Journal of Applied Biosciences 17: 941 - 947
ISSN 1997–5902

Effect of sowing date and row spacing on yield and yield components of chickpea under rain fed conditions in Iran

Shamsi K

Islamic Azad University, Kermanshah Branch - Iran
Department of Agronomy, P.O. Box 67155-1774; Baghe nai Street, Kermanshah, Iran

Corresponding author email: shams2_k@yahoo.com

Published at www.biosciences.elewa.org on May 8, 2009

ABSTRACT
Objective: To investigate the impacts of sowing date and row spacing on yield and yield components of chickpea veriety Hashem.
Methodology and results: A field experiment was conducted in 2005 at Kermanshah, Iran. The sowing date was assessed at three levels (6th November, 23rd November and 6th December) and the row spacing at three levels (20, 30 and 40cm). The layout was a complete randomized block design in factorial arrangement. Results showed that there are significant differences between the planting date and planting density effects on plant height, number of branches per plant, distance between 1st pod to soil, number of pods per plant, number of grains per plant, biological yield and grain yield. The maximum grain yield belonged to plants sown on 6th November at a row spacing of 30 cm. However, the maximum number of pods per plant and grains per plant belonged to plants spaced at 40 cm row spacing. Increasing planting density resulted in decreased yield components but increased plant number compensated for the decrease in yield components. Planting on 6th December resulted in higher distance of pod from soil surface and thus enabled easier mechanized harvesting.
Conclusion and application of results: Overall, the result showed that maximum yield of grain was observed with planting date of November 6th at a row spacing of 20 cm. However, for mechanized harvesting, planting around November 6 would be best as it had the maximum distance of first pod from the soil surface.

Key words:Chickpea,sowing date, row spacing, grain yield, yield components

INTRODUCTION
Among pulses, chickpea (*Cicer arietinum* L.) is the most important crop in Iran having high protein content. Chickpea's nutritional value and its ecological adaptability make it an important crop globally and in Iran as well as in other arid and semi arid countries (Dehnavi, 1999). Chickpea is an important crop in western Asia and it is of special importance in dry farming in western areas of Iran. The dominant rotation on non-irrigated lands of these areas is in the form of rain fed chickpea, rainfed cereals wheat and barley) (Rastegar, 1998).

The area under non-irrigated chickpea cultivation in Kermanshah province reaches 200,000 ha per year (Shams *et al*. 2004), and farmers of this region plant chickpea in spring. However, the yield of chickpea planted in spring is on average low due to the short plant growing period and susceptibility of local Bivenij chickpea to Ascochyta blight and difficulties with the traditional harvesting methods. The yield of non - irrigated chickpea in Kermanshah can be improved considerably by planting autumn varieties that are resistant to Ascochyta blight disease and more suitable for mechanized harvesting. In their experiment with five varieties of non-irrigated chickpea Hashem ILC -482 ،Arman , FLIP 93 - 93 and local Grit mass planted on 3 separate dates of March 18, January 5, and April17 Pezeshkpur *et al* (2005) concluded that grain yield is higher for the earlier planting dates.

Having tested cv. Hashem on 3 planting dates of December 6 January 21 and March 6 with different planting densities (16, 32, 48, 64 plants), Mohammadnejad *et al*, (2005) concluded that the number of fertile pods on the primary branch, grains per pod, the weight of 100 grains, and grain yield per unit area were affected by planting date. In examining the most appropriate plant density and planting date for new variety Hashem in Golestan province, Sabbaghpur،(2002) studied 4 planting dates (October 23, November 6, November 23, December 6) on 4 plant densities (13.3, 20, 29, 40 plants per m ^{2}) and found that planting on November 23 at a density of 29 plants m^{-2} produced the highest yield .

During their study on the trend of grain filling, yield, and yield components affected by density for 3 varieties of non-irrigated chickpea in Kermanshah climate, Shams *et al.* (2005) concluded that variety and density had a significant effect on grain yield and that the highest grain yield was produced by variety 12-60-31 with 28 plants m^{-2}. Pezeshkpur *et al*. (2005) showed that increasing the plant density from 54 to 66 plants m^{-2} had a positive effect on yield increase .

During research assessing the possibility planting chickpea in fall or autumn in Mashhad, Goldani *et al.* ،(1997) concluded that among 4 planting dates, (November 29) had highest yield per plant due to the increase in duration of vegetative and reproductive growth period leading to increase in dry weight of organs, number of pods (r = 95%) and number of grains (r = 96%).

Singh *et al.* (1988) reported that the number of grains per plant decreases as the plant density increases but the number of grains per unit area is higher with higher plant densities.

Harper (1993) considers grain weight as one of the invariable components in grain yield that is rarely affected by planting density. In a study they performed on chickpea varieties affected by different planting density, Shams *et al*. (2005) observed that the number of sub-branches under the effect of density, the number of nodes on main stem, and the harvest index were all affected by variety.

This research aimed to study the interaction of planting density and planting date on the yield and yield components of chickpea cv. Hashem and to determine proper autumn planting date and the best planting density.

MATERIALS AND METHODS

Study site: This research was carried out at Dorood _ Faraman Jihad agriculture service center (Kermanshah) -Iran (47°20 ' E, 34°20 ' N), with a cold, semi – arid climate at elevation of 1362 m above sea level; annual mean precipitation of 435 mm in farming year of 2004 - 2005 (table 1).

The experiment was done as a factorial design arranged as a completely randomized block design with 4 replications. Row spacing factor was assessed at 3 levels of 10 (T1), 30 (T2) ,40 (T 3) cm , and planting date factor included February 6 (D1) November 22 (D2) ,December 6 (D3) at 3 levels. Prior to the field preparation, soil sampling was done from several points of the field randomly from the depth of 0 to 30 cm; and soil analysis was performed at the laboratory of Kermanshah water and soil research department (table 1).

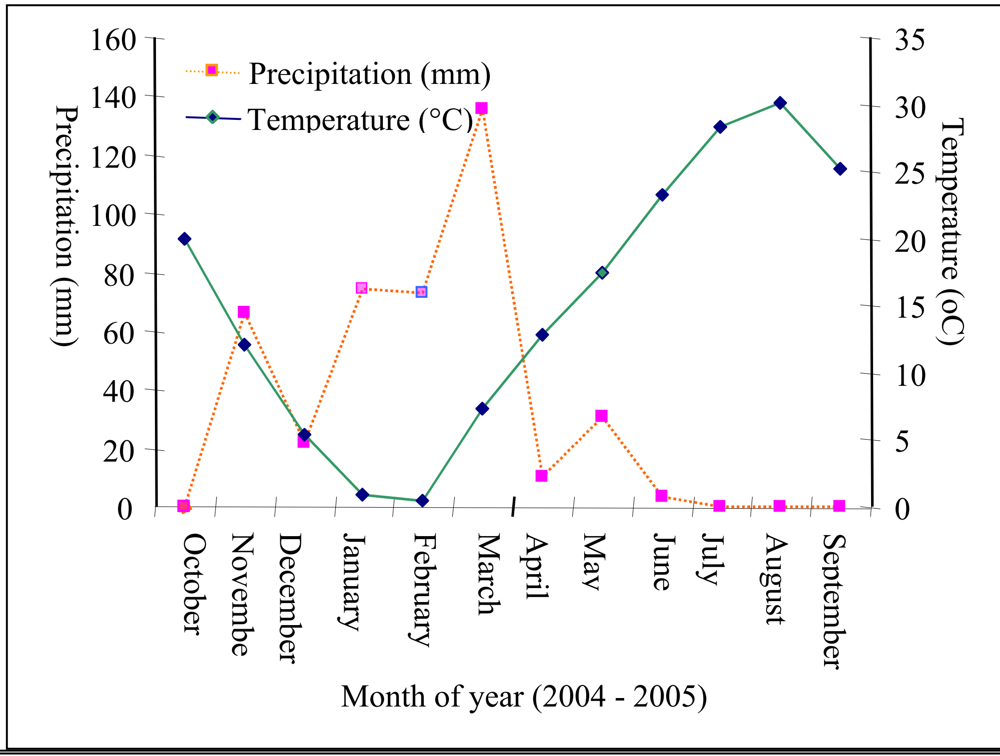

Figure 1: Means of precipitation and temperature in Dorood – Faraman region in farming year of 2004 – 2005.

Table 1: chemical and physical characteristics of the soil of experiment.

Texture	Sand %	Clay %	Silt %	K ppm	P ppm	N %	C %	EC mmohs/cm	PH	Depth (cm)
Silty clay	22	28	60	240	13.8	0.09	0.86	0.94	7.8	0-30

Experimental layout: on the basis of soil analysis 40 kg urea fertilizer per ha were evenly spread on the field before planting. This experiment consisted of 9 treatments and 36 test plots each of which had a length of 4m and width of 0.8 -1.6 m. Each plot included 4 planting lines and 0.5 m space was left between every two neighboring plots. Replications were spaced 1 m from each other.

Chick pea variety Hashem with kaboli type is the first variety resistant to Ascochyta blight disease; it has erect type of plant; it is suitable for mechanized harvesting and its planting was performed on the scheduled dates. To avoid the loss from terrestrial fungi, seeds were disinfected using Mancozeb at the ratio of 1.5:1000.

Perennial and annual weeds were removed twice manually during vegetative and reproductive growth periods. To control the loss from pod borer (*Helicoverpa viriplace*), spraying was done with Swin toxin by back pump sprayer at the ratio of 3 kg ha^{-1}.

Data recording: Ten plants from each plot were used to determine yield components and morphological properties of plants. Measurement included the number of pods per plant, the number of grains per plant, weight of 1000 grains, the number of sub - branches, the height of the first pod to soil surface, harvest index, and biological yield. Grain yield was taken and noted after eliminating 2 sidelines and 0.5 m from both ends of the middle line.

RESULTS AND DISCUSSION

Results showed that there was a significant difference (p=1%) between density and different planting dates in terms of plant height (Table 2). Among the different planting densities, spacing at 20 cm within row resulted in plants with highest height of 35.63 cm followed by spacing at 30 and 40 whose plants had a height of 32.24 and 29.57 cm, respectively (Table 3).

Singh and Sharma (1988) reported a positive correlation between plant height and the number of plants per unit area due to more competition for light. Comparing various planting dates showed that planting on November 6 had the highest plant height because of the increase in duration of the period of plant growth. Rezvani and Sadeghi (2005) stated that plant height increases as the duration of growth period increases. Rahemi and Soltani (2005), Rezvani and Sadeghi (2005), and Goldani *et al*. (2000) have also observed plant height increase with high densities and early planting dates.

There was a significant difference (p=1%) between density and various planting dates in terms of the distance of formation of the first pod to the soil surface. Among densities row spacing of 20 and 40 cm had, respectively, the highest (9.22 cm) and the lowest (4.6 cm) distances in terms of formation of the first pod to soil surface. Between varied planting dates, November 6 and December 6 had, respectively, the highest and lowest distances of forming the first pod to soil surface.

According to Rahemi and Soltani (2005), the height of the first pod to soil surface increases with earlier planting dates as well as with the increase in density. There was a significant difference (p=1%) between density and different planting dates in terms of the number of sub – branches, but not between interactions of density ×planting dates in this respect. The maximum number of sub – branches was related in plants at row spacing of 40 cm and the minimum was with plants plated at a row spacing of 20 cm (table 4).

The highest mean number of sub – branches (4.2) was associated with planting dates of November 6 and the lowest one (2.2) was associated with December 6. Singh *et al*. (1988), Goidani *et al*. (2000), Jalilian *et al*. (2005), and Shams *et al*. (2005) have examined the effects of density and planting date on the number of sub – branches and stated that the number of sub – branches decreases with the increase in density and with delayed planting. For the number of pods per plant, a statistically significant difference (p=1%) was observed between density and different planting dates. Results showed that there was also a significant difference (p=5%) in terms of the interaction of planting date × density on the number of pods per plant. Row spacing of 40 cm had the highest mean number of pods per plant (9.68) and the lowest (7.49) was in rows spaced at 20 cm.

The highest and lowest number of pods per plant were, respectively, for planting dates of November 6 and December 6; interaction of planting date × density shows that planting date of November 6 × row spacing of 20 cm had the maximum number of pods per plant (11.52) and the minimum number (4.17) belonged to the planting date of December 6 × row spacing of 40 cm. The number of pods per chickpea plant is among qualities that are highly affected by density and planting date, and it decreases with increasing density and delayed planting (Goldani, 1997; (Pezeshkpur *et al*; 2005; Mohammadnejad & Soltani, 2005).

There was a significant difference (p=1%) between density and various planting dates in terms of the number of grains per plant, as it was for interaction of planting date × density. For the number of grains per plant, planting date of November 6 had the highest value followed by planting dates of November 22 and December 6 (table 3). The number of grains per plant increases as the density decreases (Singh & Sharma, 1988). Treatment of planting date of November 6 with row spacing of 40 cm had the highest number of grains per plant (17.17) and the lowest one (11.65) was related to the treatment of planting date on December 6at a row spacing of 20 cm. Singh (1989) reported that increase in density affects the number of grains per plant, causing it to decrease; but the number of grains per unit area is higher in high density than low ones.

Many researchers believe that increase in yield is due to increase in the number of grains (Hejazi, 1994). Planting date, density, and their mutual effect had no significant impact on the weight of 100 grains. Hernandez and Hill (1983), reported that plant density couldn't produce any significant difference to the weight of chickpea 100 grains. For grain yield, there was a significant difference (p = 1 %) between planting date and density, as it was also for interaction of planting date and density (p = 5 %) .

Table 2: Analysis of variance of some agronomical characteristics of chick pea at Kermanshah, Iran.

SOV	df	Plant height	Distance the first pod to soil surface	No. sub-branch	No. pod per plant	No. seed per plant	100 weight seed	Seed yield	Biological yield	Harvest index
Rep	3	12.439	0.639	0.180	0.546	1.554	1.257	10.113	541.730	2.821
V	2	110.514**	68.830**	12.202**	56.504**	100.725**	1.837ns	2819.498**	14176.481**	9.380 ns
D	2	38.935 **	78.048**	9.970**	14.912**	25.710**	2.165 ns	12657.617**	44873.322**	8.347 ns
V×D	4	5.906 ns	0.930 ns	0.359 ns	4.397*	10.103**	5.911 ns	571.531*	2851.294**	2.247 ns
Error	24	5.573	0.463	0.136	5.573	0.905	5.328	202.252	402.961	7.983
CV%	-	7.25	9.35	11.60	12.10	8.05	7.64	12.35	8.53	6.07

*NS,*and**:Non-significant at p<0.05,significant at 5% and 1% level of probability,respectively. D, T and D×T:sowing date ,row spacing and sowing date × row spacing, respectively.*

Table 3: comparison of means of some agronomical characteristics of chick pea at Kermanshah, Iran.

Treatment	Plant height (cm)	Distance to 1st pod from soil	No. of subbranch	No. pods /plant	No. of seeds / plant	100 seed weight (g)	Seed yield kg/ha	Biological yield kg/ha	Harvest index %
D1	35.63A	225/9A	4.258A	11.02A	15.04A	30.09A	1320A	2748A	45.65A
D2	32.44B	7.992B	3.33B	8.367B	11.00B	29.88A	1113B	2182B	4649A
D3	29.57C	4.600C	2.258C	6.725C	9.425C	30.64A	1021B	2127B	47.42A
T1	33.85A	9.800A	2.20C	7.492C	10.32C	29.72A	1421A	2857A	47.09A
T2	33.30A	7.317B	3.35B	8.942A	11.89B	30.39A	1242B	2528B	46.90A
T3	30.49B	4.700C	4.00A	6.683A	13.25A	30.50A	790C	1673C	45.56A
D1T1	35.67A	12.27 A	3.225C	10.7AB	11.98C	31.13A	1721A	3495A	46.89A
D1T2	37.78A	9. 100BC	4.150B	10.8AB	15.98A	29.82A	1415B	3014B	45.59A
D1T3	33.45BCD	6.300 DE	5.400A	11.52A	17.17A	29.31A	825E	1735E	44.47A
D2T1	34.40ABC	9.975B	2.125D	7.55D	11.50B	28.40A	1345BC	2620C	46.85A
D2T2	42.88BCD	8.375C	3.175C	8.20CD	9.85C	30.18A	1211BCD	2336CD	47.58A
D2T3	30.05DEF	5.625E	3.800B	9.35BC	11.65B	31.07A	783E	1591E	45.04A
D3T1	31.48CDE	7.150D	3.800B	4.175E	7.50D	29.63A	1198CD	2457CD	47.54A
D3T2	29.25EF	4.475F	2.725C	7.82CD	9.85C	31.17A	1099D	2234D	47.54A
D3T3	27.98F	2.175G	2.800C	8.17CD	10.93BC	31.12A	764E	1691E	47.17A

In each column with similar letter(s) are not significantly different at the 5% level of probability(DMRT)D, T and D×T:sowing date ,row spacing and sowing date × row spacing, respectively.

The highest and lowest yields were pertained, respectively to planting dates of November 6 (1320 kg ha $^{-1}$) and December 6 (1021 kg ha^{-1}). Many researchers agree that early planting dates have higher yields (Subbaghpur, 2002; Pezeshkpur *et al*, 2005; Rezvanimoghaddam & SadeghiSamarjan, 2005; Gholliour & Soltani, 2005; Mohammadnejad & Soltani, 2005). Row spacing of 20 cm had higher yield (1421 kg ha^{-1}) than 30 and 40 cm (1242 and 790 kg ha^{-1}, respectively).

Singh *et al*. (1988) declared that yield increased significantly with increase in density of erect and tall genotypes form 33 to 50 plants m^{-2} by decreasing the row spacing form 30 to 20 cm. There was a significant difference (p=1%) between varied dates and densities of planting and their interaction in terms of biological yield.

Among planting dates, date of November 6 with 2748 kg ha $^{-1}$ had the highest biological yield, and dates of November 22 and December 6 with 2182 and 2127 kg ha $^{-1}$, respectively, followed. Among different planting densities, row spacing of 20 cm had the highest biological yield (2857 kg ha^{-1}) followed by row 30 and 40 cm spacings (2582 and 1673 kg ha^{-1}.

Among various treatments, the highest and lowest biological yields were for planting date of November 6 × row spacing 20 cm and planting date of December 6 × row spacing of 40 cm. Results showed that although weight per plant decreased with high densities, this weight reduction was compensated for by increasing the number of plants per unit area; and biological yield per unit area was higher in high densities than low ones.

In their experiment, Rastegar *et al*. 1998) reported similar results. According to the results of this research, planting date and density as well as their mutual effects had no significant impact on harvest index. Bagheri *et al*. (1997) argued that chickpea harvest index was obtained at a spectrum from 20 to 47%, having a positive, direct relation to grain yield. Katiyar (1980) proclaimed in his report that harvest index decreases with high densities because of delayed formation of sub – branches which have high share of plant dry weight per unit area.

Results of the present research showed that maximum yield of grain were observed with planting date of November 6 at a row spacing of 20 cm. Although the highest numbers of pods and grains per plant was associated with row spacing of 40 cm, higher numbers of pods and grains per unit area caused this density to have maximum yield. Planting date of November 6 had the maximum distance of forming the first pod to soil surface, and this facilitated its mechanized harvest.

REFERENCES

Ahmadian AM, Sobhani A, Malek M, 2005. Study of density effect on yield and its components of chickpea varieties under northern Khorassan dryf arming conditions. In proceeding of the first national conference on pulse in Iran. 20-21 November 2005.Research center for plant scienes.Ferdowesi university of Mashhad. Mashhad. Iran.

Bagheri A, Ganjali A, Parsa M, 1997. Chickpea planting and improvement. press of Mashhad Academic Jihad.Iran.

Dehnavi M, 1999. Study of the effects of planting date and density on the yield and yield components of farming chickpea in Neishabur region. Agronomy M.Sc. Thesis . Islamic Azad university Jiroft Branch . Iran .

Goldani M, 1997. Assessment of possibility of chick pea fall planting in Mashhad. MSc. Thesis Agriculture College .Ferdowsi university of Mashhad . Mashhad .Iran .

Goldani M, Bagheri A, Nezmi A, 2000. Study of the effect of planting date on phenology and morphology of chick pea varieties. In proceeding of 6th Iranian congress of crop production and Plant Breeding. 3 – 6 sep. 2000. Babolsar ,University of Mazandaran . Iran.

Gholipur M, Soltani A, 2005. Optimization of chickpea waiting planting management by using chickpea simulation model. In proceeding of the First National Conference on Pulse in Iran .20 – 21 November 2005. Research Center for Plant Sciences. Ferdowsi University of Mashhad . Mashhad . Iran .

Hejazi A, 1994. Seed Technology Tehran University press .Iran. 442 pages.

Jalilian J, Mahdi Sanavi S.A,. Sabbaghpur M, Khalifeh R , 2005. Quantitative and qualitative responses of 4 non – irrigated chickpea varieties to plant density and complementary irrigation . In proceeding of the first .National Conference on pulse in Iran . 20 – 21 November 2005 . Research Center for Plant Sciences . Ferdowsi university Mashhad . Mashhad . Iran.

Koochaki A. and. Banayanaval M, 1989. Pulse Crop Javid press of Mashhad .Iran. 236 pages.

Mohammadnejad Y. and Soltani A,. 2005. Shares of main stem and branches in determining grain yield of chickpea with different planting dates and densities. In proceeding of the First National Conference on Pulse in Iran.20 – 21 November 2005. Research Center for Plant Sciences. Ferdowsi University of Mashhad . Mashhad . Iran.

Pezeshkpur P,. 2002. Chickpea autumn, winter planting: an approach to increasing duration of vegetative and germinative growth periods in subtropic regions and decreasing the effects of warmth and dryness occurrence due to escape from drought. In proceeding of the 7th Iranian Crop Science Congress. 24-26 Aug 2002.Karaj. Iran.

Pezeshkpur P, Ahmadifar A, Daneshvar M,.2005. The effect of planting date on grain yield and its components, leaf chlorophyll index, and light penetration rate to vegetative shading floor. In proceeding of the national conference on pulse in Iran. 20-21 November 2005.Research Center for Plant Sciences .Ferdowsi university of Mashhad . Mashhad . Iran.

Pezeshkpur P,. Daneshvar M, Ahmadi A,. 2005.The effect of plant density on agronomical properties, leaf chlorophyll, and light penetration to shading floor of white chickpea variety. In of preceding the first National conference on pulse in Iran 20 21 November 2005. Research Center for Plant Sciences. Ferdowsi university of Mashhad .Mashhad,Iran.

Pezeshkpur P, .Marza'i Heidari M, 2002 . Assessment of possibility of chickpea autumn planting in Koohdasht , Lorestan .In proceeding of the 7 the Iranian Crop Science congress . Aug . 24 – 26 , 2002 , karaj .Iran.

Rezvani Moghaddam P,. Sadeghi Samarjan R,. 2005.Study of the effects on yield and morphological characteristics of chick pea ILC 3279 under climatic conditions of Neishabur. In proceeding of the First National Conference on pluse in Iran. 20 – 21 November 2005. Research Center for Plant Sciences.Ferdowsi University of Mashhad . Mashhad . Iran .

Rastegar J, . 1998. Study of growth trend and yield of chickpea varieties with different planting dates and densities . Agronomy M. Sc. Thesis. Agriculture college . Tabriz university . Iran.

Rastegar J, Rahimzadeh F, Moghaddam M, Bagheri A, 1998. Study of growth trend and yield of chick pea varieties with different planting dates and densities. In abstracts proceeding of 5 th Iranian Congress of Crop Production and Plant Breeding . Aug. 31 – sep 4 . 1998 karaj. Iran.

Rahemi Karizaki A, . Soltani A,. 2005. Allometric relationships between leaf area and vegetative qualities in plant chickpea. In proceeding of the First National Conference on Pulse in Iran. 20 – 21 Novamber 2005. Research Center for plant Sciences. Ferdowsi University of Mashhad Mashhad. Iran.

Shams K,. kobraee ,. S Rezaee Zangeneh.R,.2005. Study of the effect of planting density on the trend of grain filling, yield, and yield components of 3 chickpea varieties under Kermanshah conditions. In proceeding of the First National Conference on Pulse in Iran.20 -21 November 2005. Research center for Plant Sciences – Ferdowsi University of Mashhad . Mashhad . Iran.

Sabbaghpur H ,. 2002. Study of the most suitable plant density and planting date new Hashem variety of chickpea in Golestan province. In procceding of the 7th Iranian Crop Sciences Congress. 24 – 26 Aug . 2002 .Karaj.Iran.