of variety KC-98 resulted in lower grain yield (740 kg ha^{-1}).

Table I. Plant height, branches plant^{-1}, pods plant^{-1}, grain yield and biological yield as affected by irrigation, sowing dates and varieties of chickpea at ARS Lakki Marwat.

Irrigation	Plant height (cm)	Branches plant^{-1}	Pods plant^{-1}	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})
No irrigation	48.38	7.47	25.73	928	3054
Pre-sowing	49.66	7.31	25.3	943	3054
Irrigation at flowering	46.71	5.97	23.14	815	2956
LSD	1.612	0.953	3.949	108	464
Planting Dates					
Ist October	50.39	7.74	26.99	966	3101
15th October	49.23	7.25	25.76	915	3028
Ist November	48.03	6.87	24.79	912	2943
15th November	45.35	5.81	21.34	781	3011
LSD	1.451	0.64	2.075	70.80	215.8
Varieties					
Karak-I	50.91	7.94	27.37	1055	3431
Karak-II	49.60	7.32	26.77	929	3119
Sheenghar	47.19	6.54	24.15	859	2932
KC-98	45.30	5.87	20.59	740	2603
LSD	1.451	0.64	2.075	70.80	215.8
Interactions					
I x P	ns	*	*	*	ns
I x V	ns	ns	ns	ns	ns
P x V	ns	ns	ns	*	*
I x P x V	ns	ns	ns	ns	ns

Discussion

Plant height was significantly affected by different varieties and sowing dates and irrigation. None of the interactions was significant for plant height. Pre-sowing irrigation resulted in taller plants as compared to no irrigation and irrigation at flowering at Lakki. Unlike to present study, El-Waraky and Koliey (2000) who found that irrigation at branching, flowering and pod development stages produced plants that were taller. Delay in plating consistently decreased plant height at Lakki. Chickpea variety Karak-I attained long stature plants at Lakki, however, short stature plants were noted in KC-98.

Branches plant^{-1} were significantly affected by irrigation, sowing dates and varieties at Lakki. Interaction between irrigation and planting dates for branches plant^{-1} at Lakki was significant. Higher number of braches plant^{-1} was recorded in no irrigated plot as compared to pre-sowing irrigation and irrigation at flowering. The results are not in line with El-Waraky and Koliey (2000) who reported that irrigation at branching, flowering and pod development stages produced plants that had higher number of branches and seeds plant^{-1}. Number of branches plant^{-1} decreased with delay in planting from early to last planting. Higher number of branches plant^{-1} was produced by Karak-I and lower number of branches plant^{-1}by KC-98.

Planting dates and Varieties significantly influenced pods plant^{-1}, whereas irrigation did not affect pods plant^{-1} at all due to more rains during crop season. Interaction between irrigation and sowing dates was significant for pods plant^{-1} whereas, other interactions were not significant at all. On the contrary, Bakhsh et al. (2007) noted that on average basis 48% increase in number of pods plant^{-1} was recorded due to irrigation. Similarly El-Waraky and Koliey (2000) investigated that Irrigation at branching and pod development stages resulted with the highest number of pods plant^{-1}. Delay in planting resulted decline in number of pods plant^{-1}. Karak-I produced higher number of pods plant^{-1}, whereas variety KC-98 resulted in lower number of pods plant^{-1}. The results are in agreement with El-Waraky and Koliey (2000) who investigated that chickpea cultivar LL131 exhibited higher number of pods and seeds plant^{-1} as compared to LX89TH300.

Biological yield was significantly affected by sowing dates and different varieties, whereas the effect of irrigation was not significant on biological yield at Lakki. This may be due more rains during the crop period. Interaction between irrigation and sowing dates and sowing dates and varieties were significant for biological yield, whereas all other interactions were non- significant at all. Bakhsh et al. (2007) noted 36% increase in total dry weight due to irrigation. Likewise, Anwar et al. (2004) reported that fully irrigated crops had higher maximum dry matter accumulation. Similarly delaying plating from 1st October to 15th November, biological yield of chickpea also decreased. Variety Karak-1 was higher in biological yield. These results are not in line

with Sivakumar and Singh (1987) who reported that cultivars did not differ in dry matter production

Effect of sowing dates and varieties was significant on grain yield, whereas irrigation did not affect grain yield of chickpea. This may be due more rains during the crop period at the experimental site. Contrary to our findings, Bakhsh et al. (2007) noted that yield and most of the yield components were improved with the application of irrigation. Interaction between planting dates and varieties was significant for grain yield. All other interactions were non-significant. Grain yield considerably decreased with delay in planting. The results are in agreement with Keratinge and Cooper (1983), Zaiter and Barakat, (1995) and Anwar et al. (2003) who reported that earlier planting dates resulted in increase in grain yield. The results are in line with Sivakumar and Singh (1987) who reported that late-sown chickpea led to reduced seed size and lower yields. Similarly Sivakumar and Singh (1987) observed significant differences in seed weight between irrigation regimes and sowing dates and there were interactions between sowing dates and cultivars and between irrigation regimes, sowing dates and cultivars. Chickpea variety Karak-I was proved to be high yielding variety, followed by Karak-II, however, variety KC-98 produced lower grain yield hence proved to be low yielding in its nature. The probable reason would be the genetic potential, that out weight other varieties in yield. These results are in line with El-Waraky and Koliey (2000) who found that chickpea cultivar LL131 exhibited higher seed yield and seed weight than LX89TH300.

(vii) Conclusions

It is concluded from the above experiment that planting dates significantly affected grain yield and its components. Grain yield significantly decreased with delay in planting beyond Ist November, however, iIrrigation did not influence grain yield of chickpea at all. Chickpea cultivar Karak-I produced significantly higher grain yield followed by Karak-II at Lakki Marwat, however, the difference among varieties was not significant.

It is therefore, recommended that chickpea crop may be planted in the month of October or with a maximum delay till early November at Lakki Marwat Hence chickpea variety Karak-I is recommend for planting at Lakki Marwat,

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