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***Research Article***

# EFFECT OF PLANTING DATE, PLANT DENSITY AND CULTIVAR ON YIELD COMPONENT OF BEAN (*VIGNA SINENSIS* L.) IN DIFFERENT REGION OF KHUZESTAN STATE, IRAN

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## ABSTRACT
In order to evaluation of planting date, plant density and cultivar on yield and yield component phonological stages and growth trends of bean (Vigna sinensise L.) an factorial stripe block experiment was carried out based on completely randomized block design in for replication in summer 2011 in safi-abad region. Treatments were planting date at 3 levels (T1=June 8, T2= June 22 and T3= July 7), as stripe blocks. Plant density (D1= 10, D2= 13.3, D3= 20 and D4= 40 plant m-2) and two cultivars (V1= Kamran and V2= Mashhad) as factorial sub plat. Traits were: grain yield, yield components, biological yield, harvest index, duration of germination, emergence 6th leaf, 12th leaf, flowering, pudding, ripening and growth trends. Results showed that except growth trends, type of cultivar had not significant effects on traits. In other hand, kamran and mashhad cultivars had the same growth and production. Plant density had significant effects on pod per plant, seed weight and grain yield. The highest pod per plant (55). In safi-abad region the kamran and mashhad cultivars are recommended to planting in June 8 and plant density of 20 plant m-2 for highest use efficiency of inputs.

***Keywords***: *Bean, Planting Date, Plant Density, Grain Yield, Yield Components, Phonological*

## INTRODUCTION
Density is other determinant factors of yield. Planting density is depended to several factors such as the features of crop plant and its growth period length, the time and method of planting, soil fertility status, purpose of planting, management practices on farm and harvesting methods (Mazaheri and Majnon, 2005). Proper density is that in that the maximum seed yield is obtained by producing less dry matter (NourMohammadi *et al.*, 2006). Way of distribution and plant density on farm effected on absorption and utilization from effective environmental factors on growth and competition between plants, finally, it is determinant factors of yield (Azari and Khajehpour, 2003; Khajehpour, 1387; Gardiner *et al.*, 2001). Determining optimal density is one of the important factors for achieving to the maximum yield according to the climatic conditions in each region and features of cultivated cultivars (Nourmohammadi *et al.*, 2006). By considering an appropriate density، mutual ghosting reaches to minimum value and receiving light and therefore photosynthesis reaches to its maximum value (Sarmadiyan and Kochaki, 1376). Increasing density causes to reduce light passing through the low parts of the plant community and most plants compete for receiving light causes to reach faster aging and to fall. This includes a reduction in leaf area (Talebian, 1993).
Mathews *et al.*, (2008) believe that density plant is the determinant factor in plant growth and dry matter accumulation. In conducted research on bean, it is observed that light penetration into the canopy is inadequate and inappropriate by increasing density intense and thus making photoassimilate in each plant is dropped and the number of filled seed per plant decreases which may result in reducing yield. However, the low number of plants per unit area results not to use maximum as producing potential and causes to decrease crop growth rate. The reviews of different research results is inferred that the components of yield are independent of each other and increasing one part often cause to decrease in one of the other components. In general, the number of reproductive units per each plant is decreased by increasing number of plants per unit area. Weight of each plant is reduced by increasing the number of seeds per reproductive unit. This means that to achieve a desired yield, all independent components

compared to each other must be well balanced. Yield components were not independent of each other and changes in one, will follow compensatory effects of other components. Therefore, understanding the relationship between yield components in crop plants and outcome in relation to the yield of the final product is so sensitive and it has great important. Yield of bean seed is function of different physiological activities and the highest yield is achieved when yield components such as: number of pods per plant، number of seeds per pod and seed weight are at the maximum level but due to competition, correlations between some of the yield components are negative.
Shirtlif and Johnston (2002) and Rosalind *et al.,* (2000) respectively reported about beans and soya beans that weight of hundred seed did not change by changing planting density. But Hayat and colleagues (2003) reported that weight of hundred seed in soybean and mungbean is affected by planting density. Talei and colleagues (2000) reported a lack effects on different densities of planting on seed number per pod during the research on wax bean.

However, during studies on mungbean and other legumes, Hayat and colleagues (2003) and Ayaz and colleagues (2001) reported that the number of seed per pod is changed by changing the density of planting and increasing density is caused to reduce the number of seeds per pod. According to Zaffaroni and Schneiter (1991) increasing competition in high densities relatively effects the seed yield more than biological yield and harvest index decreased. Elahiyari (1998) in a two-year field study in a Ardebil on cowpea stated the highest seed yield (2.85 tons per hecatre) on space of 15 cm row in compared with other intervals (10,20,25 cm) is obtained 29005. The bean of Iran has high genetic diversity in term of qualitative and quantitative traits. Given the importance of genetic diversity in reforming of plants and expanding the cultivation and production of beans, understanding the genetic potential of this plant is very important.

The use of improved cultivars causes to increase crop yields or to increase yield per unit area. Choose appropriate cultivar adapted to climatic conditions in each region and determine the appropriate density is important factors in achieving high yield. Bean genotypes affected by environmental conditions for one part of yield may be different. The amount of dry matter accumulation in seed is affected by planting date, genotype and their interactions. By delay in planting because of change in photoperiod، moisture stress and competition and competition, plant size is changed. Singh in 1999 stated that the bean yield is decreased 72 kg per hectare for each reduction in growing period day in length of maturity and increasing number of days for maturity cause to increase that yield.

Farahmandrad *et al.,* (1999) in a study on the effect of planting date and planting density on cowpea stated the 29005 in Karaj that planting on 14 and 24 June and increasing density to 15 plants per square meter are increased seed yield, so that the maximum yield is obtained on 14 June planting date with 15 plants density per square meter. Mousavi *et al.,* (2005) also showed in study the effect of different planting dates and density of different planting on yield and yield components of normal bean in Khuzestan conditions and the maximum seed yield of seed cultivation is obtained on 18 May planting date and by using 10 cm space on rows.

Also the Moser *et al.,* (2006) stated that the maximum yield is obtained on 10 May planting date and 5 cm space of row by reviews of effect of planting date and density on cowpea density in Ghaem Shahr. Thus the choice of suitable cultivars and compatible with climate،determine the plant density and appropriate planting date are important factors for achieving to high yield. Generally and according to the top reviews, density and genotype has important effect on yield of cowpea, but there is not enough information about their interaction on yield and yield components of cowpea in area conditions.

Due to the growing season cowpea in Khuzestan between wheat harvest to planting it in next crop year therefore, in this period of time could be introduced the plant to the farmers that economic income is followed for them and even lead to more fertile land and it is important that their next wheat harvest that usually due to harvest of corn is delayed, timely is done.

Determining the suitable planting date of cowpea is very important. Due to the importance of this issue and the lack of information، the present study for reviewing the effects of planting date، plant density and number on yield and yield components of this plant was conducted at Agriculture Research Center of Safi Abad.

## MATERIALS AND METHODS

This study was conducted in the summer of 2011 at the Agriculture Research Center of Safi Abad which is located at 18 km from south of the Dezfoul city for one year. Safi Abad Research Center was located at a distance of 120 km from north of Ahvaz with a height of 82 meters above sea level and latitude 32 degrees and 24 minutes north. Generally all the lands of south coasts which have their height are less than 100 meters, has desert climate. Annual average of rainfall in this region is very low amounts and it is very erratic too.

Almost all of the rainfall is occurred in winter and seven months of the year is without rainfall. In order to determine physical and chemical features of soil, after selecting the place of yield testing, soil test part before any land preparation by Agar from the depth of 0-30 cm as 10 points randomly are sampled and physical and chemical features of soil were determined.

Experiment in term of Streep block in the form of randomized complete block design with four replications in which the planting date as the main factor (bar) at three levels (17 June and 1 and 16 July, respectively T1, T2 and T3) the figure in two levels (Kamran and Mashhad respectively V1 and V2) colore of Kanmran cowpea seeds is cream and cord of seeds are brown.

This cultivar is premature and has friendly market. The amount of its yield is approximately 1 to 1.5 tons per hectare in the provinces of North Khorasan, Golestan, East and West Azarbaijan. Mashhad cowpea cultivars are white and quick cooking. Hilum color of seeds of this cultivar is black. Its yield in Golestan province, Markazi and Khorasan is approximately 1.5 ton per hectare. Density at four levels (10, 13.3, 20 and 40 plants per square meter respectively D1, D2, D3 and D4) were considered. Cultivars and plant spacing of 5, 10, 15 and 20 cm on rows respectively D1, D2, D3 and D4 high densities equivalent were considered as a factorial and randomized subplots within each main plot (planting date). Each subplot included 8 lines with 6 m length and 50 cm spaces. Lines 1, 3, 6 and 8 were as margins، lines 4 and 5 were as final harvest.

In all 0.5 meter lines were regarded as margin from top and down. Between subplots were located a Nekasht row and between main bands were located a 2 meter space. Final harvest is done after physiological maturity of lines 4 and 5 for each plot after removing 0.5 meter margins from top and down with 5 meter length which is equal with 5 square meter. Flesh weight of all plants was measured in the field.

To determine the total dry weight (biological function) randomly 15 plants were selected and were fragmented by clipper. Then a sample of 150gr was isolated and then was kept in oven at 75˚C for about 72 hours and sample dry weight was obtained. Finally، biological function per square meter was obtained by using the following equation.

$$TDM = [(BWY \times SDW) .SWW] \div 5$$

To determine the seed yield and yield components، 15 remaining plants were selected and its yield and yield components were measured. Seed yield and weight of single seed were determined after drying seeds in an oven with a temperature of 75˚C for about 72 hours. Raw data was analyzed by SAS statistical program and mean comparisons were made by Duncan method.

## RESULTS AND DISCUSSION

**Table 1: Analysis of variance (mean squares) for yield component of bean**

| S. O. V. | df | Number of Pods per Plant | Number of grain per pod |
|---|---|---|---|
| Region | 1 | 34118.14371$^{**}$ | 1134259.101$^{**}$ |
| Error a | 6 | 45927.634 | 5126338.2 |
| Planting date | 2 | 51698.350$^{**}$ | 9631087.1 $^{ns}$ |
| Planting date × Region | 2 | 32372.111$^{ns}$ | 7702962.2 $^{ns}$ |
| Error b | 12 | 43478.86 | 2595048.2 |
| Cultivars | 1 | 40873.897$^{**}$ | 2025037.15$^{*}$ |
| Density | 3 | 00600.5381$^{**}$ | 8134866.18$^{**}$ |
| Density× Cultivars | 3 | 79136.571$^{**}$ | 6328569.14$^{**}$ |
| Region× Cultivars | 1 | 77511.115$^{ns}$ | 5236148.0 $^{ns}$ |
| Density× Region | 3 | 62725.1704$^{**}$ | 7284866.29$^{**}$ |
| Cultivars×Region× Density | 3 | 81645.497$^{**}$ | 1261903.26$^{**}$ |
| Error c | 42 | 96463.92 | 9075826.2 |
| Planting date× Density | 6 | 60154.127$^{ns}$ | 7581916.9$^{**}$ |
| Planting date× Cultivars | 2 | 19321.44$^{ns}$ | 1027188.15$^{**}$ |
| Planting date× Cultivars× Density | 6 | 28670.126$^{ns}$ | 5486387.6$^{*}$ |
| Region×Planting date× Density | 6 | 09383.64 $^{ns}$ | 4671847.4 $^{ns}$ |
| Region× Planting date× Cultivars× Density | 6 | 86784.109$^{ns}$ | * 8563123.5 |
| Region× Planting date× Cultivars | 2 | 55480.48$^{**}$ | 4558091.7$^{*}$ |
| Error d | 84 | 47363.69 | 4055760.2 |
| CV(%) | - | 92.31 | 03.19 |

*ns: non significant,* ,** : respectively significant (p≤0.05) and highly significant (p≤0.01)*

**Table 2: mean comparison of yield component**

| Treatment | Number of Pods per Plant | Number of grain per pod |
|---|---|---|
| | **Region** | |
| Safi-Abad | 76.34 a | 87.8 a |
| Molasani | 45.17 b | 42.7 b |
| | **Planting date** | |
| 17.3.90 | 45.28 a | 29.8 a |
| 1.4.90 | 11.26 ab | 21.8 a |
| 16.4.90 | 77.23 b | 95.7 a |
| | **Cultivars** | |
| Mashhad | 27.28 a | 87.7 b |
| Kamran | 95.23 b | 43.8 a |
| | **Density** | |
| 10 | 09.41 a | 05.9 a |
| 3.13 | 75.25 b | 78.7 b |
| 20 | 37.20 c | 69.7 b |
| 40 | 23.17 c | 08.8 b |
| Total Mean | 11.26 | 15.8 |

Mean followed by the same letters in each column are not significantly different by using Duncan multiple rang test at %5 probability level are not significantly different by using Duncan multiple rang test at %5 probability level.

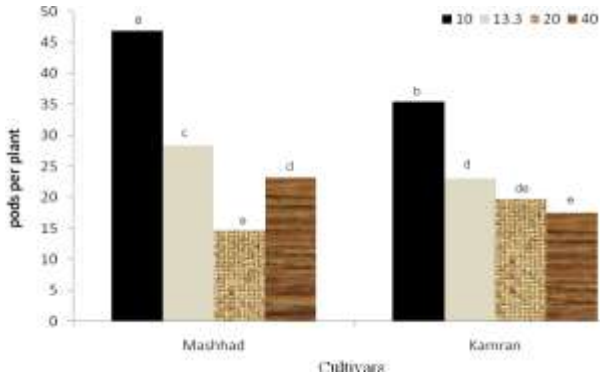


**Figure 1: Effect of Density and Cultivars in The Number of pods per plant**

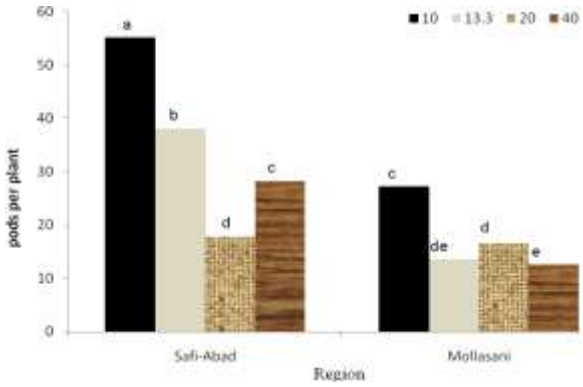


**Figure 2: Effect of Density and Region in The Number of pods per plant**

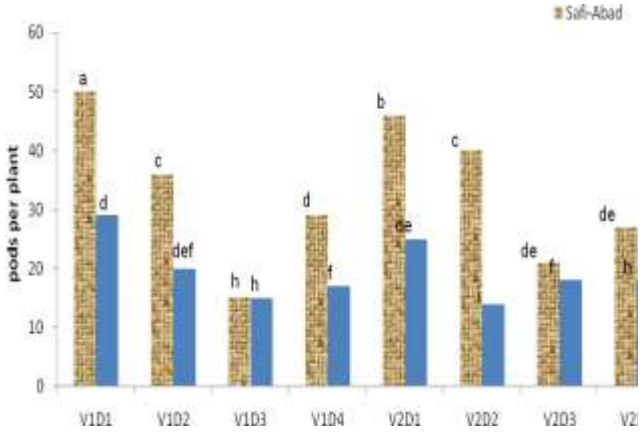


**Figure 3: Effect of Density, Region and Cultivars in The Number of pods per plant**

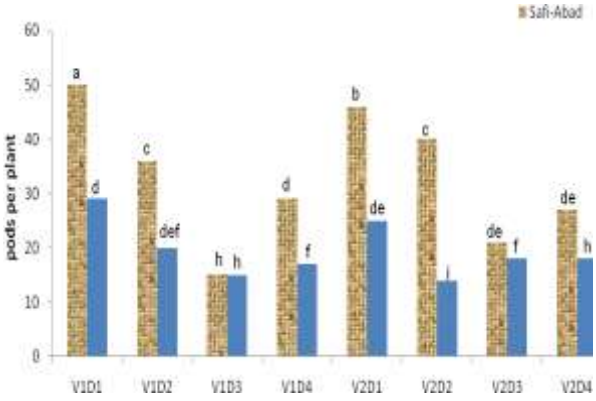


**Figure 4: Effect of Density, Planting date and Region in The Number of pods per plant**

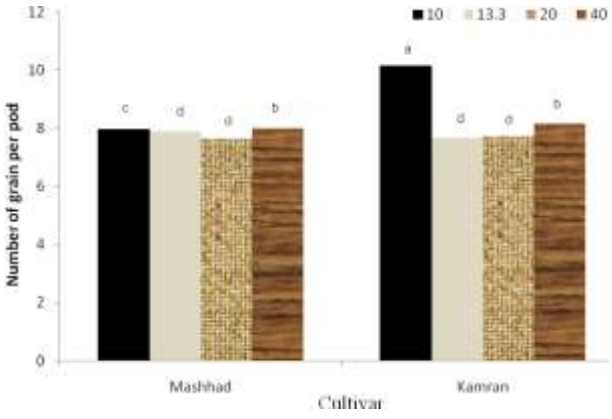


**Figure 5: Effect of Density and Cultivars in The Number of grain per pod**

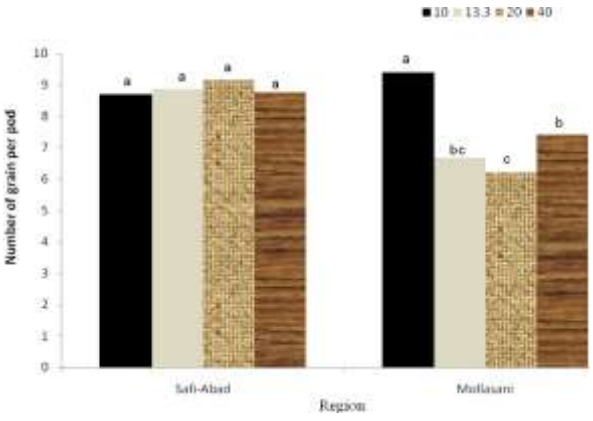


**Figure 6: Effect of Density and Region in The Number of grain per pod**

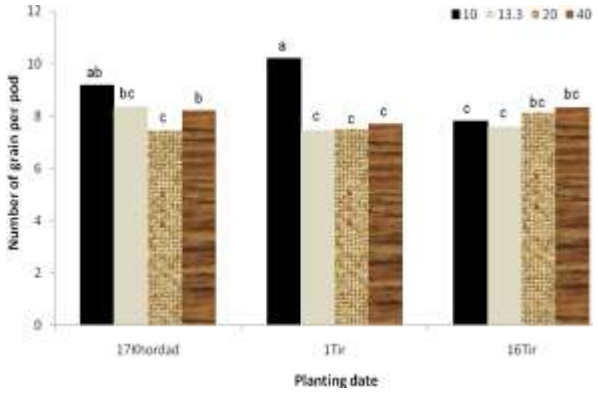


**Figure 7: Effect of Density and Planting date in The Number of grain per pod**

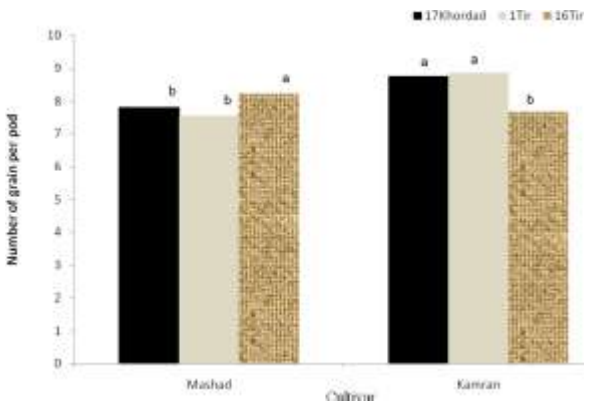


**Figure 8: Effect of Cultivars and Planting date in The Number of grain per pod**

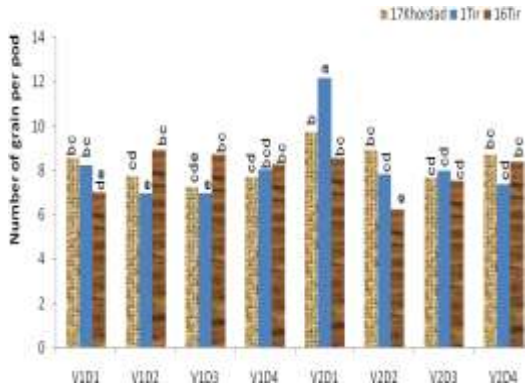


**Figure 9: Effect of Cultivars, density and Planting date in The Number of grain per pod**

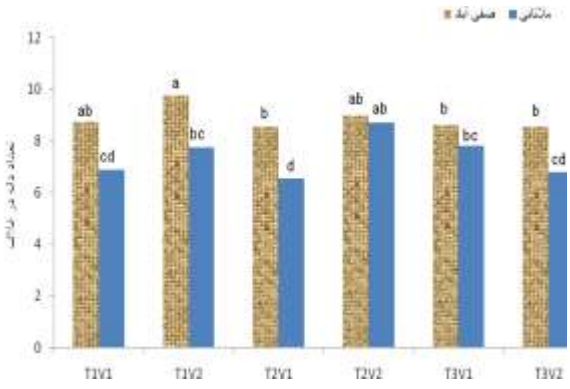


**Figure 10: Effect of Cultivars, Planting date and Region in The Number of grain per pod**

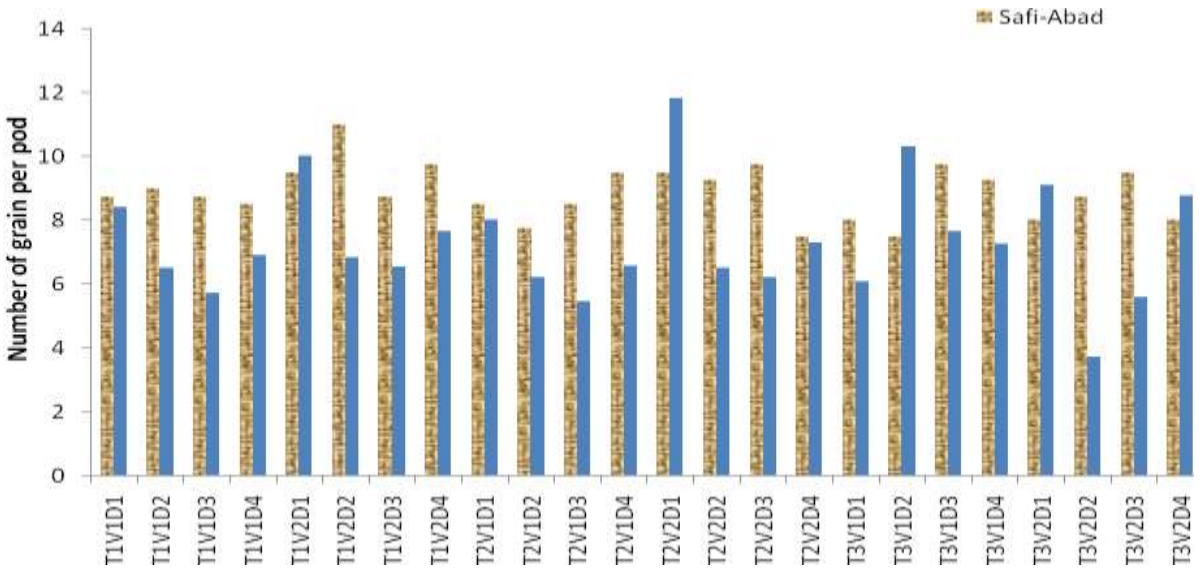


**Figure 11: Effect of Cultivars, Region, density and Planting date in The Number of grain per pod**

***Results***

***Yield Component***

***Number of Pods per Plant***

Area, planting date, cultivar and plant density had affected on number of pods per plant in the significant level. In comparison of regions, the maximum number of pods per plant was obtained for Safi Abad region. The maximum number of pods per plant was obtained in seventeenth of June of planting date and the minimum number of pods per plant was obtained by one month delaying (sixteenth of July). Ariyana and colleagues (1398) and Nakhzari and Ramroudi (1381) also stated that delayed in planting causes to reduce the number pods per plant respectively in Mungbean and Lentils. Mashhad cultivar in comparison with Kamran had high number of pods per plant. In relation to the density, the maximum number of pods per plant was obtained in 10plants per square meter density and 58% reduction was reached to 23.17% by increasing 40plants per square meter density. NakhzariMoghadam (1379) reported that number of branches per safflower plant. In general, number of reproductive unit per plant reduced by increasing number of plant per unit area (Stockkof, 1375; Fajeriya, 1374).

***The Interaction of Cultivar and Plant Density on Number of Pods per Plant***

The interaction of cultivar and plant density of 1%probability level had affected on number of pods per plant. According to Figure1-4, it is observed that the maximum number of pods per plant is belonged with Mashhad cultivar and 10plats per square meter density. Also reduction intensity of number of pods per plant is more intense by increasing plant density for Mashhad cultivar. Observations have shown that showed different cultivars responded in terms of plant density. In this regard Khajeh (1387) reported that bean genotypes affects can be different in environmental conditions for a component.

***Interactive Effects of Plant Density on Number of Pods per Plant***

The number of pods per plant was affected by interactions of region and plant density significantly. According to Figure 2-4, it is observed that in different regions number of pods per plant and also reduction intensity are different by increasing plant density. It shows that bean shows different interactions to plant density in different environmental conditions. This similar reaction is reaction of number of pods per plant to interactions of cultivar and plant density.

***Interactions of Region, Cultivar and Plant Density on Number of Pods per Plant***

Interactions of region, cultivar and plant density affected the number of pods per plant significantly. According to Figure 3-4, it is observed that reduction intensity and process of changes of pods per plant are different in different region for cultivars and increasing plant density. The maximum number of pods per plant was obtained for Safi Abad region, Mashhad cultivar and 10plants per square meter density. The minimum number also was obtained in Safi Abad region by 20 plants per square meter density for both Mashhad and Kamran cultivar. As can be seen from the number of pods per plant was affected by effects of cultivar types and plant density and region and plant density. Triple interactions affected the pods per plant and it indicates that affection of number of pods per plant is different in different cultivars, regions and densities.

***Interactions of Region, Planting Date and Cultivar on Number of Pods per Plant***

Number of pods per plant was affected by interactions of region, planting date and cultivar significantly. In Safi Abad region, in first and second date of planting, Mashhad cultivar had non-significant excellence in comparison with Kamran cultivar while in the last level of planting date (sixteenth of July) this excellence became significant. Mashhad cultivar in comparison with Kamran cultivar had significant and homology excellence for all planting dates. In other words, Kamran cultivar in comparison with Mashhad cultivar was produced number of pods per low plants in Malasani condition in all of the planting dates.

***Number of Pods per Plant***

***Individual Effects of Treatments on the Number of Seeds per Pod***

Region, cultivar and plant density respectively had high significant, significant and high significant on number of seeds per pods. In Safi Abad region in comparison with Malasani, number of seed per pods was obtained more. Seventeenth of June until sixteenth of July with one delayed month for planting number of seed per pod had non-significant 4%reduction. Kamran cultivar (43.8) in comparison with

Mashhad cultivar (87.7) had more number of seed per pods. The maximum number of seed per pods (05.9) was obtained for minimum density (10plans per square meter) that had significant difference in comparison with higher densities.

***The Interactions of Cultivar and Plant Density on Number of Seed per Pods***

Interactions of cultivar and plant density had significant effects on number of seed per pods. The maximum number of seed per pods was obtained for Kamran cultivar and in 10plants per square meter density.

***Interactions of Region and Plant Density on Number of Seed per Pods***

Interactions of region and plant density had significant effects on number of seed per pods. In Safi Abad region, there was no change in number of seed per pods by increasing plant density. While in the Malasani region, the maximum number of seed per pod was obtained in 10plants per square meter density and the number of seed per pods was reduced by increasing plant density.

***Interactions of Planting Date and Plant Density on Number of Seed per Pods***

Number of seed per pods in the 1% probability level was affected by interactions of planting date and plant density. In planting dates of seventeenth of June and first of July number of seed reduced by increasing plant density. While in the planting date of sixteenth of July number of seed per pods remained stable by increasing plant density.

***Interactions of Planting Date and Cultivar on Number of Seed per Pods***

Number of seed per pods was affected by interactions of planting date and cultivar significantly. Number of seed per pods increased by delay for Mashhad cultivar; while number of seed per pods reduced by delay for Kamran cultivar.

***Interactions of Region, Cultivar and Plant Density on Number of Seed per Pods***

Number of seed per pods was affected by interactions of region, cultivar and plant density significantly. In Safi Abad region, increasing plant density had no effects on number of seed per pods for Mashhad and Kamran cultivars. While in Malasani region number of seed per pods of both cultivars had reduction and significant process by increasing plant density.

***Interactions of Planting Date, Cultivar and Plant Density***

Interactions of planting date, cultivar and plant density had significant effects on number of seed per pods. The maximum number of seed per pods was seen in second planting date and first density level for Kamran cultivar.

***Interactions of Region, Planting Date and Cultivar on Number of Seed per Pods***

Interactions of region, planting date and cultivar had significant effects on number of seed per pods. According to Diagram11-4 Kamran cultivar in comparison with Mashhad cultivar in first and second planting dates in both Safi Abad and Malasani regions had high number of seed per pods; but in third planting date of Mashhad cultivar had relatively low excellence in comparison with Kamran cultivar.

***Interactions of Region, Planting Date, Cultivar and Plant Density on Number of Seed per Pods***

Quad interactions were significant on number of seed per pods. On Malasani condition only increasing and then decreasing process was seen on number of seed per pods for Mashhad cultivar in planting date of sixteenth of July by increasing plant density.

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