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Original article

Investigation of the Effect of Different Phosphorus and Nitrogen Doses Applied to Bean (*Phaseolus vulgaris* L.) Plant on Vegetative Characteristic and Grain Yield

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Abstract

This study was carried out in Kahramanmaras conditions in 2020 in order to determine the effects of different phosphorus and nitrogen doses on the vegetative characteristics and grain yield of Goksun bean variety. Four different doses of nitrogen (0, 4 , 8, 12 kg da^{-1}) and four different doses of phosphorus (0, 3, 6, 9 kg da^{-1}) were used in the experiment. In the conducted research, flowering day duration, first pod height, plant height, number of branches, maturation day time and grain yield per decare of bean plant were investigated. According to the results of the analysis of variance, different phosphorus and nitrogen applications during the flowering day and the interactions of these applications with each other were found to be insignificant. As the nitrogen dose increased, the first pod height, plant height and number of branches increased, and the nitrogen dose was found to be important at the rate of 1% for these characteristics. Phosphorus doses applied for the same properties did not make a significant difference. It was determined that different doses of phosphorus and nitrogen applied to Goksun bean cultivar did not make a statistically significant difference on maturation day time. The lowest grain yield was obtained from the application of 171.561 kg da^{-1} to 0 kg da^{-1} nitrogen dose, the highest grain yield was obtained from the application of 254.025 kg^{-1} to 8 kg $^{-1}$ nitrogen dose. Grain yields obtained from different doses of phosphorus (0, 3, 6, 9 kg da^{-1}) varied between 191.682 – 237.641 kg da^{-1} . Different phosphorus dosage applications did not make a statistical difference in terms of grain yield. In the study carried out, the highest grain yield was obtained as 288.124 kg da^{-1} from the interaction of 8 kg da^{-1} nitrogen application and 6 kg da^{-1} phosphorus application.

Keywords: Beans, Vegetative Characteristics, Grain Yield, Phosphorus and Nitrogen Doses.

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INTRODUCTION

Legumes, which have been cultivated in the world since 5000 BC, have formed an important part of human nutrition. Edible legumes including dry beans, chickpeas, lentils, broad beans, peas and black-eyed peas; compared to other herbal products, it contains high protein, low fat, high levels of vitamins and minerals. The most developed individual, the human being, is incapable of synthesizing amino acids, the building blocks of proteins. Eight amino acids (isoleucine, leucine, lycine, methionine, threonine, trtptophane and valine) must be met with people's daily diets, and daily deficiencies of these amino acids cannot be met with another day's excess (Sehirali, 1988). It is stated that 22% of vegetable proteins in human nutrition, 7% of carbohydrates, 38% of proteins in animal nutrition and 5% of carbohydrates in animal nutrition are obtained from legumes in the world (Adak et al. 2010). They are considered very good complementary dietary products in human and animal nutrition, especially in combination with cereals (McPhee and Muehlbauer, 2002). In places where animal proteins cannot be adequately provided for various reasons, vegetable protein sources are used in order to be fed in a balanced way. Legumes are very important in closing this gap (Adak, 2014).

Bean (*Phaseolus vulgaris* L.) has an important place among leguminous plants in terms of plant-derived proteins and its homeland is America. It ranks first among legumes in terms of cultivation area and production in the world. It is widely consumed as a fresh vegetable as well as dried grains. Dry bean cultivation areas in the world are approximately 34.80 million hectares, production is 27.55 million tons and yield is 790 kg/ha (FAO, 2020). The cultivation area of beans in Turkey is 88.9 thousand ha, dry bean production is 225 thousand tons and the grain yield per unit area is 253 kg da^{-1} (TUIK 2020). Beans, which are consumed both fresh and dry, have a superior place among similar foods in terms of the high protein content of the grains, the fact that the proteins are close to meat protein in terms of amino acid composition, and that they are rich in carbohydrates, calcium, iron and especially phosphorus (Broughton et al. 2003). It is important in terms of human nutrition, as well as making use of the free nitrogen of the air through the nodosite bacteria (Rhizobium sp.) in the nodules in the roots, enriching the soil with nitrogen, and leaving a nitrogen-rich soil for the plants to be planted after it (Sprent 2001). On the other hand, thanks to its pile roots, it penetrates deep into the soil and causes the nutrients accumulated in the lower layers to be transported to the upper layers of the soil, thus enriching the soil with nutrients and increasing the soil organic matter with its decaying roots after harvest (Akcin 1974). Nitrogen and phosphorus are the leading nutrients in plant production, and the lack of these nutrients in the soil causes yield losses (Acar 2019). Nitrogen is very important for plant development, so it is a macronutrient that has a very important place in human and animal life. Although it is found in the atmosphere at the highest rate (78%), nitrogen is one of the nutrients that plants need the most, because nitrogen is included in the structure of organic compounds that have important functions such as protein, amino acid, amide, nucleic acid, chlorophyll in the plant (Muftuoğlu and Demirer1998). Nitrogen is the building block of protein, which is considered to be the composition of important structural elements of all living things. It is also an important nutrient element in the structure of chlorophyll, enzymes and vitamins. Phosphorus, on the other hand, is very important in increasing the quality of the seed as well as having a high effect on seed yield. In addition, phosphorus fertilizers increase the availability of nitrogen in the soil by affecting nodulation and nitrogenase activity (Arioğlu1994). Due to the high fixation of phosphorus to the mineralogical components of the soil, it offers very low levels of soluble phosphorus to the plant. For this reason, fertilization should be supported to meet the phosphorus needs of plants (SUZA et al., 2006). Phosphorus is a valuable macro element in legumes, and phosphorus fertilizer must be given to the soil before planting. Legumes can meet their own nitrogen needs, but they cannot meet their phosphorus needs. For this reason, if there is not enough phosphorus in the soil, it should be added by fertilization (Parsak 2006).

The main aim is to increase the yield and quality to be obtained from the unit area within the researches of cultivation techniques in edible legume plants. In this framework, determining the dose of phosphorus and nitrogen fertilizers is among the important issues. Therefore, in this study, it was aimed to investigate the effects of nitrogen and phosphorus fertilizer doses on plant characteristics and grain yield in bean plant in Kahramanmaras conditions.

MATERIALS and METHODS

In the experiment, Goksun bean variety obtained from the Ministry of Agriculture and Forestry, Eastern Mediterranean Transition Zone Agricultural Research Institute was used. As the application factor, 4 doses of nitrogen (0, 4, 8, 12 kg da^{-1}) and 4 doses of phosphorus (0, 3, 6, 9 kg da^{-1}) were used. In nitrogen dose application, 46% urea fertilizer and in phosphorus dose application Triple super phosphorus fertilizer was used as the test material. The trial was carried out between March 2020 and June 2020 in Kahramanmaras Sutcu Imam University, Faculty of Agriculture, Field Crops Research Area. The experiment was planted by hand in three replications in a divided plot design with 50 cm row spacing and 10 cm in-row spacing, 5 m long. Phosphorus doses were applied to the main plots and nitrogen doses were applied to the subplots. In fertilizer applications, all of the phosphorus fertilizer was applied by planting, half of the nitrogen fertilizer was applied by planting, and the other half was applied between the rows when the plants were 10-15 cm tall in the last week of April. The first irrigation was done with drip irrigation on 19 May 2020. By observing the condition of the plant and the soil condition, the water need of the plant was met with the drip irrigation system. Harvesting was completed in the second week of July. The climate data of Kahramanmaras Province during the period of the research are given in Table 1.

Table 1. Climate data of Kahramanmaras Province

Months	Monthly Total Precipitation (mm)	Monthly Average Temperature(°C)	Monthly Average Relative Humidity
	2020	2020	2020
March	173.4	12.5	67.3
April	61.8	15.9	58.2
May	18.5	15.9	47.2
June	0.3	25.4	46.9
Mean	254	17.42	54.82

As seen in Table 1, the average relative humidity value in the climate data of the trial area varies between 46.9% and 67.3%, the average temperature value is between 12.5 °C and 25.4 °C, and the total precipitation is between 0.3 mm and 173.4 mm between the months, with a total of 254 mm. value has been observed. According to the soil analysis results of the trial area; Soil sample taken from 0-30 cm depth from the trial area, clay loam (69.96), salt-free (0.05%), moderately calcareous (6.09%), low in organic matter (1.58%), potassium (K_2O) ratio above the sufficient level (55.51). kg da-1) and phosphorus (P_2O_5) at a very low level (2.84 kg da^{-1}). (Anonymous, 2020b *) In the study, flowering day time (days), maturation day time (days), first pod height (cm), plant height (cm), number of branches per plant (number $plant^{-1}$), grain yield per decare (kg da^{-1}) properties were examined. The data obtained according to the results of the examination were analyzed according to the JMP package program and the comparison of the means was determined according to the Duncan multiple comparison test.

RESULTS and DISCUSSION

In the study carried out in Kahramanmaras; The effects of the nitrogen x phosphorus dose interactions applied to the Goksun bean cultivar on the investigated properties and the obtained data were analyzed statistically and the averages of these values are given in table 2, the effects of nitrogen and phosphorus doses on the investigated properties and the averages of these values are given in table 3.Flowering time, maturation time, first pod height, plant height and number of branches per plant were found to be statistically insignificant in terms of nitrogen x phosphorus interactions, while grain yield per decare was statistically significant. While the effect of phosphorus doses on the investigated properties was insignificant, nitrogen doses applied at different rates were found to be statistically significant in terms of first pod height, plant height, number of branches and grain yield per decare.

Table.2. Averages of nitrogen x phosphorus dose interactions for the investigated properties

Nitrogen X Phosphorus	Flowering Time (days)	Maturating Time (days)	First Pod Height (cm)	Plant Height (cm)	Number of Branches	Grain Yield * (kg da^{-1})
N_0 X P_0	49.00	121.33	7.66	44.00	3.13	171.77 de
N_0 X P_3	51.66	122.66	7.93	44.33	3.60	205.44 a-e
N_0 X P_6	48.66	119.66	7.86	45.50	3.20	170.10 de
N_0 X P_9	51.66	121.00	7.60	41.13	4.00	138.93 e
N_4 X P_0	50.66	123.33	9.20	45.73	3.26	218.77 a-e
N_4 X P_3	49.33	122.66	9.20	45.43	3.40	231.64 a-d
N_4 X P_6	50.00	120.33	8.66	46.46	3.13	179.49 c-e
N_4 X P_9	52.66	123.33	8.73	43.46	4.33	226.87 a-d
N_8 X P_0	52.33	121.00	10.00	47.06	3.56	195.33 b-e
N_8 X P_3	49.00	120.33	9.46	47.00	3.90	272.14 ab
N_8 X P_6	49.00	118.66	9.26	45.88	3.66	288.12 a
N_8 X P_9	48.00	122.33	9.16	43.46	4.30	260.49 abc
N_{12} X P_0	49.33	124.66	12.40	48.66	3.36	212.91 a-e
N_{12} X P_3	48.00	120.00	10.43	46.13	3.93	241.33 a-d
N_{12} X P_6	51.66	121.00	10.40	46.00	4.26	175.56 d-e
N_{12} X P_9	51.33	116.33	10.93	42.73	4.20	140.42 e

Table 3. Averages of nitrogen and phosphorus doses for the investigated properties

Averages	Flowering Time (days)	Maturating Time (days)	First Pod Height (cm)	Plant Height (cm)	Number of Branches	Grain Yield (kg da^{-1})
N0	50.250	121.167	7.766 c	43.741 b	3.483 c	171.561 c
N4	51.416	122.417	8.950 b	45.008 a	3.650 bc	214.197 ab
N8	49.583	120.583	9.508 b	45.850 a	3.858 ab	254.025 a
N12	49.833	120.500	11.041 a	45.883 a	4.016 a	192.558 bc
P0	50.333	122.583	9.850	46.366	3.408	199.700
P3	49.500	121.417	9.258	45.725	3.758	237.641
P6	50.583	119.917	9.050	45.958	3.633	203.322
P9	50.666	120.750	9.108	42.433	4.208	191.682

Flowering Time (days)

Table 2 shows the average values of the flowering period (days) obtained from different doses of phosphorus and nitrogen applied to Goksun bean cultivar under Kahramanmaras conditions and the interaction of these doses with each other. The effect of nitrogen x phosphorus dose interactions applied at different doses was not found to be statistically significant on flowering time (days). The earliest flowering period (days) is obtained from 48 days with 8 kg da^{-1} N ile 9 kg da^{-1} P and 12 kg da^{-1} N and 3 kg da^{-1} P interactions. The latest flowering days are 52.66 days. It was obtained from the interaction of 4 kg da^{-1} N ile 9 kg da^{-1} P. When the effects of nitrogen and phosphorus doses on the flowering time were examined separately, it was determined that there was no statistical difference between the doses. Flowering times varied between 49.58-51.41 days at different nitrogen doses and between 49.50-50.66 days at different phosphorus doses. In previous studies, Anlarsal et al. (1998), as a result of a 2-year study, determined that the duration of flowering days varied between 30-40 days in the 1st year and 31-41 days in the 2nd year. Karaduman (2011) reported that the flowering period affects the vegetation period of the varieties and reported that the flowering day duration in bean genotypes varies between 33.30-62.00 days. Canci et al. (2019) observed that the flowering day duration in bean genotypes varied between 38.00 days and 59.00 days. Idikut et al. (2021) reported that the duration of the flowering day ranged from 48.25 days to 53.25 days. As can be understood from the results of previous researchers, the flowering time of beans has changed according to the variety used, ecological conditions and years.

Maturating Time (days)

Table 2 shows the average values of maturation time (days) obtained from different phosphorus and nitrogen doses applied to Goksun bean cultivar under Kahramanmaras conditions and the interaction of these doses with each other. The effect of nitrogen x phosphorus dose interactions applied at different doses was not found to be statistically significant on maturation time (days). In the nitrogen x phosphorus interaction, maturation times varied between 116.33 – 124.66 days and no statistical difference was recorded. When the effects of nitrogen and phosphorus doses on the maturation time were examined separately, it was determined that there was no statistical difference between the doses (Draw.2.). At the applied nitrogen doses of 0, 4, 8, 12 kg da-1, maturation times of Goksun bean cultivar ranged from 120.50 to 122.41 days. Maturation day time did not create a statistically significant difference in terms of nitrogen dose. It was noted that maturation times varied between 119.91 – 122.58 days in different phosphorus (0, 3, 6, 9 kg da-1) doses. The maturation times did not differ statistically in terms of applied phosphorus doses (Draw. 3).

Idikut and Karabacak (2021) reported that the maturation period of 11 bean varieties varied between 115 days and 116 in Elazig conditions. Ulker and Ceyhan (2008) emphasized that the vegetation period of 17 bean genotypes grown in Sarayonu and Cumra districts in Central Anatolian ecology took place in 91.67-120.17 days, and the genetic structures of the bean genotypes were an important factor affecting the vegetation period. Elkoca and Cinar (2015) reported that the maturation period in 15 bean genotypes varied between 96.0-125.5 days in Erzurum ecological conditions. They stated that cultivars with low total temperature demand mature earlier depending on the temperature increase. Since the bean plant is a temperate climate plant, besides the variety, the climate characteristic is more dominant on the maturation period.

First Pod Height (cm)

The first pod height values obtained from the interaction of different doses of phosphorus and nitrogen applied in the study were found to be statistically insignificant. The average height of the first pod of the interactions was between 7.66 -12.40 cm. The height of the first pod obtained from the applied nitrogen doses of 0, 4, 8, 12 kg da^{-1} ranged between 7.76 and 11.04 cm and was found to be statistically significant. The first pod height showed a positive response to the nitrogen dose increase. The height of the first pod varied between 9.05 and 9.85 cm in different phosphorus (0, 3, 6, 9 kg da^{-1}) dose applications. While the applied phosphorus doses increased, the first pod height of the bean decreased. Differences in first pod height were not statistically significant. As can be seen from the results obtained in the study, although the height of the first pod reacted to the applied nitrogen and phosphorus doses, it did not create a statistically significant difference in the phosphorus dose applications, and it was determined that it created a statistically significant difference in the nitrogen dose applications. Babagil et al. (2011) reported that they found the first pod heights between 11.9 and 22.5 cm in their study conducted by applying 3 kg da $^{-1}$ N x 6 kg da $^{-1}$ P. Ozturk (2019) reported that nitrogen application in the bean plant with nitrogen fertilizer, the highest value was obtained at the first pod height at 6 kg da-^{1} nitrogen dose, and the lowest first pod height at 3 kg da^{-1} nitrogen dose. In their study conducted with 8 bean genotypes in Eskisehir conditions, Iyigun and Kayan (2019) noted that the height of the first pod varied between 14.23-19.59 cm. Anlarsan et al. (1998) determined that the average first pod height was between 11.60-29.30 cm according to the results of a 2-year study in bean genotypes and populations. Girgel et al (2018) reported, the height of the first pod was between 76.7-11.1 cm. The effect of environmental and climatic factors on the first pod height is more dominant than genetic factors. It is understood from previous studies that the height of the first pod is affected by environmental factors.

Plant Height (cm)

According to the findings, the interactions of nitrogen x phosphorus doses were insignificant in the study conducted with different nitrogen and phosphorus doses. The average plant height was found to be 41.13 cm from the interaction of the lowest N0 x P9 dose, and the highest plant height was obtained as 48.66 cm from the N12 x P0 interaction (Draw.2.). The effect of nitrogen dose on plant height was found to be statistically significant, and the highest plant height was determined at N12 (45.88 cm), N8 (45.85 cm) and N5 (45.00 cm) nitrogen doses (Figure 3). The effect of phosphorus doses on plant height was found to be statistically insignificant and the average plant height ranged between 42.43 and 46.36 cm (Draw. 3).

Plant height is one of the important yield elements in beans, as in all plants, due to the role it plays on resistance to lodging and yield elements in morphological characteristics. In Goynuk 98 bean variety, which was applied different amounts of phosphorus and TKI-Humas by Mtua (2015), it was noted that plant height increased with increasing phosphorus doses. Zewdie and Hassen (2021) reported that phosphorus doses applied to the bean plant increased the plant height in the application of 2.3 kg da^{-1} compared to the control, and decreased the plant height in the application of 4 kg da^{-1}. They noted that the highest plant height was obtained from the application of phosphorus at 2 kg da^{-1} and there was no statistical difference similar to our study. Onder and Akcin (1995) applied fertilizer doses at the level of N0P0, N0P4, N0P8, N0P12, N5P0, N5P4, N5P8, N5P12 to two bean varieties.The highest plant height was measured in the plots where N5 x P0 dose was applied, as the average of the two cultivars,(38.3cm) this was followed by the N0 x P12 dose (37.3 cm). Cavusoğlu and Akcin (2007) stated that different doses of nitrogen and phosphorus applied to two bean cultivars in Kocaeli conditions did not have a significant effect on plant height and that it would be due to a variety of plant height, nitrogen at a dose of 5 kg da^{-1} and phosphorus at a dose of 0, with a maximum plant height of 39.15 cm. They reported that the highest was obtained from the lowest control application with 37.7 cm. Kacar et al (2004) determined that nitrogen doses applied to three bean varieties in Bursa conditions did not have a significant effect on plant height, and plant height values varied between 45.26-47.61 cm. Altınkaynak (2018) In different nitrogen fertilization applied to Alberto bean variety, the lowest plant height was obtained from the control application, the highest plant height was obtained with the application of nitrogen at 2.5 da^{-1} sowing and 2.5 kg da^{-1} flowering, the plant height varied between 56.53-91.20 cm stated. In the study conducted by Ozturk (2019) with nitrogen fertilizer on the bean plant, it was noted that the nitrogen application did not have a significant effect on the plant height, and the plant height varied between 46.0-51.83 cm. As can be understood from previous studies, plant height varied according to variety, regions and applied factors. Some researchers state that the plant height is between 39.70-46.50 cm (Karahan, 1997), 40.32-45.55 cm (Babaoğlu et al., 1999), 31.62- 36.15 cm (Bulut, 2013) in bean bacteria and nitrogen applications. The results obtained from this research were higher than the above research results. We believe that these differences are due to the bean variety used. In the study, plant height increased at different nitrogen doses compared to the control. The best increase was obtained from12 kg nitrogen dose per decare. Babaoğlu et al. reported that nitrogen application increased plant height in beans.These results show parallelism with our findings. In our study, while the plant height parameter was compatible with some of the previous studies, it was not compatible with others. The main reasons for this difference may be climatic conditions, soil structure, regional ecology and differences in the varieties used.

Number of Branches

Table 2 shows the average number of branches obtained from different doses of phosphorus and nitrogen applied to Goksun bean cultivar under Kahramanmaras conditions and the interaction of these doses with each other. The effect of nitrogen x phosphorus dose interactions applied at different doses was not found to be statistically significant on the number of branches. In the nitrogen x phosphorus interaction, the number of branches varied between 3.13 and 4.33 and no statistical difference was recorded. When the effect of nitrogen and phosphorus doses on the number of branches separately was examined, statistical significance was determined between the nitrogen doses (Table 2). At the applied nitrogen doses of 0, 4, 8, 12 kg da^{-1}, the highest number of branches in Goksun bean variety was obtained from N_{12} nitrogen dose with 4.01 and the lowest number of branches was obtained from N_0 nitrogen dose with 3.48 units. It was noted that the number of branches varied between 3.40 and 4.20 in different phosphorus (0, 3, 6, 9 kg da^{-1}) dose applications. The number of branches did not differ statistically in terms of applied phosphorus doses (Table 3).

In the study conducted with 8 bean genotypes in Eskisehir conditions, it was emphasized by Iyigun and Kayan (2019) that the number of branches varied between 5.87-7.42 cm and the statistical difference was not significant in terms of the number of branches between the varieties, and that the climatic factors had a significant effect on the number of branches. In the study of Batirca et al. (2016) found that the effects of nitrogen and phosphorus on the average branch numbers of gum beans and their interactions were statistically insignificant. They reported that the average number of branches was between 5.8-6.9 depending on the nitrogen applications, while the number of branches was between 5.1-7.0 in the plants according to the phosphorus doses. Babagil et al. (2011) reported that they found the number of branches between 2.1 and 3.2 in their study conducted by applying 3 kg da $^{-1}$ N x 6 kg da^{-1} P with six dry bean varieties in Erzurum and Erzincan. The reason why our study results do not agree with some of the previous studies is seen as environmental factors such as the variety or genotype used, soil difference, and climate. It is known that there is an increase in the number of main branches when the environmental conditions are optimum.

Grain Yield (kg da^{-1})

Table 2 of the average grain yield per decare obtained from different phosphorus and nitrogen doses applied to Goksun bean cultivar under Kahramanmaras conditions and the interaction of these doses with each other is given in table 2. The effect of nitrogen x phosphorus dose interactions applied at different doses was found to be statistically significant on grain yield per decare. The highest grain yield was determined as 288.12 kg da^{-1} from N_8 x P_6 interaction and the lowest grain yield was determined as 170.10 kg da^{-1} from N_0 x P_9 interaction. When the effect of nitrogen and phosphorus doses on grain yield per decare was examined, statistical significance was determined between nitrogen doses, and the effect of nitrogen doses on yield was determined between 171.56 - 254.02 kg da^{-1}. Grain yield per decare varied between 191.68-237.64 kg da^{-1} at different phosphorus doses. There was no statistical significance of different phosphorus doses on grain yield per decare (Table 3).

In many studies, it has been revealed by many researchers that the grain yield of the bean plant is affected by bacteria and nitrogen applications (Sehirali et al., 1983; Onder and Ozkaynak, 1994; Bozoğlu et al., 1997; Odabas and yusuf, 2001; Bildirici, 2003; Bilen, 2003; Cetin Karaca, 2010; Bulut, 2013). However, Babaoglu et al. (1999) reported that bacteria and nitrogen applications were not effective on grain yield in beans. Cavusoğlu and Akcin (2007) emphasized that the soils of the region may need nitrogen fertilization depending on the variety and it is necessary to avoid unnecessary phosphorus fertilization. Kacar et al. (2004) reported that nitrogen doses applied to three bean varieties in Bursa conditions had a significant effect on grain yield. It was noted that the least grain yield was in the control, the highest grain yield was obtained from the application of 12 kg da^{-1} nitrogen, and there was no significant difference between the application of 9 kg da^{-1} nitrogen. Ozturk (2019) reported that grain yield was not affected by nitrogen fertilizer application in his study conducted with nitrogen fertilizer application in bean plant. Altinkaynak (2018) reported that in different nitrogen fertilization applied to Alberto bean variety, the lowest grain yield was obtained from the control group, and the highest grain yield was obtained from nitrogen application of 5 kg da^{-1}. Onder and Ozkaynak (1994) reported that the bean yield ranged between 264.23-358.47 kg da^{-1} in Rhizobium phaseoli and nitrogen fertilizer applications in Konya conditions. Kacar et al. (2004) determined the grain yield between 65.20-186.90 kg da^{-1} in bean cultivars in which they applied bacteria inoculation and nitrogen fertilizer application in Bursa ecological conditions. Bulut (2013) determined that the grain yield of beans varies between 105.65-141.33 kg da^{-1} in the ecological conditions of Van with bacteria and different fertilizer applications. The results of the research are not in harmony with some literature in terms of grain yield, due to the fact that grain yield depends on cultural measures, factors such as climate, planting time and genetic structures of varieties. Elkoca and Cinar (2015) reported that the grain yield in 15 bean genotypes varied between 92.4-195.4 kg da^{-1} in Erzurum ecological conditions. In their study conducted with 8 bean genotypes in Eskisehir conditions, Iyigun and Kayan (2019) emphasized that the grain yield varied between 59.89-127.47 kg da^{-1} and that the statistical difference in grain yield between cultivars was important. Mtua (2015) reported that phosphorus doses had a significant effect on Goynuk 98 bean variety applied with different amounts of phosphorus and TKİ-Humas, the lowest grain yield was obtained from the control application, the highest yield was obtained from the 10 kg phosphorus application, and the grain yield increase was not parallel to the applied phosphorus increase.Samago et al (2018) stated that rhizobial inoculation and P application (20 kg P ha^{-1}) could improve plant growth, symbiotic performance and grain yield of bean varieties grown in low P soils. While our grain yield results obtained in our study are in agreement with some of the above studies, it is seen that they are inconsistent with some of them. We guess that the main reasons for this are the different types used, ecological factors, environmental conditions, different cultural practices and hereditary differences.

Conclusion

In the study, different doses of phosphorus (0, 3, 6, 9 kg da^{-1}) and nitrogen (0, 4, 8, 12 kg da^{-1}) applied to the bean (*Phaseolus vulgaris* L.) plant in Kahramanmaras conditions were determined on the vegetative properties of the bean plant and the grain. The effect on the yield was investigated. Generally, high rates of nitrogen fertilization and top fertilizer application are applied in bean cultivation in Kahramanmaras. Therefore, in this study, it was aimed to determine the nitrogen and phosphorus doses that should be given to obtain the highest efficiency. According to the results of the study, although the phosphorus doses alone did not affect the yield, the highest grain yield was obtained from the 8 kg nitrogen dose per decare. In addition, it was determined that the highest yield value was achieved with the combination of 8 kg da^{-1} N x 6 kg da^{-1} P doses. While the statistical effect of applied nitrogen doses on first pod height, plant height, number of branches and grain yield per decare was observed, it was determined that phosphorus dose applications alone did not make a statistical difference.

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