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Research Article

IMPACT OF VARIOUS PLANTING SPACES AND DIFFERENT LEVELS OF NITROGEN FERTILIZER ON YIELD AND YIELD COMPONENTS OF GREEN BEANS [CULTIVATED] UNDER THE WEATHER OF GUILAN [PROVINCE]

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ABSTRACT
To evaluate the effect of row spacing and nitrogen fertilizer on growth and yield of green beans, during the 1392 crop year, the Branch tests using a split plot in a randomized complete block design with three replications. In this experiment, the distance between row of four levels (10×40,20×40 , 30×40 ,40 ×40) cm as a main factor with four levels of nitrogen (0, 25, 50, 75) kg ha was used as a subplot. The test results showed that the yield was significantly affected by nitrogen fertilizer and planting distance And was also found that the effects of row spacing and nitrogen fertilizer on yield, biomass, harvest index, height, and number of pods per plant is significant ($p < 0.01$). The highest green pod yield of 1319 kg per ha d2N3 and 20 x 40 cm and 50 kg N fertilizer rate was obtained.

Keywords: *Fertilizer N, Green Pod Yield Green Beans, Spacing*

INTRODUCTION
Planting is a vital source of people's livelihood on the planet. Cultivating crops allows human beings to supply their necessary elements including starch, proteins, vegetable oils and vitamins. Among others, members of leguminous family are an important source of proteins and energy for human beings (Rastegar, 2002).
Among different commercial crops, green beans have the highest level of protein contents. There are favorable light and moisture conditions in Iran to plant such crops; sunny summers and cool nights as well as high-quality soil of Iran have prepared an ideal condition for planting and producing green beans, as the yield of this crop in Iran is 2.5 times more than the world average; in other words, the average yield of green beans in the world is 810 kg/ha, while in Iran it is 1800 kg/ha.
Not only genotype, but also the yield components are influenced by routine agricultural management activities (RAMAs).
Determining seed density per unit area, the required nitrogen level and their interaction is a very important management tool which, if used properly, may pave the way to achieve the ideal yield. Among the consuming elements, nitrogen is an element which affects considerably the crops' yields. Lack of nitrogen slows down considerably the plant's growth; thus, compensating shortage of the element is manifested through the apparent reactions and development of plants including as re-development of leaves surface. Plant density affects the yield considerably through influencing its capacity to take advantage of the growth inputs, particularly light and competition.
Various studies show that reaction of grains, including beans, to different levels of nitrogen fertilizer is different. In most studies, using nitrogen fertilizer, less than 100 kg/ha, will improve the yield; otherwise we will face a declined final yield (Kulig, 1995; Boromandan *et al.*, 1997; Hamada, 1992). Studies on the impact of various plant densities indicate that changing density through altering the radiation level, useable for plants, and competition between plants may affect both the yield and the yield's components considerably; as the plant density is increased per unit area, the absorbed light as well as the efficiency of using total yield radiation will be increase, as well.
On the other hand, when the plant density per unit area is increased, single plant yield, number of secondary branches per plant, pods per plant, 100-seed weight are decreased, while plants' yield per unit area is increased (Board *et al.*, 1992; Beizaie, 2000; Rezvani and Rahimian, 2000; Osroush *et al.*, 1999).

MATERIALS AND METHODS

Our experiment was carried out in a 500-m^2 land area located at 49.93 degrees latitude and 37.14 degrees longitude with a height of 8 m above the sea level in Lahijan City in 2013. The average annual rainfall in this region is 1162 mm. The temperature of the area varies between -5°C and +36° C. Our experiment was carried out in a 500-m^2 land area located at 49.93 degrees latitude and 37.14 degrees longitude with a height of 8 m above sea level in Lahijan City in 2013. The average annual rainfall in this region is 1162 mm. The temperature of the area varies between -5°C and +36° C. The following table summarizes the results gained from testing the soil sample of the region:

Soil Analysis of Field Experiment

Texture	**Class (clay, loam, sand)**	**Potash (%)**	**Phosphorous (%)**	**Nitrogen total (%)**	**Neuter (%)**	**Carbon organic (%)**	**Conductivity ($_{dsm}$ $^{-1}$)**	**ph**	**Element**
Loam clay	21,40,39	268	27	0/34	2	4/06	0/406	6/54	total

The experimental design used was a split-split plot in Randomized Complete Block Design (RCBD) with 3 replicates. *Planting space* in four densities (d1 = 40x10 cm, d2 = 40x20 cm, d3 = 40x30 cm, and d4 = 40x40 cm) and *yield amounts* in four levels (n1 = 0 kg/ha, n2 = 25 kg/ha, n3 = 50 kg/ha, and n4 = 75 kg/ha) were considered as main and accessory factors, respectively. The plan was carried out in an area of 500 m^2. Since three replicates and 16 treatment compositions have been used here, 48 experimental terraces were considered. Size of each terrace was defined 8 m^2 (4m x 2m) and five lines of beans were planted in each terrace. According to the advices made by the soil testing laboratory, two types of fertilizers namely triple superphosphate (50 kg/ha) and potassium sulfate (100 kg/ha) were used in the land. Urea fertilizer was used two times (before planting and after flowering). SAS, MSTAT-C, and EXCEL were used for statistically analysis of data and depicting graphs. Duncan's Multiple Range test was employed to compare the range of means for 5 percent level.

RESULTS AND DISCUSSION

Number of Pods per Plant

The result of variance analysis (table 1) indicates that the impact of planting space on number of pods per plant per unit area is significant (1%) and results gained from comparing range of means (table 2) suggest that the most pods per plant is 15.33 pods, which is achieved in a treatment known as 40x20 cm, while the least pods per plant is 12.41 pods, which is achieved in a treatment known as 40x30 cm. Number of pods per plant is the most variable feature among the yield components of the grains. There is a high potential for developing seedlings and flowers in legumes; however, achieving such potential depends on the environmental condition, which explains why number of pods are very variable (Kouchali and Banaian, 1994).

Mosley (1972) reported that the increased plant density for beans may result in decreasing the number of pods per plant; the same has been reported for the mung beans by Hayat *et al.,* (2003). Nitrogen fertilizer plays a key role in the vegetative growth; hence, its impact on reproductive organs may bring about, to some extent, an additive effect beyond which we may face a new vegetative growth of plant and the decreased number of pods in the plant. As table 1 shows the impact of nitrogen fertilizers on the number of pods per plant is significant (1%). As table 3 suggests the most pods per plant is 14.91 pods, which is achieved in a treatment known as 50kg nitrogen fertilizer, while the least pods per plant is 12.83 pods, which is achieved in a treatment known as 75kg nitrogen fertilizer. Hatami *et al.,* (2006) demonstrated that using nitrogen fertilizer may affect significantly the number of pods in soy bean species. The interaction between planting space and nitrogen fertilizer on the number of pods in the bean plant per unit area is 1% which is significant. Therefore, the most pods per plant was gained in a planting space of 40x20 cm with 50 kg/ha, while the least pods per plant was gained in a planting space of 40x30 cm with

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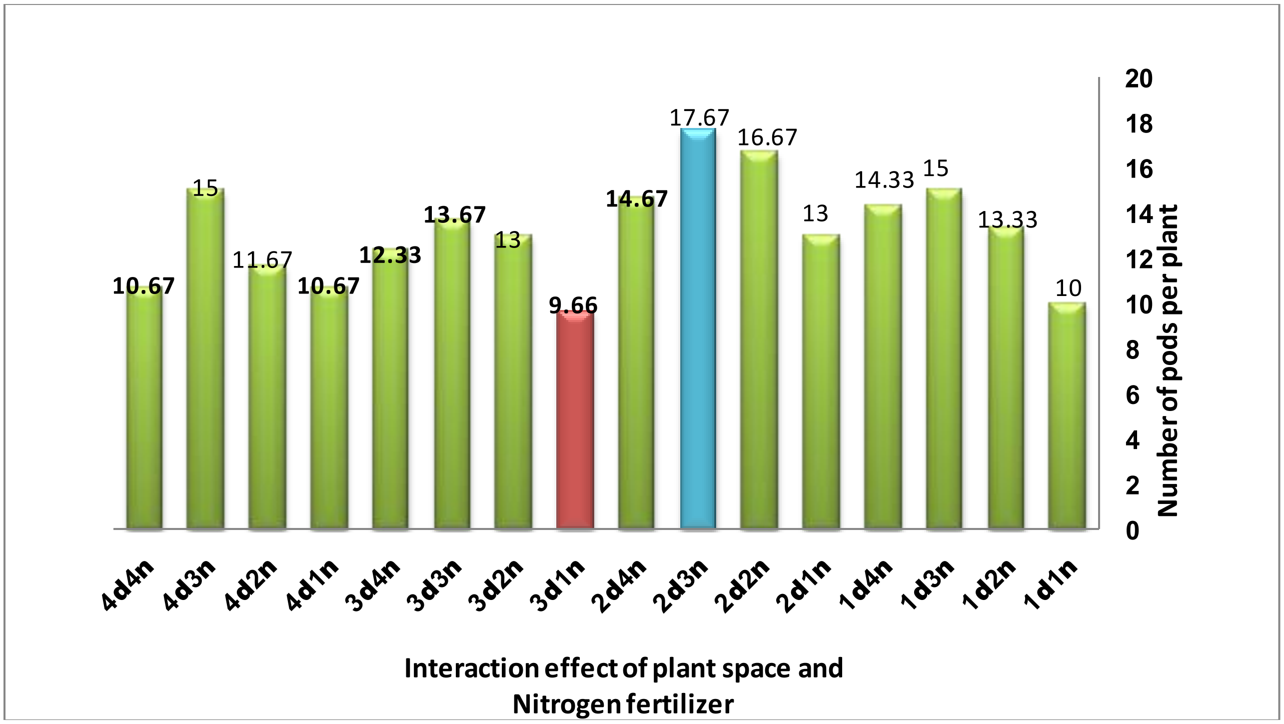
25 kg/ha (9.66 green pods/plant). Kashfi *et al.*, (2010) reported that the interaction between planting density and nitrogen fertilizer on the number of pods per pea was significant.

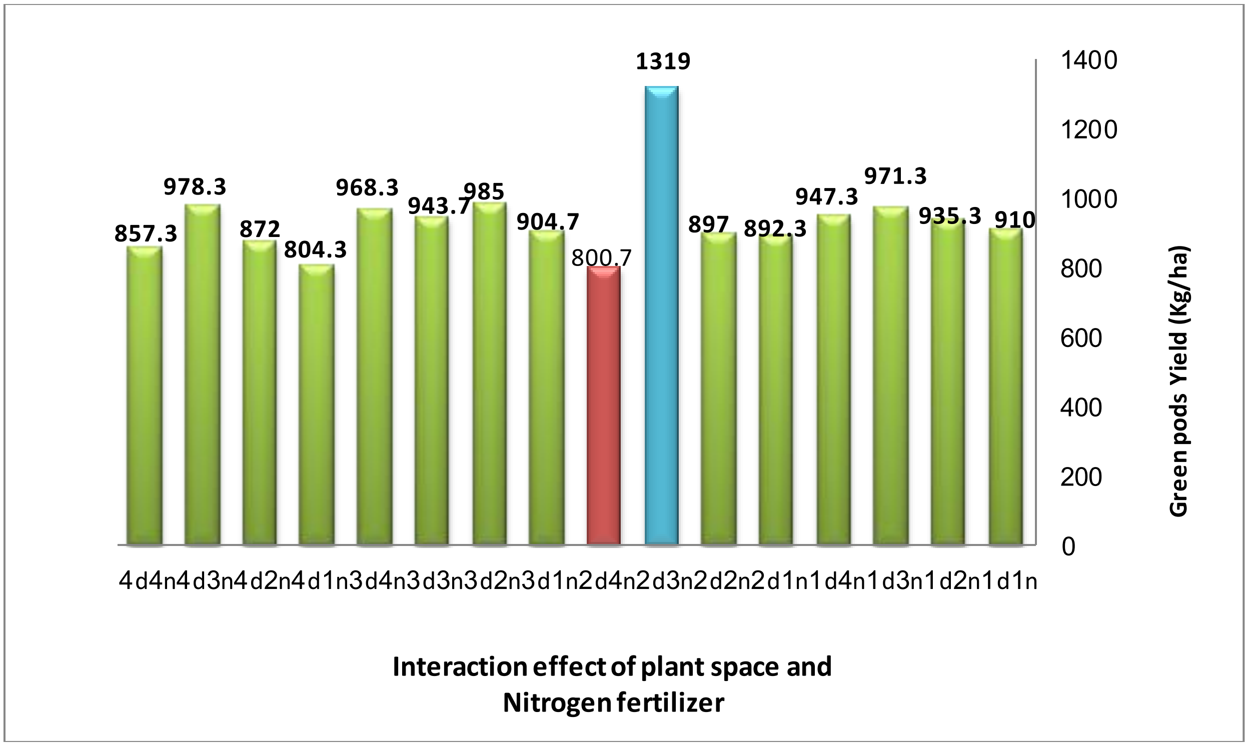


Green Pod Yield

Variance analysis table (table 1) showed that the impact of planting space on green pod yield of beans per unit area was significant (1%). The result of comparing range of means (table 2) suggested that the most yield (2611.33 kg/ha) belongs to treatment 40x20 cm and the lowest yield (868.25 kg/ha) belongs to treatment 40x20cm.

The favorable density refers to a density in which all environmental factors (water, air, light and soil) are completely used and at the same time both intra-plant and extra-plant competitions are at minimum level in order to achieve the highest possible yield with the ideal quality. Most studies indicate that the yield of beans per unit area is decreased as the result of increasing the space between rows and between two plants in a single row and decreasing the density. The increased plant density will result in decreasing Co_2 and increasing moisture around plants and increases the likelihood of developing white fungus (Tremella fuciformis) in plants (2001). Anonymous regarding the results of table 1, the impact of nitrogen fertilizers on green pod yield of beans per unit area is significant (1%). Results gained from table 3 suggest that the highest yield (2115.67 kg/ha) belongs to the treatment in which the nitrogen fertilizer (50 kg/m^2) is used while the least green pod yield (1467.5 kg/ha) belongs to the treatment in which no fertilizer is used (control). Muhammadzadeh *et al.*, (2010) tested red beans and concluded that using nitrogen will result in the bigger leaf surface, higher leaf's relative water content, leaf's pigment content, leaf proline amount, canopy temperature depression (CTD) in the drought and tension conditions and higher bean seed yield. The results of table 1 show that the interaction between planting space and nitrogen fertilizer on green pod yield of bean per unit area is significant (1%). The best yield (1319 kg/ha) belongs to the treatment in which the planting space is 40x20 cm and 50 kg/ha nitrogen fertilizers is used, while the lowest yield (800.7 kg/ha) belongs to the treatment in which the planting space is 40x20 cm and 75 kg/ha nitrogen fertilizer is used. Khoram *et al.*, (2007) reported that the interaction between planting space and nitrogen fertilizer on rice yield per unit area is significant (5%). Likewise, Khamoushi *et al.*, (2011) reported that the interaction between planting space and nitrogen fertilizer on seed is significant, as the density of

25x25 plants per unit area with 40 kg nitrogen fertilizer was defined as the treatment in which the best yield is obtained.



Biomass: The intense competition between plants with short spaces is the main cause of low biomass production. In higher densities, the competition between plants belonged to a single species will result in decreasing of plant weight, at the same time in such densities we see that numerous plants will compensate the little weight which in turn enhances the biological yield per unit area.

As table 1 shows the impact of planting space on Biomass per unit area is significant (1%). Results of table 2 show that the highest biomass (6706.3 kg/ha) belongs to the treatment of 40x20 cm, while the lowest biomass (2452 kg/ha) belongs to the planting space of 40 x 40 cm.

Beheshti *et al*., (2010) studied grain Sorghum and Pinto Bean and reported that the effect of density on biomass yield was significant and the highest biomass yield was gained for both crops in a high-density planting situation. Nitrogen enhanced the yield of dry matter through affecting the vegetative growth parameters which in turn enhances the Biomass. To a certain extent, this fertilizer has an additive effect on the plant's total biomass after which it may decrease the yield as well as plant's total weight.

As table 1 represents, the impact of nitrogen fertilizers on biomass per unit area is significant (1%). Table 3 suggest that the highest biomass (5008.3 kg/ha) belongs to the treatment in which 50 kg/ha nitrogen fertilizer is used, while the lowest biomass (3706.6 kg/ha) belongs to treatment without fertilizer. The interaction between planting space and using nitrogen fertilizer on biomass of green bean became significant (table 1).

The highest biomass (2721 kg/ha) belonged to the treatment in which planting space was 40x20 cm and 50 kg/ha nitrogen fertilizer was used, while the lowest biomass (1930 kg/ha) belonged to the treatment in which planting space was 40x40 cm and no nitrogen fertilizer was used. Mohammadian Roshan *et al*., (2007) reported that the interactions between planting space and nitrogen fertilizer on straw beans became significant.

Resam *et al*., (2007) d=found similar results.

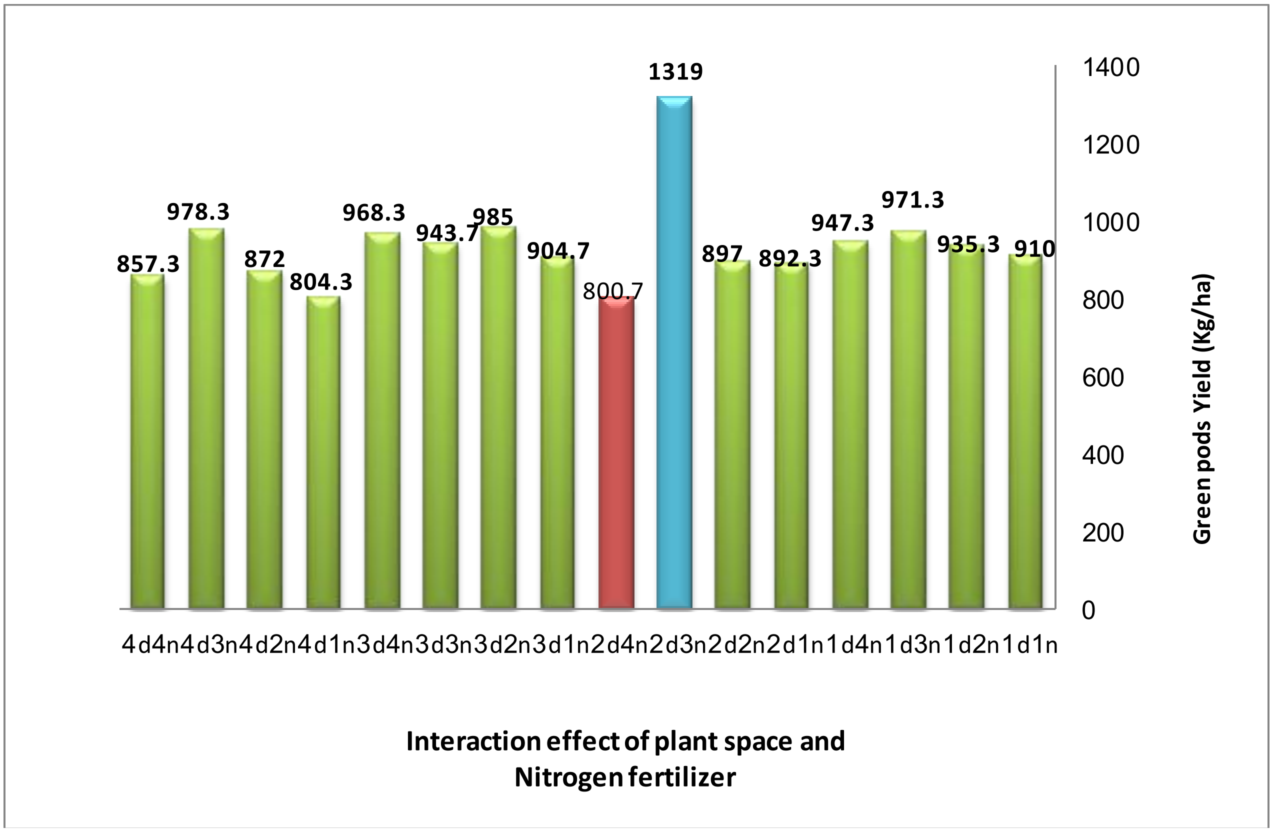


Table 1: Analysis variance of mean square Yield and yield component of green bean

s.o.v	df	Number of pill	Number of pod	pod length	height	index	yield	biomass
Block	2	0.89	24.02**	1.25	49.02**	21**	58644**	37225**
Space	3	0.43	20.57**	2.22	130.8**	131**	10022722.69**	57158724.7**
Error a	6	0.46	5.9	1.005	62.49	16.77	59271.33	66952.4
Nitrogen	3	0.06	14.24**	0.49	4.75	26.24**	911929.58**	4381156.5**
S×F	9	0.39	30.53**	0.8	23.39	67.26**	1212550.24**	3886261.7**
Error b	24	0.37	4.79	0.46	14.73	9.44	50352.56	208704.8
CV	-	11.44%	15.81%	6.30%	9.83%	7.74%	12.38%	10.17%

Table 2: Mean comparison effect of plant space on properties of green bean

S.O.V	Number of pill	Number of pod	pod length	Height	Harvest index	Yield	Biomass
Plant space							
10*40	5/33a	13/16bc	10/45b	37/25b	42/583a	a2577/83	b6015/4
20*40	5/54a	15/33a	10/98ab	40/833a	37/66b	2611/33a	a6706/3
30*40	5/12a	12/41c	10/41b	35/417b	42/417a	1187/83b	c2787
40*40	5/54a	14/5ab	11/30a	36/66b	36/083b	868/25c	c2452

Table 3: Mean comparison effect of Nitrogen fertilizer properties of green bean

S.O.V	Number of pill	Number of pod	pod length	Height	Harvest index	Yield	Biomass
Nitrogen (Kg/ha)							
0	5/41a	13/00 ab	10/82a	38/25a	40/167a	1467/5c	3706/6c
25	5/29a	14/66 ab	10/91a	39/25a	39/04a	1921/5b	4921/2a
50	5/45a	14/91 a	10/93a	38/917a	38/05b	2115/67a	5008/3a
75	5/33a	12/83 b	10/49a	39/75a	40/333a	1740/58b	4325/5b

Conclusion

The results of variance analysis table (table 1) indicate that there were significant differences between various planting spaces of green bean and various levels of nitrogen fertilizer in terms of green pod yield, biomass, harvesting index, plant height and number of pods per plant ($p < 0.01$). However, there was no significant difference between various planting spaces and various levels of nitrogen fertilizers in terms of pod length and number of seeds per pod.

This study indicated that the interaction between planting space and nitrogen fertilizer for a treatment with planting space of 40x20 cm and 50 kg/ha nitrogen fertilizer had the best yield (1319 kg/ha) and the lowest amount (800.7 kg/ha) belonged to planting space of 40x20 cm and 75 kg/ha nitrogen fertilizer.

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