

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

Khalid Nawab¹ Tariq Kamal^{1*} Abdur Rab² Rahmatullah³ Mahmood Iqbal¹

1. Department of Agricultural Extension Education and Communication, Faculty of Rural Social Sciences, The University of Agriculture, Peshawar, Pakistan

2. Department of Horticulture, Faculty of Crop Production, The University of Agriculture, Peshawar, Pakistan

3. Department of Agricultural Extension Education, Baluchistan Agriculture College, Quetta, Pakistan

*Email of the corresponding author: tariqkamal10@gmail.com

Abstract

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 Bannu, 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. It was found from the results of the above experiment that planting dates significantly affected grain yield and its components. Grain yield significantly decreased with delay in planting beyond 1st November at Bannu. Irrigation did not influence grain yield of chickpea at Bannu as well. Chickpea cultivar Karak-I produced significantly higher grain yield followed by Karak-II at Bannu. It is therefore recommended that chickpea crop may be planted in the month of October or with a maximum delay till early November at Bannu. Chickpea variety Karak-I is recommend for planting at Bannu for obtaining higher grain yield. It is concluded from the above experiment that planting dates at Bannu 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 Bannu. Irrigation did not influence grain yield of chickpea.

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 Helicoverpa 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 (Bannu) 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 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 expansion 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 Stations (ARS), Bannu. 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. Pod borer and other insects and diseases were controlled with the suitable protective measures. The research findings will be published in research journals.

The experiment was conducted at ARS, Bannu 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, 1st, 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. No of productive branches/plant
2. No 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

Data regarding plant height are presented in Table I. Statistical analysis of the data showed that plant height was significantly affected by different varieties and sowing dates, whereas the effect of irrigation was not significant. Interaction between irrigation and sowing dates was significant, whereas all other interactions were not significant. Plots sown on 1st October resulted in taller plants (44.73 cm), followed by 15th October (43.24 cm) whereas short stature plants (41.19 cm) were found in 15th November sown plots. Among varieties, long stature plants were recorded for Karak-I (45.70 cm), followed by Karak-II (43.55 cm), whereas minimum height (39.99 cm) was attained by plants of variety KC-98.

Branches plant⁻¹

Statistical analysis of the data indicated that branches plant⁻¹ was significantly affected by sowing dates and varieties. Irrigation did not significantly affect branches plant⁻¹. None of the interaction was significant for branches per plant. In case of sowing dates, higher number of branches plant⁻¹ (5.14) was recorded by early planting (1st October), followed by 15th October sowing (4.78), whereas lower number of branches plant⁻¹ (3.95) was recorded in plots sown on 15th November. Comparing different varieties, it was found that Karak-I resulted in higher number of branches plant⁻¹ (5.23), followed by Karak-II (4.70). Lower number of branches plant⁻¹ (3.97) was recorded by KC-98.

Pods plant⁻¹

Pods plant⁻¹ were significantly affected by sowing dates and varieties, whereas effect of irrigation was non-significant. All interactions were not significant except irrigation and sowing dates. Delay in planting resulted decline in pods plant⁻¹ consistently and higher pods plant⁻¹ (16.75) were recorded in early sowing (1st October), followed by plots sown on 15th October (15.53). Minimum number of pods plant⁻¹ (13.60) were recorded in plots sown on 15th November. Comparing different varieties, Karak-I resulted in higher number of pods plant⁻¹ (16.99), followed by Karak-II (15.45). KC-98 resulted in lower number of pods plant⁻¹ (13.69).

Biological yield

Biological yield was significantly affected by sowing dates and different varieties, whereas the effect of irrigation was not significant on biological yield. None of the interaction was significant for biological yield. Delay in sowing considerably reduced biological yield of chickpea and thus higher biological yield (2115 kg ha⁻¹) was produced in early sown plots (1st October), followed by 15th October plots (2047 kg ha⁻¹), whereas lower biological yield (1743 kg ha⁻¹) was recorded in plots sown on 15th November. Evaluating different varieties of chickpea, Karak-I was higher in biological yield (2158 kg ha⁻¹), followed by Karak-II (1986 kg ha⁻¹), whereas KC-98 resulted in lower biological yield (1799 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 was significant, whereas, other interactions were not significant. Grain yield greatly decreased with delay in sowing and greater grain yield (623 kg ha⁻¹) was produced in plots sown on 1st October, followed by 15th

October (590 kg ha⁻¹), however, these were at par with each other. Lower grain yield (441 kg ha⁻¹) was produced by plots sown on 15th November. Comparing different varieties, it was found that Karak-I resulted in higher grain yield (633 kg ha⁻¹), followed by Karak-II (564 kg ha⁻¹), whereas KC-98 resulted in lower grain yield (459 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 Bannu.

Irrigation	Plant height (cm)	Branches plant-1	Pods plant-1	Grain yield (kg ha-1)	bB d df fb	Biological yield (kg ha-1)
No irrigation	42.78	4.97	15.27	566		1889
Pre-sowing	43.32	4.67	14.92	551		2015
Irrigation at flowering	42.74	4.12	15.17	530		1989
LSD	3.161	0.452	5.347	39.13		333
Planting dates						
1st October	44.73	5.14	16.75	623		2115
15th October	43.24	4.78	15.53	590		2047
1st November	42.63	4.49	15.31	542		1953
15th November	41.19	3.95	13.60	441		1743
LSD	1.142	0.336	0.831	44.90		108
Varieties						
Karak-I	45.70	5.23	16.99	633		2158
Karak-II	43.55	4.70	15.45	564		1986
Sheenghar	42.54	4.45	15.08	540		1914
KC-98	39.99	3.97	13.69	459		1799
LSD	1.142	0.336	0.831	44.93		108
Interactions						
I x P	*	ns	*	Ns		*
I x V	ns	ns	ns	Ns		ns
P x V	Ns	ns	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 however, irrigation did not alter height of the plants. None of the interactions was significant for plant height except interaction between irrigation and sowing dates which was significant at study site. Unlike to present study, El-Warakly 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 and Bannu. Chickpea variety Karak-I attained long stature plants at Bannu while, short stature plants were noted in KC-98. Irrigation did not significantly alter branches plant⁻¹. Interaction between irrigation and planting dates for branches plant⁻¹ was not significant. The results are not in line with El-Warakly 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. 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. 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-Warakly 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-Warakly 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. This may be due more rains during the crop period. All 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. 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 irrigation and sowing dates was significant. 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. These results are also 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. Chickpea variety KC-98 produced lower grain yield and 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-Warakly and Koley (2000) who found that chickpea cultivar LL131 exhibited higher seed yield and seed weight than LX89TH300.

CONCLUSIONS

It is concluded from the above experiment that planting dates at Bannu 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 Bannu. Irrigation did not influence grain yield of chickpea. It is therefore, recommended that chickpea crop may be planted in the month of October or with a maximum delay till early November at Bannu. Chickpea variety Karak-I is recommended for planting at Bannu for obtaining higher grain yield.

References

- A. Bakhsh, S. R. Malik, M. Aslam, U. Iqbal and A. M. Haqqani. 2007. Response of chickpea genotypes to irrigated and rain-fed conditions. Intern. J. agric. and biology. 09 (4): 590–593.
- A. Khan, M. Rahim, F. Ahmad and A. Ali. 2004. Performance of chickpea genotypes under Swat valley conditions. Journal of Research (Science) Bahauddin Zakariya University, Multan, Pakistan. 15(1): 91-95.
- Anonymous 2001. Agricultural Statistics of Pakistan, MINFAL, Islamabad, Pakistan.
- H.Z. Zaiter, and S.G. Barakat. 1995. Flower and pod abortion Plant.Sci.75:321–327.
- J.D.H. Keratinge, and P.J.M. Cooper. 1983. Kabuli chickpea as winter-sown crop in northern Syria: Moisture relations and crop productivity. J. Agric. Sci. 100:667–680.
- M. Bashir, and B.A. Malik. 1988. Disease of major pulse crops in Pakistan-a review. Tropical pest management 34 (3): 309-314.
- M. K. El-Warakly, and M. M. El-Koley. 2000. Response of two chickpea genotypes to irrigation at different physiological stages of growth. Assiut Journal of Agricultural Sciences. 31(5): .137-150
- M.R. Anwar, B.A. McKenzie, and G.D. Hill. 2003. Water-use efficiency and the effect of water deficits on crop growth and yield of Kabuli chickpea (*Cicer arietinum* L.) in a cool-temperate subhumid climate. J. Agric. Sci. 141:285–301.
- M.V. Sivakumar, and P. Singh. 1987. Response of Chickpea Cultivars to Water Stress in a Semi-arid Environment. Experimental Agriculture (1987), 23:53-61 Cambridge University Press.
- R.G.D. Steel, and J.H. Torrie. 1984. *Principles and procedures of statistics*, 2nd ed., p.172-177. McGraw Hill Book Co., Singapore.
- R. M. Anwar, B. A. McKenzie and G. D. HILL. 2004. Phenology and growth response to irrigation and sowing date of Kabuli chickpea (*Cicer arietinum* L.) in a cool-temperate subhumid climate.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:

<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

Academic conference: <http://www.iiste.org/conference/upcoming-conferences-call-for-paper/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

