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Comparison Winter and Spring Sowing Dates and Effect of Plant Density on Yield, Yield Components and Some Quality, Morphological Traits of Chickpea (*Cicer arietinum* L.) Under Environmental Condition of Urmia, Iran

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Abstract: A field experiment was carried out during 2005-2006 growing season to comparison winter and spring sowing dates and studies the effect of plant density on the yield, yield components and some quality, morphological traits of one local cultivar chickpea (ghazvin). The experiment comprised of three sowing dates viz. mid November, mid March and mid April, four planting densities viz., 30×7.5, 30×10, 30×15 and 30×20 cm that representing 45, 34, 23 and 17 plant m^{-2}. The experiment was laid out in a split plot design, based on the completely randomized blocks. Results indicated that early sowing (mid November and mid March) crops produce higher yield as compare to mid April and plant density did not significantly affect on the yield. Also effect of sowing date and different plant density on the height plant, branch number per plant and 100 seed weight were not significant but highest number pod per plant attained in mid November sowing date at a density of 30×15 cm, the number of days to maturity was the highest in planted on mid March with a plant density of 30×20 cm and the highest seed protein content was obtained in planted on mid March at densities of 30×7.5 cm.

Key words: Chickpea, winter and spring sowing, planting density, yield, yield components, seed protein content

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the important food grain leguminous in the diet of people in south and west Asia and northern Africa. It is grown on over 11 million hectares worldwide and annual production average over 8 million tones (Kumar, 2001). Of the world production, 91% is produced in Asia, 3.0% in Africa, 1.0% in Europe, 2.5% in north and central America (mainly Mexico) and 2.4% in Oceania (mainly Australia). In Asia, Indian accounts for 70.6% of the area and 74.8% of the production. Other important Asia countries such as Iran, Myanmar, Pakistan and turkey account for 26.9% of the area and 22.6% of the production (Upadhyaya *et al*., 2001). Chickpea is the third major cool season grain legume crop in the world after dry bean (*Phaseolus vulgaris* L.) at 19 MT and field pea (*Pisum sativum* L.) at 10.3 MT (FAO, 2004). But in Iran country is the first important grain legume between pulses crops due to higher sowing area and production (Banaii, 1997). Among the various agronomic practices, sowing time is single most important factor influencing the yield of chickpea. Optimum sowing time of chickpea may very from one variety to another and also from one region to another due to variation of agro-ecological conditions. Winter sowing is a kind of planting date that time of sowing is high susceptibility. Traditionally, the chickpea is sown in spring in order to avoid Ascochyta blight (*Ascochyta rabiei* pass) and frost, both in Mediterranean and temperate regions. It has been well documented that if the chickpea is sown in autumn, higher yield can be obtained than with traditional spring sowing in Mediterranean and dry regions. Ozdemir and Karadavut (2003) reported a 102% yield increase in autumn sowing over spring sowing. Singh *et al.* (1997) reported that winter-sown chickpea produced seed yield as 70% higher than spring-sown crop in Syria. Iiiadis (2001) calculated 23-188% more seed for winter over spring sowing in Greece. In most of these studies the high yield potential of winter crop has been attributed to the extended growing period and favorable rainfall during winter and early spring. Low winter temperatures restrict the seedling growth of chickpea, however, it enters a phase of rapid growth when temperature increase in spring, the time when the soil allows spring sowing (Siddique *et al*., 1999; O´Toole *et al*., 2001). The longer growing period of

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winter-sown chickpea resulted in higher biomass production, which contributed mainly toward increased seed yield. Sowing the crop in winter with cultivars tolerant to cold and to aschochyta blight (*Aschochyta rabiei* (pass.) Lab.). Minimizes the effects of terminal heat and drought stress and increased and stabilizes productivity (Singh *et al*., 1997). Also in this sowing time required cultivars tolerant to cold and to aschochyta blight. The sowing density used depends principally on soil water availability. More research is needed to determine the relationship between sowing dates and planting density for different chickpea varieties. Yigitoglu (2006) reported that highest seed yield of chickpea was obtained in early winter sowing and high plant density (45 plant m^{-2}). Planting density depends to environmental condition, seed size, plant type and way of sowing. Singh *et al.* (1980) reported that optimum planting density for chickpea is 35 plant m^{-2} with consider to environment conditions. however, in north-west of Iran Ahmadi and kanoni (1994) reported optimum planting density of chickpea is 25 plant m^{-2}. The present study was therefore, undertaken to find out the suitable sowing date of chickpea (ghazvin local cultivar) and optimum planting density to achieve higher grain yield under environmental condition of uremia, Iran.

MATERI ALS AND METHODS

The experiment was conducted at the agricultural research farm and natural resources of west Azerbaijan in station dry land Khormabad, Uremia during 2005-2006 growing season. The site is located at 37°50' N latitude and 45°07' E longitude. The soil texture of the experimental station was sandy clay loam. Seeds were dressed with the fungicide Karbocsitiram before sowing to prevent seedling loss. The experiment comprised of three sowing dates viz., 15 November as a winter crop, 15 March as a early sowing and 15 April as a spring crop (region usual sowing by farmers) and four planting densities represented by four plant spacing viz., 30×7.5, 30×10, 30×15 and 30×20 cm. The experiment was laid out in a split plot design based on the completely randomized blocks with four replications assigning sowing time in the main plots and planting densities in the sub-plots. Each sub-plot consisted of 4 rows 4 m long, 30 cm row spacing and were sown by hand. Seed was placed at 5 cm deep. Experimental cultivar was ghazvin local cultivar that obtained from research seed breed of unit leguminous west Azerbaijan, uremia. Weeds were controlled by hand weeding. No insecticide or fungicide was used to control insect pests or diseases. The following observations were recorded: date of flowering when 50% of the plants in the plot had at least one flower and date of maturity when the plants had dried and were ready for harvest. Plant height (cm), number of branches and number of pods per plant were calculated in the field. 2 rows of center of each plot were harvested with hand when the crop had dried sufficiently for satisfactory threshing and the amount was calculated as kilograms per hectare. One hundred seed weight (g) was determined in the seed laboratory. Ascochyta blight tolerances were scored according to: 1: no diseases symptom, 3: 20-45%, 5: 45-70%, 7: 75-90% and 9: 100% diseases. Analysis of variance was performed on data using MSTATC. Differences among treatment means were tested with Duncan multiple range tests. A weather station on the experimental site recorded monthly rainfall; minimum, maximum and mean temperature and number of frost days and mean moisture that presented in (Table 1). Rainfall totals in station uremia was 308.6 mm and rainfall distribution were 14.4% in fall, 57.2% in winter and 28.3% in spring season.

Table 1: Monthly rainfall, minimum, maximum and mean temperature and number of frost days and mean moisture during 2005-2006 cropping season at west Azerbaijan, Uremia-Iran

Months	Rain fall (mm)	Min. (°C)	Max (°C)	Mean (°C)	Frost days	Mean moist
October	3.0	−3.4	29.0	14.7	1	57.0
November	25.0	−3.0	22.4	7.2	15	67.0
December	16.5	−6.2	17.0	5.5	13	68.0
January	43.1	−14.0	12.6	−1.6	27	72.0
February	101.5	−15.2	8.2	−0.2	22	69.0
March	32.0	−6.8	18.0	5.1	12	57.0
April	48.0	−4.6	24.4	10.9	1	65.0
May	39.5	−0.2	26.2	14.9	0	64.0
June	0.0	12.4	30.8	20.6	0	36.8
July	0.0	15.0	32.0	23.7	0	49.6

RESULTS AND DISCUSSION

Seed yield: Seed yield was significantly affected by sowing dates, while the effect of plant density on the seed yield was not significant. Crops planted on mid March and mid November produced highest seed yield (1042.08 and 962.91 kg ha^{-1}) followed by mid April (709.16 kg ha^{-1}) planting (Table 2). Experimental cultivar sown in early sowing, mid November and mid March, gain substantially higher yields than mid April. This result was due to the reproductive phase of the early sowing crop is initiated in a more favorable thermal and moisture regime than the mid April sowing crops. Calcangno *et al.* (1987) reported a 60% yield increase in autumn sowing over spring sowing. Also Ozdemir and Karadavut (2003) reported that autumn-sown crops produced 1642 kg ha^{-1} more seed yield than the spring-sown crops. In this study we expected that winter-sown crops have a higher seed

Table 2: Mean comparison the effects of the sowing dates and planting density on the yield, yield components and some quality, morphological traits

Treatments	Seed protein (%)	Days to maturity	Second branches	Plant height (cm)	Yield (kg ha^{-1})	100 seeds weight (g)	Pods/plant (No.)
Sowing date							
Mid November	21.27b	191.60b	1.50a	29.06a	962.91a	35.04a	37.69a
Mid March	22.63a	195.60a	2.06a	28.69a	1042.08a	33.75a	22.25b
Mid April	22.10ab	76.56c	1.68a	27.56a	709.16b	35.16a	14.56c
LSD (0.01)	1.03	3.02	ns	ns	4.01	ns	30.20
Plant density							
45	22.31a	153.80b	1.66a	29.58a	957.08a	35.06a	18.00c
34	22.16ab	154.20b	1.79a	27.75a	948.33a	34.44a	23.33bc
23	21.85ab	154.80ab	1.50a	28.00a	870.41a	34.56a	31.50a
17	21.69b	155.60a	2.04a	28.42a	842.91a	34.54a	26.50ab
LSD (0.01)	0.48	1.11	ns	ns	ns	ns	5.66

The same letter(s) are not significantly different ($p<0.01$), ns: non significant

Table 3: Relationship between sowing date and the scores of Ascochyta blight of chickpea, the blight scores was rated using a (1-9): 1: No. diseases symptom, 3: 20-45%, 5: 45-70%, 7: 75-90% and 9: 100% diseases

Treatments	Intensity of ascochyta blight 1	2	3	4
T_1	7	7	7	7
T_2	3	3	3	3
T_3	5	5	5	5

T_1: Mid November, T_2: Mid March and T_3: Mid April sowing crops, 1, 2, 3 and 4 are replications

yields than spring-sown planting. The decrease of seed yield (79.17 kg ha^{-1}) in mid November than mid March was due to environmental condition in region quite favorable for Ascochyta blight infestation and experimental cultivar was susceptible so there was blight incidence in sowing time particularly in winter-sown date (Table 3), this indicated that there was a strongly negative relation between yield and ascochyta blight score. Saxena and Singh (1987) reported that for getting success with the winter sowing of chickpea it is necessary that the cultivars have high level of tolerance to cold and resistance to Aschochyta blight. Present results are in agreement with (Hawtin and Singh, 1984; Reddy and Singh, 1990; Singh and Reddy, 1996; Toker and Cagiran, 2003; Gan *et al.*, 2006). Seed yield were not significantly affected by planting densities. Saini and Faroda (1998) reported seed yield increase of Kabuli chickpea up to 36% with plant density increase from 20 to 35 plant m^{-2} in semiarid northern India. Similarly, Beech and Leach (1989) showed that a plant density of 40 plant m^{-2} was required to obtain maximum seed yields. Also Liu *et al.* (2003) reported that the seed yield per unit area responded positively to plant densities. However, in our study plant densities were not significantly effect on the seed yield. This result may be due to use of one cultivar of chickpea that was pure line and had a same growing habit in different plant densities. The experiment demonstrated that yield losses of winter-sown chickpea can be minimized by using cultivars with a higher level of resistance, selecting fields isolated from sources of infection and using strategic fungicide application. In this study experimental cultivar (ghazvin) represented that was not resistance to Ascochyta blight and winter-sown crop were not successful. It is recommended that for achieve to high seed yield of this cultivar should be planted in the mid March as an early sowing than mid April, at the 45 plant m^{-2} planting densities.

Yield components: Effect of sowing date and planting densities were not significant on 100 seed weight but had significant influence on pod per plant. The results indicated that in the chickpea, 100 seed weight is a highly stable character and variation mainly depends on genotype. Ozdemir and Karadavut (2003) reported that autumn sowing increased the mean 100 seed mass by an average of 10% over spring sowing and said this result was due to the moderate temperature regime during the seed-filling stage. Also studies conducted elsewhere have also demonstrated that plant density has none or little influence on mean seed weight in chickpea (Siddique *et al.*, 1984; Beech and Leach, 1989; Saini and Faroda, 1998). The highest number of pods plant^{-1} (Table 2) was found on mid November (37.69) planting followed by mid March (22.25) and mid April (14.56). The highest number of pods plant^{-1} in the winter-sown was due to extend duration vegetative and reproductive phase growth in winter crop. Ozdemir and Karadavut (2003) reported that the longer growing period of autumn-sown chickpea affected positively pods per plant. Present results are in agreement with (Singh and Bejiga, 1990). Results of means comparison indicated that the highest number of pod per plant (31.5) was recorded from 23 plant m^{-2} density. The results indicated that the increase in pod number in lower planting density may be the result of availability of better growth resource to the individual plant. Jettner *et al.* (1999) reported that the number of pod per plant decreased in highest planting density. The decreased pod production (18) with increasing plant density (45 plant m^{-2}) was presumably due to plant-to-plant competition for resources. Present results are in agreement with (Beech and Leach, 1989; Biswas *et al.*, 2002).

Morphological traits: The early sowing (mid November as winter-sown and mid March as spring-sown crops) emerged at the 5 April and 11 April, respectively but the spring-sown (mid April) crop emerged in 17 May and continued to grow more of one month later than the early sowing. Winter-sown crops flowered on 26 May and spring-sown crops on 2 June and 12 June, respectively. Flowering initiation of chickpea sown in winter shifted earlier than the sown in spring by 7-16 days. The time of plant maturity for harvest was on average 17 days earlier with early sowing than mid April (region usual sowing by farmers). The results clearly indicated that prolonged period of flowering and growth due to early sowing had a significant influence on the productivity. Also, the reproductive phase of early sowing was longer than mid April, contributing to higher seed yield. Present results are in agreement with Ozdemir and Karadavut (2003). Morphological traits were not significantly influenced by sowing dates and planting densities but had significant effect only on days to maturity. Singh *et al.* (1997) and Ozdemir and Karadavut (2003) reported that plant height and branch number per plant were most influenced by sowing time. On the other hand, plant height and brunch number per plant increased in winter than spring sowing dates. Parvez *et al.* (1989) and Khan *et al.* (2003) in soybean reported that plant height increased slightly with increase in planting density. However, in this study effect of experiment factors were not significant on the morphological traits. This result may be due to use of one cultivar of chickpea that had a same growing habit. Maximum days to maturity were recorded from the mid March (195.6) sowing date and a decrease trend in days to maturity (76.56) was observed with mid April sowing dates. Minimum days to maturity with mid April sowing may be due to quick changes in photoperiod and temperatures. The results indicated that early sowing (mid March) took maximum days to maturity. In planting densities maximum days to maturity (155.6) were found in the 17 plant m^{-2}. A steady increase in number of days to maturity tack place when decreased plant density. Golozani *et al.* (1994) in chickpea reported that with decrease plant density, increased number of days to maturity. These results are in agreement with Khan *et al.* (2003) in soybean that reported that early sowing dates and low plant density have a maximum day to maturity.

Seed protein content: Seed protein content was significantly affected by sowing dates at 1% level and planting density at 5% level of chickpea. Results indicated that the highest seed protein content was recorded in mid March and in the 45 plant m^{-2} planting density. These results clearly indicate that there was a negative relation between protein content and number of pod per plants. In higher plant density pod per plant decreased and the result of this seed protein content will be highest. Badshah *et al.* (2003) reported that protein content is negatively correlated to seed size, volume and density. Present results are in agreement with (Sandhu *et al.*, 1989; Saraii, 2000). It is recommended that for achieve to high protein content of this cultivar in region should be planted in the mid March as an early sowing.

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