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Evaluating the effect of plant density and planting formation on yield and yield components of pinto bean (cos16 line)

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Abstract

In order to evaluate the effect of plant density and planting formation on some quantitative characteristics of wax been named Line cos16, we generated this research in the form of fragmented patches in totally random plots and in three stages, on the agricultural and natural resource research station of Boroujerd in agricultural year 2008-2009. In this research the main 3 service patches with row distances of 25, 50 and 75 cm are illustrated with the sign A1, A2 and A3 consequently, and the side 3service density patches with 30, 40 and 50 bushes are showed with the sighs B1, B2 and B3 consequently. After analyzing the soil, the field was plowed and in the day 20 April the operations of disking, lolering, paddling and cultivations were performed, subsequently. The amount of fertilizer was determined according to the soil analysis. In order to kill weeds, we used 2liters of terfelan ca kind of herbicidal per hectare. In the growth progress we used pesticides, too. After harvesting, some characteristics such as the number of marginal branches, the length of sheathes bean number in a sheath, one hundred beans weight, biologic performance and the bean function, were evaluated. The experiment result showed that the difference between bean functions in mid-row distances in a hectare, and various densities in 5% possibility scale was very significant. And the maximal production in field scale was obtained in the farthest mid-row distances and highest density (i.e. B3)

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Introduction

According to studies, a proper combination of grain and corn's protein can obviate the Amino acid's shortage and poor nutrition. Otherwise, regarding the azote stabilization potency in plants, putting them in agricultural cycle can aid the stability of forming systems (Torabi jafrodi, 2007). A wax been named spotted bean or pinto bean (with the scientific name, Phaseou Vulgaris var.) is the most important number of grain family. Because of high protein percentage and other desired agricultural characteristics, it allocated the largest under cultivation area to itself (Majnoun Hoseyni, 1993). Based on the studies, a proper combination of grain and corn's protein can obviate the Amino acid's shortage and poor nutrition. Otherwise, regarding the azote stabilization potency in plants, putting them in agricultural cycle can aid the stability of farming systems (Bagheri *et al*, 2001). Increasing the production of farming products is possible in two ways: increasing the under-cultivation area and the enhancement of operation in the surface unit. Because of the limited talented and cultivatable lands and inappropriateness of climatic conditions, since we should inevitability, try to enhance the performance in surface unite which is the main goal in agriculture.

These factors can cause growth and performance changes in pinto bean. Among them the bean density and planting formation are two main factors for performance enhance. The desired plant density, is a density which cause total use of environmental factors including water, light, nutrition materials and soil, and at the same time, the in-bush and out-bush competition are minimal that gives maximal performance (Khajepour, 2000). Moreover, the formation of bushes inside a specific density is important, in the manner that placing a desired density of healthy bushes in the most suitable bush arrangement model is the base of a successful system of agricultural production. We can change the arrangement of the bushes or their geometrical condition by altering the row width or the distance between the bushes on the rows (Ghanbari and Taheri mazandarani, 2003).

Fallah in 2007 evaluated the effect of date and planting density on the characteristics of farming pea and concluded that the less sheath in bush is acquired from the highest density in bushes, in a way that with increasing the density from 18 to 36 bushes in every matter, the number of seeds reaches from 1.24 to 1.16 in every sheath. Furthermore, he demonstrated that the effect of plant density weight on 100 seeds per 1% surface means the minimal weight of 100 seeds concerns the highest density of bushes. Batery (1996) stated that one of the reasons for the sheath reduction in every plant in high density is the increasement of sheath less marginal branches. Ghanbari and Taheri mazandarani (2003) in Khomein national station of been researches also evaluated and defined the most suitable date of planting and density of bushes for wax been and concluded that there is a significant difference between the number of sheath in bushes, the number of seed in bushes, weigh of one hundred seed and the seed performance among various densities. The maximal number of sheathes and seeds in bushes and also weight of 100 seeds, besides the number of sheaths in a bush and the number of sheath in a sheaths, is a main factor for increasing the bean performance. Herbert and his colleges reported that: the number of sheath and number seed has the dominant role in the performance degree of black-eyed pea and their number managing fully reduces after the increasement in density. The performance of seed relates to its characteristics involving the number of sheath in a bush, number of seed in a sheath and the seed weight. When the product of these parameters is the maximum quantity, then the highest performance is achieved. The capacity of retrieving performance parts, because of intra-plant competition for metabolically and food materials prevents severe changes in performance. (Westerman and Crothers ,1997). The researches of Mousavi *et al* (2005) showed that after the increasement in planting density of beans from 20 bushes to 40 bushes, the seed might was increased and Biologic and seed performance was multiplied because of increasement in the number bushes in unit of surface. The main reason to do this research was to evaluated the effect of plant density and planting formation on

performance characteristics of a wax been named Line cos16, on the agricultural and natural resource research station of Boroujerd to identify the optimal density and planting formation in this region using the findings of this research.

Materials and methods

Material

This research was generated in April of 2008 in project farms of agricultural research station of Boroujerd placed at the 18 kilometers to east Boroujerd with 34 degree of northern latitude and 48.5 degrees of eastern longitude and 1476 mater altitude from the see level. The mean yearly rainfall is 500 mm and the maximal 24-hour raining for a 10-year period is 83 mm and 91 mm for a 5-year period. Ambrotermic meteorology diagram of Boroujerd in farming year 2007-2008

The samples were taken from the depth 0 to 30cm of the soil and in order to analyze them, they were sent to Boroujerd soil laboratory.

Methods

This research was generated in agricultural research station of Boroujerd in the form of spitted plot with 3 stages of totally random blocks based on two factors. (I.e. the distance between rows and plant density) in 6 months interval in the farming year 2008. This research used the densities of 30,40,50 bushes per a square meter and the distances of 25, 50 and 75cm between rows to determine the best density as well as the distance between rows. In this project, the distance between the rows was arranged in main plots and the plant density was arranged in lateral plots. Three stages of row distances were illustrated with signees A1, A2 and A3, and three stages of plant density were showed by signees B1, B2 and B3. Every experimental Pluto consisted of 7 lines which were 6 meters long, and a line was calculated as the transplant line between 2 lines. The fertilizer use instruction contains 50 kilograms of urea per hectare, 100 kilograms of super phosphate and 100 kilos of potassium sulfate per hectare which were spreader throughout the farm land before disk and loller operation. Irrigation was done every 4 days before the positioning plantlets and every 8 days after the plantlets positioning. The weed killing method was performed based on the farm necessities (i.e. chemical, mechanical or human weed-killing complain). Furthermore, in order to encounter pestilences during the growth time, we used 1.5 liters of Diagnosing in 1000 liters of water for two occasions and daintily for one time to get sample from every experimental patch involving 7 planting lines, we omitted two marginal lines and then crossed 0.5 meter of line edges (top and down) of the rest 5 mid-lines , and then we took samples from these 1*1 meter plots regarding the plant distances on the rows and between them. Sampling is generally taken from mid-lines because of the lowest marginal effect. In every sampling, 5 or 10 bushes are chosen and the required measuring performs over them. The under-evaluation characteristics involve the number of marginal branches, number of nodes on stalks, sheath length, the amount of seeds in a sheath, Biologic performance and the seed performance in every hectare. In order to statistical analysis of data we used the version 9.1 of SAS software and also to depict diagrams and charts we took the advantage of excel 2007. Furthermore, the comparison of means was done in a 0.05 scale using the DUNCAN method.

Results and discussion

Number of marginal branches in a bush

The results from variance analysis table (table 2) and the table of means analogy (table 3) showed that the distance between the rows didn't have significant influence on the number of marginal branches. Furthermore, density didn't have much influence on this factor, too. The reduction of distance between rows and the distance of bushes caused the reduction of sheath-giver marginal branch, and also the reduction of sheath number in the plant. Besides, the density increasement due to the reduction of row distances and bush distances prevent the solar light to reach the down parts of the plant and consequently the phenomenon causes the reduction of fecund sheath in that parts of the plant.

Table 1. Chemical composition and food value of wax been (Majnoun Hoseyni, 1993).

Seed kind	Water percentage	Protein percentage	Fat percentage	Hydrocarbon percentage	Fiber percentage	Ash percentage
Green seed	66.5	7.5	0.8	22	1.5	1.7
Dry seed	11	22	1.6	8.57	0.4	3.6

Sheath length

Results from variance analysis table (table 2) and the table of mean analogy (table 3) showed that the distance between the rows didn't have a significant effect on the sheath length in 5% level. So that, the maximal sheath length belonged to the distance between the row (A3) with 10.67cm length, and the minimal length belonged to the row (A2) with 10.16cm length. The density also didn't have much influence on the sheath length factor. Furthermore, the results showed that the two-way effect of distance between rows and density didn't influence the sheath length in 1% level, effectively. In a way that, the maximal length was 10.88cm and belonged to the distance between row A1 and density B3, and the minimal length was 9.67cm belonged to the distance between row A2 and density B2.

Number of seed in a sheath

Results from variance analysis table (table 2) and the table of mean analogy (table 3) illustrated that the distance between rows and density didn't influence on the number of seed in a sheath, significantly.

In addition, mutual impact of the distance between rows and density on the number of seeds in a sheath is not significant. If a grain such as can be quickly increased or decreased. Albeit in this crop the seed number in sheath, is less influence by the environmental conditions. It is because; in lower densities there is not any competition in primitive stages. Hence there emerge much number of flower-breeding cellules and parallel to growth boom, the competition exceeds. Therefore, in the seed-filling stage the photosynthesis elements will become insufficient and this causes the stillborn of many flowers. So, in lower density, the number of seeds and seed weight drops but in desirable densities the plant is able to provide photosynthesis elements because the number of seeds is based on the generated competition. The result of this research is similar to finding of Ghanbari and Taheri mazandarani (2003). They stated that, the number of seed in a sheath is not influenced by planting arrangement, but this character is mostly controlled by genetics.

Table 2. The results of soil analysis of the performance station.

Soil texture	The percentage of soil texture parts	Total fluid materials in TDS extract	PH	Electrical direction capability EC
Slit-loam	Sand slit clay	Mg/L	___	ds/m
	26% 50% 24%	217.6	8.15	0.34

Weight of one hundred seeds

The results of above-mentioned tables showed that the influence of distance between rows and influence of density on the weight of one hundred seeds is not significant, but the effect of density on 100 seeds is meaningful. Accordingly, the maximal weight belongs to density B2 and was 38.38 grams, and the minimal weight related to the density on the weight of 100 seeds is not meaningful. Plants try and compete each other to gain the elements of spatial and earthen environment. Parallel to the expansion of least surface, the leafs of neighbor bushes began overlapping and competing for light. In cases that shadow casting is reciprocal, this condition results in an incompetent leaf system and the leafs under the umbrella perform in a reduced level of photosynthesis. So, when choosing a right density and arrangement of the bush for the plant, it is important

to count the competition for light because the higher density results in lower weight of 100 seeds. In higher densities, the amount of nutrition factors distributed to a bush is lower and this influences on the weight of 100 seeds. Various researches, including Herbert and Bugerman (1983); Sperent *et al.*, (1997); Stotozel and Aufhammer, (1991); Fallah, (2007), have proved this results with the increasement in density, the size of been decreases. Kahrarian (2002) concluded that in lower densities the competition between plants decreases and more photosynthesis substances was at the hand of every seed and consequently the seed might increase, but this is incompatible with our results. This is because, in inappropriate densities a severe competition establishes between bushes and consequently the plant confronts source limitation and cannot provide photosynthetic factors for generated storages. This issue causes vacuity and the production of low-weight seeds. Therefore, in the competition created for photosynthetic materials inside germinates and generative organs, the germinates organs absorb photosynthetic materials because of dominance in competition and subsequently the seed performance and weight of 100 seeds drops down.

Table 3. Number of seed in a sheath.

classification	Total toughness water	SAR	Cautions and Anions								Total fluid material in TDS extract	pH	Electrical direction capacity EC Micro mouse
			Magnesium	Calcium	Sulfate	Calcium+ Magnesium	Sodium	Claire	Bicarbonate	Carbonate	Mg/L	-	Umohs/com
Tough half	218.83	0.384	1.7	2.7	0.0	4.4	0.57	2.3	0.7	0.0	350.29	8.02	547.33

Biologic performance per hectare

Results from table 2 and table3 showed that the influence of distance between rows on Biologic performance per hectare is not expressive and the influence of density on Biologic performance in 5% level is significant, in a way that that the maximal Biologic performance was 10336.6 kilogram per hectare and belonged to density B3 and the minimal Biologic performance belonged to density B1 with 7753.6 kilogram per hectare. With the increasement of plant density, the Biologic performance increases to same levels. But if some limitation, such as Nutrition shortage and low space for growth and also overlapping of bush shadows, emerges then the performance reduces gradually. Moreover, the mutual effect of distance between rows and density on Biologic performance per hectare in 1% level is significant, in a mummer that the maximal Biologic performance belongs to the distance between row A3 and density B1 with 6932 kilogram per hectare. The performance of whole produced dry material due to the proficiency of plant society in using the solar light along the germinates season. Connected to this issue, the plant society need appropriate leaf surface which is distributed equally and covers the ground thoroughly. This goal is achievable with changing the plant density and suitable distribution of bush on the ground. So, one of the important roles of farm manager is choosing appropriate plant density in order to absorb maximal such light. Sun light, humidity, soil fertility are environmental factors which influence the desirable plant density to function. |If the density is very low then all the total potential production is not achieved, and if it is very high, then the sever competition between plants especially because of high humidity tension, total productivity reduces. Then, based on the diagrams, we demonstrate that after the increasement of

bushes, the Biologic performance increases. Along with the increasement of plant density in germinates organs of plant, the competition for reaching the nutrition factors and light increases and as a result the generative organs' size increases. Hence, after the increasement of generative and germinates organs' size, so- called stalk and seed, the Biologic performance of plant increases. When evaluating the weight of one bush we saw that after the increasement of density the weight of one bush decreases. This is due to the competition and lower availability of nutrition factors. But because of increasement in bush number in surface level we perceived that finally the weight of bushes increases. This subject is compatible with the results of some researchers such as: Abdi (2009), Dhanjal (2001).

Table 4. results of analysis in Bloke and Raw distance

	df	Number of marginal branches	Sheath length	Number of seed in sheath	Weight of one hundred seeds	Seed performance per hectare	Biologic performance per hectare
Bloke	2	0.29	1.241	0.245	7.362	48.1974644	1347194.02
Raw distance a	2	0.31	0.59	0.25	13.91	3325161.99	370478.26
error	4	2.42	0.12	0.97	24.04	3346574.26	91785.77
density	2	1.46	0.51	0.12	28.8	8963275	16885308.43
ab	4	0.40	0.43	0.65	3.18	3452397	373120.03
CV		20.21	4.35	29.81	8.88	13.94	10.99

Table 5. size, so- called stalk and seed, the Biologic performance of plant

Biologic performance per hectare	Seed performance per hectare	Weight of one hundred seed	Number of seed in a sheath	Sheath length	Number of marginal branches	
9033/8 a	5551/3 b	38/13 a	3/66 a	10/42 ab	4/11 a	A1
8739/4 a	5664/1 ab	35/75 a	3/53 a	10/16 b	4/00 a	A2
8726/1 a	6535/1 a	36/23 a	3/33 a	10/67 a	4/36 a	A3
7753/7 b	4981 b	36/99 ab	3/44 a	10/60 a	4/33 a	B1
8504/1 b	6121/7 a	38/38 a	3/44 a	10/14 a	3/69 a	B2
10336/6 a	6667/6 a	34/83 b	3/64 a	10/50 a	4/44 a	B3
8989 bc	5948 bDc	39/71 a	3/33 a	10/34 ab	4/33 a	A1B1
9200 bc	6234/5 bc	39/05 a	3/33 a	10/04 ab	4 a	A1B2
8913 bc	3271/5 E	35/64 a	4/33 a	10/88 a	4 a	A1B3
7752 bc	4319/7 DE	35/03 a	3/33 a	10/67 a	4/33 a	A2B1
6950 c	5550 Dc	37/86 a	3/66 a	9/67 b	3/33 a	A2B2
12010 a	7795 ab	34/36 a	3/61 a	10/12 ab	4/33 a	A2B3
6932 c	4997/7 EDc	36/25 a	3/66 a	10/79 a	4/33 a	A3B1
9076 bc	6427/7 abc	38/24 a	3/33 a	10/72 a	3/76 a	A3B2
10170 ab	8180 a	34/49 a	3 a	10/49 a	5 a	A3B3

Seed performance per hectare

The above mentioned tables showed that the influence of distance between rows on the performance of seed per hectare in 5% level was significant, so that the maximal weight was 6535.1 kilograms and belonged to row A3 and the lowest seed weight belonged to row A1 with 5551.3 kilograms per hectare. The influence of seed performance per hectare in 5% level was meaningful in a manner that the maximal weight was 6667.6 kilograms in density 133 and the lowest weight belonged to the density B1 with 4981 kilograms. Furthermore, the mutual influence of distance between rows and density on the performance of seed in 1% level per hectare was significant. In a way that the maximal seed performance belonged to the distance between row

A3 and density B3 with 8180 kilograms and the minimal seed performance was in distance between row A1 and density B3 with 3271.5 kilograms. Sun light, humidity and soil fertility and environmental factors which influence the desirable density of bushes for performance. If the density is very low then all the total potential production is not achieved and if it is very high, then the sever competition between plants especially because of high humidity tension, total productivity decreases. The performance parts have compensatory relation with each other, i.e. we can never suppose a condition which all the performance parts in it are in maximum position, but farm manager can reduce or increase some of this parts. Seed performance showed that in rows with low distances in comparison with rows with high distances, the bushes seek soil water sooner and absorb most of the soil water along the germinates growth and leave less water for the generative growth. This limitation for generative growth in low-distance rows is important when density is in maximal form. If the distance between rows in increased, the seed performance increases. If the density increases, the seed performance increases because along with the increasement of density in surface level, the photosynthetic level increases and the percentage of photosynthetic material absorption via bushes boots and consequently the total performance enhances. As we perceived in evaluation of above mentioned characteristics, after the increasement of distance between row the number of sheathes in a bush, which is one of the performance parts, increases and this can be one of the reasons for increasement of seed performance. Hashemi Jazi and Danesh (1995) concluded that with increasement in distance between rows, the seed performance increases. This is compatible with our research results. Also, they resulted that after the increasement in density, the seed performance decreases and this is incompatible with our results. Kahrayan (2002) in this researches on bean and soybean concluded that with the increasement in density, the light penetration into the Kanopi will be in appropriative and in adequate and consequently the construction of photosynthetic factors in a bush and the number of in filled seeds increases, and this issue results in reduction of performance and this is incompatible with this research results.

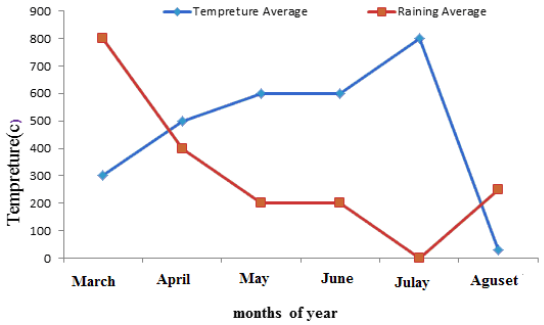

Fig. 1.

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