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The economic yield evaluation and some of the morphological traits of chickpea cultivars under the influence of different densities

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Abstract

In order to study yield and yield components of three chickpea genotypes at different plant densities under dry land conditions, a Field experiment was conducted during 2013 at the Research Farm of the Islamic Azad University of Kermanshah. The experimental design was factorial based on randomized complete block design with three replications. Five plant density (10, 20, 30, 40 and 50 plant/m^2) and three chickpea cultivars (ILC482, Arman and Flip84-48C) were factors which studied. Results showed that effect of plant density on grain yield was significant at 1% level. With increase of plant density from 10 to 30 plant/m^2, grain yield increased and from 30 to 50 plant/m^2, grain yield decreased, the reason of this was competition and shading of plants in surface unit. The highest yield (1033.1 Kg/h) was achieved in 30 plant/m^2. Effect of cultivar on grain yield was significant at 5% level. The highest yield (1011.2 Kg/h) was achieved with ILC482 cultivar. With increase of plant density plant height increased but number of pod in plant, number of grain in plant, number of primary branch, number of secondary branch and hundred seed weight decreased. Plant density had no significant effect on number of seed per pod. The highest number of pod in per plant and plant height and lowest seed weight belonged to ILC482 cultivar. Arman cultivar had maximum seed weight. Effect of cultivar on seed per pod was not significant. In order to sowing of Chickpea in the area we predicate use from ILC482 cultivars with density of 30 plant/m^2

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Introduction

The increasing world population growth, the achievement of all people to adequate nutrition and optimal in trouble and made more than 20 percent of the people are faced with malnutrition. Now about 70 percent vegetable proteins used to humans by cereals (Majnoun Hosseini, 2008). Among legumes, chickpea is the most important plants of this family that is rich in protein and starch. This plant is sowed in the majority of areas in dry land in the spring therefore rain and moisture stored in the soil relies on the most effective hinder is produced as a result of drought. It should be noted that poor plant density can be soil moisture depletion in the early growing season cause being faced with plant drought stress during the reproductive growth. For this reason the use of proper plant species and cultivars, optimum understanding of plants is compatible with the climatic conditions of the tremendous importance of experts (Jalilian *et al*., 2005). The yield of each herb plant derived crop competition between and within the different plant growth structures such as light, soil and food. If the plant could use all of the elements of growth and the competition could become near to the lowest point, we could have maximum seed production in surface (Biabani, 2008). Thus, a correct and wise decision about the density of planting as basic factor for agriculture in the semi-arid regions and dry land cultivation seems essential (Raey *et al*., 2007). Therefore, the necessity of any research on this product is stressed in this regard, in order to check the reaction of chickpea cultivars in yield and yield components *Cicer arietinum* L. to plant density in terms of the dry land conditions was laid the following objectives: determine the best cultivars according to the climatic conditions of the area, the most suitable density of cultivation in order to achieve the maximum economic performance, the effect of cultivar and the density on yield and yield components. Chickpea plant in appropriate density also make full use of nutrients and moisture to compete well with weeds (Koochaki and Banyan Aval, 1989). Whish *et al*., (2002) report on the performance of the sowing Chickpea narrow row spacing cultivated yield were stability more than plants grown in wide row spacing in the presence of weeds. The narrow row spacing is the ability to compete in a lot of products due to the closure of the fast canopy and the beginning of early competition with weeds. Frade *et al*., (2005) effect of plant density on the number of seeds in pod were reported insignificant they were reporting a significant number of seeds in a operating changes less environmental impact and greater control of this trait is influenced by genetic factors. Hawthome *et al*., (2003) report series for DS pod chickpea plant density between 34-45 plant/m^2 (equivalent to 80-110 kg/h) and cable type between 25-30 plant/m^2 (equivalent to 150 kg/h). Mohammadi., (2002), The number of pods in the plant, number of seeds in pod with increasing plant density in surface unit have reported significant. Number of pods in the chickpea between 30-150 the number of variables, which depends to a large amount of the year, the location and date of planting and other factors. In lower density there are not any, environmental restrictions for the plant and the plant absorbs enough light and enough water and food, and result in more takes place flowering plants (Fallah, 2008). With an increase in photosynthesis by the plant and by providing photosynthesis material, pods have higher potential of seeds and the formation of a lower height probably environmental stress will have a bit effect on seed number in pod, in vise versa with increasing of pod density, we have high competition for environmental factors such as water, increasing food elements and we have decreasing of photosynthesis matter transference from beginning to destination and decreasing yield is absolute (Imam *et al*., 2003). Frade *et al*., (2005) which is based on the number stated in the bushes with the increasing density in the Chickpea plant from 8 to 56 square meters in the plant, but the density is between 25 and 40 plants/m^2 variation was observed. On the high density of peas, there's a limitation in radiation, as also the further number of pods in surface unit, increased the transpiration as a result of transpiration in the meantime creating water, stress decreased 1000-seed weight, and reduced net photosynthesis

(Fallah *et al.*, 2008). Fredrick *et al.*, (2001) concluded that the high plant density aggravate competition between adjacent plants and reduce the number of secondary branches, pod and seed in plant, and while Barary *et al.*, (2003) with intervals between rows of 30, 40, 50 and 60 cm on the row intervals of 5, 7.5 and 10 cm such traits, there are no significant differences in view. Some of the researchers reported the correlation between yields in surface unit with number of branches and also there is negative correlation between plant density with number of branch and pod in plant (Delachiava and pinho, 2003). Imam *et al.*, (2004) will report on harvest index between different plant density also was significantly different so that the maximum harvest index was, at 20 plant/m² density. One of the major reasons for the higher density of 20 plants in harvest index can be less competition for plants growth factors in radiation absorption in particular growing season. (Raey, 2007) also reported similar results. The biological yield may be long, with the creation of the type of plant stands and pressed to improve so that the possibility of increasing plant density measurements exists. Biological function was increased with increasing the number of branches and prolonged periods of flowering and grain filling, number of seeds are a highly desirable way of photo assimilates (Bagheri *et al.*, 1997). Ayaz *et al.*, (2004) effect on plant density and yield on biological varieties are meaningful. Due to the opportunity to get lighter, more dry matter production. The density of 35 per square meter with maximum dry matter in Hectare compared to the density of 25 plants per square meter or its production as well as the 1983 kg also in different cultivars with further growth, because of more opportunity for receiving light to provide more dry matter assimilation further growth, Sharer *et al.*, (2001) reports that the relationship between grain yield and quantitative, such as plant height, number of branches per plant, number of seeds and grain weight based with plant density was significant, in between some of the characters plant height increased with increasing density, Therefore, the emphasis was to achieve high-performance should be much more seed (70 kg/h) and the rows less than the distance (30 cm). Bagheri *et al.*, (2000) they report that the density of 20 plant/m² compared to 40 plants per square meter has a greater yield. Increase performance in this case is 5.6%. The density of 20 plant/m² due to the further use of environmental factors produced more seed yield. But in the higher density, creating competition between productive and reproductive organs decreased grain yield rather than to less density (Imam *et al.*, 2004).

Materials and methods

Site description and soil analysis

This experiment was conducted in 2012-2013 at field experiment of Islamic Azad University of Kermanshah. Geographical situation and meteorological indexes of experiment region were presented in Table 1.

Table 1. Results of climatic properties of experimental location in 2012-2013.

Climate	Cold-temperate semi-arid
Latitude	47° 20'
Longitude	34° 23'
Height above sea level	1318.5
Annual absolute maximum temperature	41.9 (°C)
Annual temperature mean	16.4 (°C)
Annual absolute minimum temperature	-9.5 (°C)
Annual rainfall mean	376 (mm)
Annual evaporation rate	1784 (mm)
Sundial	2618.7
Number of rainy days	57

Number of frost days	69

The highest rainfall with 115.3 mm in October and the lowest with 0 mm in June, July, August, September and October happened. According to the ombrotermik curve, the desired area with having 150 days dry, was concluded hot and dry Mediterranean climate zones and with having wet and cold winter and hot and dry summer, was concluded semi-arid temperate regions. Then to determine the physical and chemical properties of the soil sample the soil in 0-30 cm depth (Table 2).

Table 2. Results of soil Physical and chemical properties of experimental location.

Sampling depth	pH	Ec dsm^{-1}	Organic matter (%)	Silt (%)	Clay (%)	Sand (%)	Total Nitrogen (%)	Available Phosphor $mgkg^{-1}$	Available Potassium $mgkg^{-1}$	Available Zinc $mgkg^{-1}$	Soil Texture
0-30	7.3	0.88	2.6	49.1	42.4	8.1	0.12	8.9	558	0.81	Silt Clay

Table 3. Analysis of variance for studied traits in chickpea.

		MS									
Source of Variation (S.O.V)	df	Plant height (cm)	Leaf Area Index (%)	Number of Primary branches (%)	Number of Secondary branches (%)	Number of Pods/plant	Number of Seeds/plant	100-seed weight (gr)	Economic yield (Kg/ha)	Biological yield (Kg/ha)	Harvest Index (%)
Block	2	0.04263	1.52	0.146432	12.132543	328.49538	352.75479	4.59873	18.125178	1217.6171	11.145321
variety	2	286.94894**	91.32 **	13.846872**	11.352142*	151.42532 ns	310.24652 ns	580.19254**	136.245103*	6561.9267**	42.846926*
Plant density	4	16.124243**	5.12 **	0.2825321 ns	4.3178454**	1341.0782**	1475.89762**	17.76125**	239.13514**	14492.136**	228.97820**
Variety. Density	8	0.6522410 ns	0.31 ns	0.0792532 ns	4.2531045**	41.97854 ns	57.025421 ns	3.79456*	35.124578 ns	849.63045 ns	19.156321 ns
Error	28	0.891246	0.621513	0.1842541	1.8218124	104.86325	120.25431	1.51025	28.74528	1124.1723	16.21467
(%) C.V	-	3.025648	6.18	18.23141	16.12521	36.12525	37.92354	3.917641	6.3514814	11.32512	12.91514

ns: Non- significant, * and ** : Significant at α =0.05 & α=0.01, respectively.

Treatments and experimental design

The experimental design was factorial based on Randomized complete Block design with three replicates that including Hashem, Arman and ILC482 and plant density in five levels 10, 20, 30, 40 and 50 plant/m2 were compared. The total area of experimental farm about 367.5 square meters was considered and in a year ago, was fallow. Beginning in the fall of the year, mentioned field order to maintain and store moisture was plow by using a pen plow in fall, in order to shatter a hunk and a uniform soil condition, the field be disked. Based on the results of soil analysis (Table 2) and Cody advise, (about 40 Kg/h Nit and 100 Kg/h P2O5 from two sources of urea (2500 gr) and ammonium phosphate (3200 gr) plus 2.5 Lit/h Treflan herbicides (Trifluralin) along with the disc was given to earth style and mixed with the soil. Then the farm by faror (deep wide cultivation act) likes streamlet and hill. The dimensions of each experimental plot were 7 square meters. Between the blocks is also approximately 1 meter of distance as the doorway was embedded. Each experimental plot contains 6 sowing lines that is 4 m^2 with a distance of 25 cm plant spacing and lines on the rows based on the desired plant density was variable. Two lines in each side-plot (1 and 6 lines) were in the Commons as the margin of 4 middle lines to specify the phonological stages of the plant and evaluation of all the various traits were used. To prevent damage of fungi Pathologies seeds with fungicides venom (Toxicant) such as Vitavax (Carboxin-Tiram) in a ratio of 1.5 in thousand antiseptic. Planting on 26 March to manually at the desired density by changing the distance between plants on the row is done. Meanwhile the density for 10, 20, 30, 40 and 50 plants/m^2 distances of the seeds on the row in order

40 were 20, 13, 10 and 8 cm. For enough seed germination and plant emergence confidence lay at any point were two seed that after germination decrease to a plant. At the time of planting paid attention carefully on that the seeds to be placed at a depth of 4-5 cm soil. In order to achieve the appropriate plant density in step 2 to 6-leaf stage, emprise to thin and also remove the weeds. Permanent or perennial weeds during the experiment weed but annual weed with once or twice weed were controlled. Also, in order to prevent damage of eater silk worm of Chickpea attempted to poison with Sevin (karbanil) poison in rate of 150 gr in 600 m² (2.5 kg/h).

Table 4. Mean comparison of studied traits in chickpea.

	Mean										
Factor	Plant height (cm)	Leaf Area Index (%)	Number of Primary branches (%)	Number of Secondary branches (%)	Number of Pods/plant	Number of Seeds/pod	Number of Seeds/plant	100-seed weight (gr)	Economic yield (Kg/ha)	Biological yield (Kg/ha)	Harvest Index (%)
Variety											
ILC 482	27.82^{b}	11.21^{b}	3.05^{a}	8.75^{a}	31.72^{a}	1.16^{a}	32.52^{b}	28.32^{b}	1011.2^{a}	3014.3^{a}	33.17^{b}
Arman	31.12^{b}	10.82^{c}	1.32^{a}	7.22^{a}	24.33^{a}	1.02^{a}	24.32^{a}	30.15^{c}	961.8^{b}	2835.2^{b}	35.32^{a}
Hashem	28.21^{a}	15.21^{a}	2.89^{b}	8.91^{a}	28.42^{a}	1.06^{a}	28.62^{b}	26.18^{a}	983.2^{ab}	3229.2^{ab}	34.12^{ab}
Plant density	29.62	10.98^{b}	2.45^{a}	8.44^{a}	45.30^{a}	1.06^{a}	48.36^{ab}	33.42^{a}	946.4^{dc}	2621.4^{c}	36.16^{a}
10											
20	30.38	11.56^{b}	2.42^{a}	8.11^{a}	32.43^{b}	1.07^{a}	36.84^{b}	32.60^{b}	1005.2^{ab}	2812.4^{b}	33.51^{a}
30	31.21	12.26^{a}	2.35^{a}	8.11^{a}	27.64^{bc}	1.13^{a}	28.73^{bc}	31.06^{b}	1033.1^{a}	3015.2^{b}	33.28^{a}
40	31.82^{b}	12.57^{a}	2.28^{a}	8.44^{a}	20.10^{cd}	1.03^{a}	21.10^{cd}	30.51^{a}	967.2^{bc}	3286.9^{a}	28.41^{b}
50	32.17^{a}	12.64^{a}	2.21^{a}	8.66^{a}	16.87^{d}	1.00^{a}	16.82^{d}	29.84^{a}	908.2^{d}	3317.4^{a}	26.38^{b}

Similar letters in each column shows non- significant difference according to Duncans Multiple Range Test in 0.05 levels.

Plant sampling and measuring

Sampling for measuring leaf area and drought weight of the plant is begun, two weeks after the closure of the samples and next samples is done once in 15 days interval of all plots as a demolition. Comply with the margins and in each sampling of lines 2 and 5, 5 plant numbers by Clipper cut from the surface of the soil to measure leaf area was transferred to the laboratory. The area of this 5 plants harvested based on the makeup experiment was calculated in every plant patients. After separating the leaves of the plant, was determined the leaf area with digital device Leaf area matter. The aerial part of the plant, to break down the leaves and stems in the later stages of pods and seeds for 48 hours at 70 °C oven was put to dry. After drying was weight with a milligram weighing scale. At the end of the growing season to determine the traits such as plant height, number of primary branches, secondary branches, a number of pod in plant, number of seeds in plant, number of seeds, 100 seed weight selected randomly mentioned ten plants to each experimented plot to measure mentioned traits. In this way, first calculated the total height of the plants, and the average height of the plant enrolled as height of its plot. To measure the height from the place of collar to the end of the main stem, measured with an accuracy of 1 mm. So that all flowering sub stems in per plant considered as sub branches. From 10 plants that have been selected in order to determine morphological traits calculated number of pod in main branch and sub branch. Based on adding the average number of main stem and sub branch was determined. The number of plant to calculate the number of grain in pod was required in a number of seed in the pods of main stem and the sub branch in each plant calculated separately and acquired average of 10 per plant then determined number of seed in pod from average number of seed in main branch and sub branch of pod. Harvest operation after you delete the margins of two rows in the middle of each plot (3 and 4 lines) and remove half a meter from the beginning and end of the lines of which is equal to 1.5 m². Samples of harvested laid on hemp bags after slamming the seeds were parted of pod and a weight of seeds with an accurate scale for weighing with an accuracy of one milligram and seed yield was calculated in kg/h. harvest index was calculated by dividing seed yield on entire biomass.

Statistical analysis

The variance of the data, compared with a test average of Duncan and the calculation of the correlation coefficients was used with MSTAT-C software. Excel soft ware was used for drawing the charts.

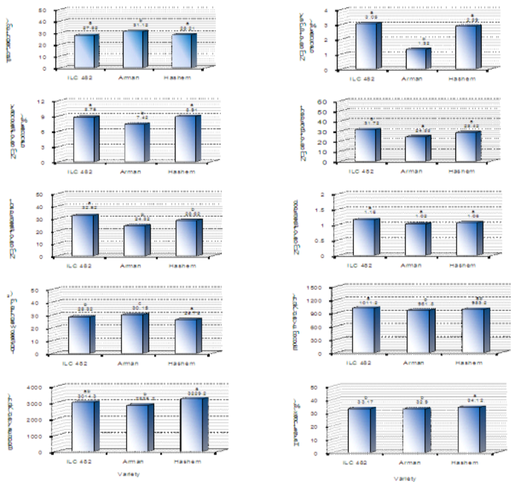

Fig. 1. The effect of cultivars on Yield an yield components of chickpea in experimental condition.

Plant height

As expected and can be viewed in (Table 3) as well as the effect of cultivar and planting density on plant height, both at the level is 1% is significant. The height of the trait that significantly depends on the environmental conditions. In high density due to competition for light increased the height of the plant. This subject indicates that the canopy of plant increased the length of the stem inter nodes as a, result increase the height of the plant. So that the density of 50 plants per m², with an average height of 32.17 cm had a maximum density and the density of 10 plants per m², with an average of 29.62 cm had the lowest height of the plant (Table 4). These results are similar to the results (Kerby *et at*., 1990; Singh, 1988; Seedfeldet *et al.*, 2002). As well as the average of the comparison table (Table 4) show that Arman cultivar with 12.31 cm average height had higher plant than Hashem cultivar with 28.21 cm. Higher plant and the shortest plant height related to ILC482 with 27.82 cm height. The results of the mentioned reports similar Leport *et al.*, (2005) and Rafiee *et al.*, (2006). This is the difference between the heights of the plant varieties can be caused by genetic differences.

The number of Primary branches

As specified in (Table 3) between different cultivars in terms of the number of primary branches, significant differences can be seen at the level of 1% but this morphological trait is influenced by the density and the sowing density and interaction did not show a significant difference. Take a look at the comparison table can be specified that ILC482 cultivar (3.05) with inconsiderable difference rather than Hashem (2.89) had higher number of primary branch Arman cultivar (1.32) had minimum number of primary branches (Table 4). It also compares the average planting density showed that by increasing the density the number of primary branch reduced. In this regard the density of 10 plants in m² with a 2.45 and a density of 50 plants per in m² with 2.21 had The maximum and minimum number of primary branches (Table 4). These results are similar to the (Koochki *et al.*, 1989 ; Goldani, 1997).

The number of Secondary branches

Based on (Table 3) chickpea cultivars studied in this experiment in terms of the number of secondary branches had a very significant difference 1%. As well as the effect of density and interaction cultivar and a density of 5% level on the number of secondary branches were meaningful. The maximum number of secondary branches of the Hashem (8.91) with inconsiderable difference placed in the second place. The minimum number of secondary branches related to Arman cultivar (7.22) (Table 4). Increasing plant density with reducing the number of secondary branches accompanied so that the maximum number of secondary branches in 10 plants/m² densities were obtained and the lowest were related to the density of 50 plants/m²(Table 4). It seems that with the increasing distance between two plant in row the or decrease plant density due to increase the gettable sunlight and reduce competition between plants to achieve, resources has been provided greater growth for each plant and as a result of increased the number of secondary branches. (Saddique *et al.*, 1985; Khan *et al*., 2001; Bourd *et al*., 2001; Shukla *et al*., 2000; Sayeed Akhtar, 2008 and Rafiee *et al*., 2006) reported that during the investigation reducing the number of branches with increasing plant density is probably due to the intensify competition between adjacent plants and reduce light penetration into the plant canopy in prevented growth of buds that making branches.

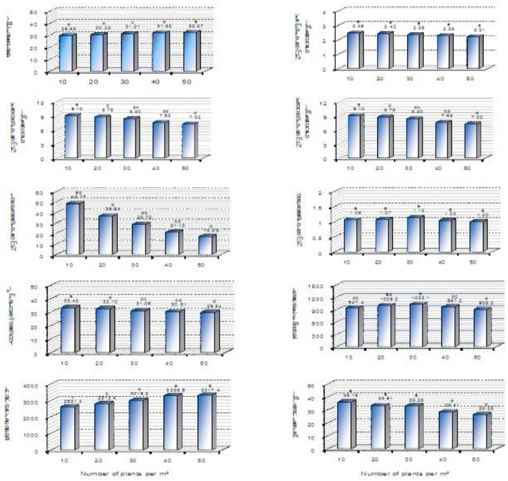

Fig. 2. The effect of plant density on Yield an yield components of chickpea in experimental condition.

The number of Pods in plant

Effect of different planting densities on a per plant level 1 percent was significant, but the cultivar had no significant effect on the number of pod in plant (Table 3). Chickpea plant based on the average number of reviews under different density, indicated that, with increasing the number of plants per are a unit, the number of pod in per plant decreased (Table 4). With increasing plant density (from 10 to 50 m²) the number of pods in plant rather than densities less decreased because it can be applied to the moisture and food availability for plants in less density. The density of 10 plants per square meter (plant based 45.30) had the highest and a density of 50 plants per square meter plant (16.87) had a minimum. This part of yield components had the prominent role in legume on seed yield capacity. (Aghaalikhani *et al*., 2006). In the low densities, there are no environmental limitations and the plant absorbed the enough light, also water, and food elements and as a result there is more flowering in a plant. On contemporary with the high density, due to the competitiveness of the plant for using food elements, especially for the use of available water, reducing the yield is definitive because photosynthesis transporting from the origin to the destination reduced. (Tawaha *et al*., 2005; Frade *et al*., 2005; Firouzeh, 2006; Biswas *et al*., 2002; Aghaalikhani *et al*., 2006; Imam *et al*., 2003; Fallah, 2008 and Bagheri *et al*., 2000) have reported similar results. Compariso Arman cultivar produced the minimum number of pods relatively and ILC482 produced the most pods in plant (Table 4). ILC482 is an early cultivar with the short productive growth duration and this causes reproductive growth stages of the plant-including flowering with high temperature at the end of the growing season, did not encounter any flowers and plants are loss less, resulting in a number of varieties of this plant will have more. The negative effect of water stress on components yield of chickpea confirmed (Saxena, 1990; Yadav *et al*., 1994; Hall *et al*., 2004 and Leport *et al*., 1999).

The number of Seeds in plant

Analysis of variance table (Table 3) shows the number of seeds per plant effect of plant density on the number of seed in plant in 1% level of probability was significant. But the effect of cultivars and their interaction on this trait was not significant. With increasing plant density per unit area number of seeds per plant was reduced so that the maximum and minimum number of seeds per plant, obtained on the planting density of 10 plants per m² (48.36), and 50 plants/m² (16.58), (Table 4). Because of the reduced number of seeds per plant in 50 plants/m2 density can know on the one hand intensified competition and on each other canopy of plants to each others that the plant makes to increase maintenance respiration and less material transfer photosynthesis to grain. On the other hand, due to less production in a plant, number of seeds in a plant rather than less density is reduced. (Goldani, 1997; Mohamadi, 1999; Bagheri *et al*., 2000; Boquet, 1990; Watt *et al*., 1992) are also done during the investigation because of high density, number of seeds in a plant decreased. The mean comparison table (Table 4) indicated that ILC482 (32.52) is the highest and Hashem (28.62) is the lowest number of seeds in a plant. The number of seeds in a plant has the close relations ship with number of pods in a plant. Therefore, the genotypes that have few numbers of pods have few numbers of seeds. Because generally there is a seed in each pod and due to fewer abortions will be and contrariwise, the plants that have many pods will have also of seeds (Bagheri *et al.*, 2000 and Hegazi, 1995).

Number of seeds in the pod

The results of analysis of variance (Table 3) showed that the number of seeds in the pod was not affected on sowing density and was not significant. In the present experiment due to near the density levels is an important impact, these factors didn't have important impact. The effect of cultivars on number of pods in the plant is not significant too. But ILC482 with (1.16) relatively produced the most number of seed in between rather than the other cultivars. (Table 4). The different density of plant density of 50 per square meter had minimum density and 30 plants in per m^2 had the maximum number of seeds in the pod (Table 4). In the studies Jafroudi *et al.*, (2002) and Frade *et al.*, (2005) similar results have been reported. They said that seed number changes in the pod, less influenced by environmental factors and this trait more controlled by genetic factors. On the one hand Tawha *et al.*, (2005) and Hayat *et al.*, (2003) were reported with increasing density, due to increased competition, reduced the number of seeds in the pod. In the low density with an increase in photosynthesis by plants and with providing photosynthesis material, pods had greater seed production potential and on the other hand, due to the formation of pods in lower height, probably environmental stress will have the less effect on the number of seeds in the plant (Boquet, 1990) as well as a similar report has to offer. Mutual effects of cultivars and plant density also had no significant impact on the number of seeds in the pod (Table 3).

100- Seed weight

The effect of cultivar and the effect of plant density on seed weight were showed the significant difference (Table 3). With the increasing density from 10 to 50 plants, seed weight in per square meter (declined) decreased from 33.42 to 29.84 gr (Table 4). In high density due to an increase in the number of plants in per area unit, the rate of transpiration in plants can be increased that this would be because the plant is exposed to more humid stress and photosynthetic rate strongly reduced, As a result, plant faced to reduce of photosynthesis material to the seed and 100 seed weight decreased. However, in high density in spite of high humidity discharge, due to have few pods and based on physiological purposes, seed weight. Did not decrease strongly Fallah *et al.*, (2005); Leport, (1999) and Ehsanzedeh, (1999) in their reviews on the chickpea were observed with increasing plant density, seed weight reduced.

The results of the data average comparison showed that and the leat of late spring had the less 100 seed weight (Table 4). Where Arman (30.15) compared to the ILC482 and Hashem respectively with 28.23 and 26.18 gr in per square meter had the most of 100-seed weight. Arman based on having fewer pods in per plant and seeds in per plant than Hashem, it seems that the competitions among its pods were not more, resulting in photosynthesis materials assigned move favorable to the seed. While in ILC482, as a result of a large number of pods in the plant and in testified competition between them, 100 seed weight partly reduced. Hashem cultivar because of being delayed and facing with seed filling period with moisture stress and the heat of late spring had the less 100 seed weight. These results are similar to reports of Yousefi *et al.*, (1997).

Economic yield

Effect of plant density on seed yield at 5% level was significant (Table 3). The maximum grain yield obtained (1033.1 kg/h) with a density of 40 plants m^2, respectively, with the highest planting density had the significant difference so that the density of 50 plants per m^2, reduced seed yield (908.2 kg/h) (Table 4). Increasing the plant density to the definite level, increased the seed yield in the surface area was not increased the seed yield, but also reduced the seed yield and most of it not only. Similar results in this case by (Frad *et al*., 2005; Bagheri *et al*., 2000; Purcel *et al*., 2002 and Dhanjal *et al*., 2001). Were reported the density of 30 plants per square meter due to the use of plant growth, to environmental factors could produce more seed yield. But in the higher density creates competition between life forms and reproductive organs decreased seed yield compared to less density. (Torabi moghadam *et al*., 2005; Imam *et al*., 2004; Khademhamzeh *et al*., 2004 and Boquet, 1990) also have such results. The results of variance analysis of experiment showed that (Table 2) between the studied, in terms of seed yield were significant at the 5% level. The superiority of seed yield genotypes ILC482 (1011.2) compared to Hashem (983.28) and Arman (961.8) was significant (Table 4). The causes of the superiority of ILC482 were more pod production, higher seed 100-weight, and high drought mutter, at the same time the relative earliness. As well as more leaf area index covered the spaces between the rows and used the better of solar radiation. Earliness trait in dry land was made areas flowering time and making pods were not at peak time sync with the heat and this respect ILC482 has been the advantage. The report (Bagheri *et al*., 2000; Berger *et al*., 2006 and Falah *et al*., 2005) confirms the above results. Meanwhile, the seed yield is not affected by the interaction of the cultivar and density and did not show significant differences (Table 3).

Biological yield

As shown in table 3 and cultivar effect and effect of plant density on biological yield at 1%. Is significant at a density of 50 plants per square meter (3317.4 kg/h) was produced the most drought matter and at a density of 10 plants per m^2 (2621.4 kg/h) was produced the lowest biological yield (Table 4). (Isik *et al*., 1997) with different density report that with increasing plant density, plant single weight is reduced, however, due to the increasing number of plants in per surface area and, biological yield increased that is consistent with the results of this research. As well as the findings of a similar survey results report (Ayaz *et al*., 2004) on the legume of seeds. Increasing in total drought matter production at harvest by decreasing the distance between rows, could be related to increase in the number of plants in surface unit and increased drought matter in surface unit (Jafroudi *et al*., 2002). The results of average comparing showed that among the different the maximum rate of genotypes Hashem (3224.3 kg/ha), and the lowest yield related to Arman (2835.2 gr/m^2). Hashem cultivar probably due to be delayed, prolongation of flowering period, rather high height and more leaf area index had the most physiological yield than the other genotypes, because of had the most opportunity to get more light and the most drought matter production. Ayaz *et al*., (2004) and Bagheri *et al*., (1997) have provided similar reports. In the meantime the mutual effects of cultivars and plant density had no significant effect on the biological yield (Table 3).

Harvest Index

Chickpea harvest index among cultivars and different sowing densities showed significant differences in the level of 5 percent and 1 percent. But the interaction of cultivars and sowing density was not significant (Table 3). The results of this study showed that the highest and lowest percentage of harvest index respectively with 33.17 of 35.32 amounts related to ILC482 and Hashem, respectively (Table 4). Hashem cultivar due to more growing period duration of leaf area index and more number of secondary branches used better the existing resources period duration of specially humidity and radiation and with more photosynthesis transportation to the seed will increase harvest index (Imam *et al*., 2004). Youself *et al*., (1997) also reported their cultivars in terms of the biological yield had significant differences. As well as by increasing the density, percentage of harvest index is reduced. In high density due to the severe competition of plant for the productivity of the growth factors such as radiation absorption during the agricultural season will be. In these circumstances probably more photosynthesis materials to spend growing growth and produced the stem and building tissues to reproductive organ, so the contribution of each seed of photosynthesis material production decrease and thus the harvest index reduced. In low density happened conversely. Researchers such as Seddique *et al.*, (1986) and Imam *et al.*, (2004) in their research reports emphasized on above cases. One of the reasons for the low harvest index in higher densities, low reproductive components share in sub branches for effect of canopy and reducing the growth in production has been reported (Raey *et al*, 2007). Arman the different densities, the highest leaf area index corresponds to a density of 10 plants per m^2 (36.16) and the lowest were related to the density of 50 plants per square meter (26.38%), respectively (table 4). This results concord with the findings of the (Barary *et al.*, 2003). Meanwhile, Thompson and Martin, (1995) as well as during a study on the plant showed that by increasing the density of transfer once of carbohydrates to the tank at the end of the growing season can be faced with a significant reduction that concord with the results obtained.

Conclusion

The results of the experiment showed that if the chickpea sowing with proper management had a good potential for the production of seed. With the selection of appropriate plant density and reaching the level of appropriate vegetation (low density) while coming down the competition among plants and maximum solar radiation use of a single plant, number of primary branches, the number of secondary branches, number of pods in the plant, number of seeds in the plant, number of seeds in the pod 100 seed weight, and, finally, the percentage of harvest index was at the highest level. But these increases will not be able to compensate, reducing the yield that caused by shortage of number of plants and number of pods in surface area, and be able to use potential maximum potential production. High density causes canopy of plant, solar radiation absorption constraints, reducing photosynthesis and increased transpiration in plants. In among experimental cultivars ILC482 due to the earliness, compliance with environmental conditions and proper use of Earth and environmental factors, particularly rainfall and sunlight improves the yield components, such as, the number of primary branches, secondary branches, number of seeds in the plant, number of seeds in the pod and economic yield, showed the significant superiority. Despite being insignificant interaction density and the cultivar was determined by Duncan experiment ILC482 with 1011.2 kg/h and a density of 30 plants per m^2, which is the best combination were to achieve optimal yield in the Kermanshah region is recommended.

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