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Research Article

Determination of Chemical Fertilizer and Various Organic Fertilizers on Some Agricultural Characteristics of Green Bean (*Phaseolus vulgaris* L.)

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ABSTRACT

This research was conducted to determine the effects of chemical fertilizers, some organic fertilizers, and control applications on seed yield and some agricultural characteristics of fresh beans in 2021. The trial was carried out in the Faculty of Agriculture of the University of Selçuk more precisely in the research and application station of Prof. Dr. Abdülkadir AKÇİN. In the study, pure bean lines PV2001, Riberia, PV2002, and PV2003 developed by hybridization were used as materials in the experiment. Then the seed yield, some agricultural characteristics, and the protein rate were determined. In this study, it was determined that the effects of chemical fertilizers and some organic fertilizer applications on all other traits examined were found to be statistically significant. As a result of the research, it was determined that the height of the bean plant ranged between 39.81 cm (control) and 51.19 cm (cow manure), the number of pods per plant changed between 14.36 (control) and 27.92 per plant (chemical fertilizer), the number of seeds per plant was 53.76 (control) and 127.52 (chemical fertilizer), the seed yield changed between 116.81 kg da^{-1} (control) and 239.48 kg da^{-1} (fertilizer chemical), the weight of 100 g of the seeds ranged between 36.632 g (control) and 40.91 g (sheep manure) and the protein content varies between 26.48 % (cow manure) and 27.49 % (control). The reactions of the bean lines used in the study to chemical fertilizers and some organic fertilizer applications showed differences. As a result, when the results obtained in this one-year study were reviewed, it was revealed that cow and sheep manure could be used in the organic cultivation of beans.

1. Introduction

Green bean is a vegetable that has an important place in human nutrition and health and is consumed fondly as fresh, dry, and canned. It is generally grown easily in every region of our country and is known to have an important place in covering the needs of the people for fresh vegetables. Bean, which is a type of vegetable that originates from Central America, has a very wide distribution area in the world. Its production in 2020 was 23.276.716 tons in the world. Asian and European countries have a significant share in this production. The production of China, which is the largest producer of green beans in the world, was 17.964.222 tons in 2020. Turkey, on the other hand, ranks 4th with a production of 547.349 tons (FAO, 2022).

Bean plant has important roles in human nutrition as well as in sustainable agriculture and animal nutrition. With the *Rhizobium phaseoli* bacteria in the nodules in its roots, it fixes the free nitrogen in the air, increases the nitrogen amount of the soil, and leaves a nitrogen-rich soil for the plants to be planted after it (Şehirali, 1998).

Throughout history, humanity has done many studies to increase productivity in this respect but has ignored the damage to natural resources and the environment. The desired yield increase was achieved with pesticides and fertilizers used in large quantities, but the natural balance began to deteriorate. Also, there have been consequences over time such as loss of quality in the product, deterioration of the soil structure, end of microorganism activities, decrease in the amount of organic matter in the soil, an increase of diseases and harmful factors, and soil erosion, which affect plant production negatively (Akgün, 2018).

Fertilizers support the plant at the stage when the macro and microelements it takes from the soil are insufficient. The right dosage and form of fertilizers contribute to plant growth and increase the amount of product in a unit area. Fertilizers can be applied in chemical and organic forms (Kaya and Erdönmez, 2020).

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Today, it is a matter that must be taken as a basis to make the most use of it without damaging the air, water, and soil. Producers become conscious of organic agriculture, good agricultural practices, and sustainable agriculture, which is one of the new agricultural practices. In this way, the purpose is to restore the natural balance, develop environmentally friendly production systems, and increase production by providing organic and green fertilization instead of synthetic chemical drugs and fertilizers (Başdemir et al., 2020).

In line with the purpose and target of the present study, the possibilities of reducing the dependence on chemical fertilizers and re-gain of the organic materials that are gradually depleted with intense agriculture were investigated. The differences between traditional fertilization and different organic fertilizer sources in terms of their effects on yield and some yield elements in beans were also uncovered in this study.

2. Materials and Methods

The Riberia genotype and three fresh bean pure lines, which are the candidates for registration, of Dr. Ercan CEYHAN (PV2001, PV2002, and PV2003 pure lines), were used as the study material in the study.

Some characteristics of sheep manure used as the study material were; moisture 10.35%, organic matter 74.1%, pH 7.53, nitrogen 1.63%, water-soluble P_2O_5 0.17%, water-soluble K_2O 3.26%, water-soluble Zn 1.60 ppm, and water-soluble Fe 4.80 ppm. Some characteristics of the cow manure were; moisture 2.96%, organic matter 76.67%, pH 7.38, nitrogen 1.55%, water-soluble P_2O_5 0.16%, water-soluble K_2O 3.00, water-soluble Zn 2.40 ppm, and water-soluble Fe 29.60 ppm.

According to the 17-year meteorological observations made in the city of Konya during the vegetation period in the year, the experiments were established, the 17-year average temperature, total precipitation, and average relative humidity were 22.5ºC, 80.1 mm, and 40.8%, respectively. In 2021, when the experiment was established, it was 21.8ºC, 105.2 mm, and 42.2%.

The previous plant was wheat in the study area. The soil was plowed deeply in October after the wheat plant was harvested, allowing it to spend the winter in this way. In March, the trial area was first plowed and parceled out, and then organic fertilizers (cow and sheep manures) were applied to the main plots. Control (without manure) was randomly placed on the main plots with 5 kg/da of nitrogen as pure substance from chemical fertilizer (urea), 3000 kg/da of bovine (cow) animal manure, and 2000 kg/da of ovine (sheep) animal manure. According to the trial design, control (without manure), 0.72 kg/da of urea manure, 195 kg of cow manure, and 130 kg of sheep manure were applied to the main plots. Organic fertilizers and chemical fertilizers, which were weighed for each main parcel, were distributed evenly to the parcels with the help of a shovel and rake and mixed with the soil with a hand tiller rotavator.

The trial was performed on the annealed soil with 3 replications according to the "Divided Plots Trial in Random Blocks" pattern on May 2, 2021, in Selçuk University, Faculty of Agriculture, Prof. Dr. Abdülkadir AKÇİN Research and Application Station. In the study, fertilizers were placed on the main plots and the varieties were placed randomly on the sub-plots, which were 5.0 m x 2.5 m = 12.5 m^2. The seeds were sown manually at a depth of 4 cm in rows opened with a marker, with 50 cm between rows and 8 cm between rows. Five rows were planted in each plot.

To clean the trial plots from weeds, to break the cream layer formed after irrigation, and to ensure the deterioration of capillarity, 2 hoeings and 5 times irrigation were applied depending on the water needs of the bean plant depending on the climatic conditions during the plant development period. The first irrigation was carried out during the period when the plants were 10-15 cm after emergence because of the lack of precipitation, and the second irrigation was carried out just before the pod planting, at the time of flowering, and the other irrigations were performed during the pod binding period according to the climatic conditions. Harvesting was carried out by hand between 20 and 31 August 2021 when 90% of the plants were ripe in each genotype.

Each agricultural characteristic examined in the trial was subjected to statistical analysis separately, and the differences in the averages calculated for each treatment were grouped according to the "LSD Test" as 1% in some and 5% in others (Yurtsever, 1984). Statistical analyzes were made using the JUMP package program in the study.

3. Results and Discussion

3.1. Plant Height

According to the analysis of variance results, it was found that the effects of the fertilizer types on plant height were statistically significant at the rate of 5% in four different bean genotypes that received organic and chemical fertilizers (Table 1). According to Table 2, it was determined that the fertilizer application with the highest average plant height was cow manure at 51.19 cm, and the control application with a minimum of 39.81 cm. According to the LSD test, cow manure, sheep manure, and chemical manure were in the first group (group a), and the control group was in the second group (group b) (Table 2). When other study results were examined, it was found that there were similar results. Aldemir (2019) reported that in his study that was conducted on the chickpea plant, he obtained the longest plant height of 43.18 cm from the plots on which barnyard manure was applied, and the shortest plant height from the control plot of 40.11 cm. When Göksu (2012) examined the two-year results of the study on pea plants, he reported that organic and chemical fertilizers increased plant height significantly when compared to control and microbial fertilizers. Bulut (2013), on the other hand, reported that he obtained the highest plant height from the

plots where chicken manure was used and the lowest from the control plots in his study that was conducted on bean plants.

Table 1
Variance analysis of the plant height of the bean genotypes that received organic and chemical fertilizers

Variance Sources	DF	Plant Height	Number of Pod per Plant	Number of Seed per Plant
Replication	2	25,860	0,378	4,286
Fertilizer (F)	3	318,256*	407,003**	11447,100**
Error 1	6	40,436	2,114	93,434
Genotype (G)	3	52,320	3,663	40,395
F X G İntrac.	9	40,956	2,061	102,820
Error 2	24	27,739	3,647	130,050
Variance Sources	DF	Seed Yield	Weight of Hundred Seed	Protein Ratio
Replication	2	212,979	0,052	1,082
Fertilizer (F)	3	30940,100**	49,750**	2,157
Error 1	6	153,094	1,271	1,327
Genotype (G)	3	1434,810**	61,457**	4,714**
F X G İntrac.	9	212,083	5,107*	2,105
Error 2	24	152,360	1,288	0,927

* : $p < 0.05$

Table 2
Variance analysis of the plant height and pod per plant of the bean genotypes that received organic and chemical fertilizers

Genotype	Chemical and Organic Fertilizers								Mean
	Control		Chemical Fertilizer		Cow Manure		Sheep Manure		
Plant Height (cm)									
PV2001	34,89		50,00		50,55		48,44		45,97
Riberia	39,56		51,11		47,78		43,89		45,58
PV2002	40,67		51,78		53,22		43,33		47,25
PV2003	44,11		47,56		53,22		55,89		50,19
Mean	39,81	b	50,11	a	51,19	a	47,89	a	47,25
Pod per Plant (number)									
PV2001	14,89		26,89		19,22		17,63		19,66
Riberia	15,67		28,11		18,92		17,81		20,13
PV2002	13,56		27,79		17,89		16,44		18,92
PV2003	13,33		28,89		20,27		17,70		20,05
Mean	14,36	c	27,92	a	19,08	b	17,40	b	19,69

*: The differences between the means denoted by the same letter were not statistically significant.
Plant height $LSD_{Fertilizer}$: 6.35; Pod per plant: $LSD_{Fertilizer}$: 2.22

The variation of the seed yields of the genotypes used in the trial according to different fertilizer applications was statistically insignificant (Table 1). As an average of the fertilizer applications, the highest plant height was measured at 50.19 cm from the PV2003 genotype. This was followed by plant heights of PV2002 (47.25 cm) and PV2001 (45.97) genotypes, in decreasing order. The lowest plant height was measured at 45.58 cm from the Riberia genotype (Table 2). Other researchers working on this subject obtained similar results (Ceyhan, 2004; Ülker and Ceyhan, 2008a; Varankaya and Ceyhan, 2012; Kepildek and Ceyhan, 2021).

3.2. Number of Pod per Plant

According to the analysis of variance results, it was determined that the effects of the organic and chemical fertilizers applied to four different bean genotypes on the number of pods were statistically significant at the 1% level (Table 1). According to Table 3, it was determined that the average number of pods was a maximum of 27.92 number per plant of chemical fertilizers, and the minimum average of 14.36 number per plant was the control application. According to the LSD test, it was determined that chemical fertilizer was in the first group (group a), cow and sheep manure was in the second group (group b), and control application was in the third group (group c) (Table 3). Erdönmez (2020) found the effects of different doses of fertilizers applied to soybean on the number of pods to be significant and reported that the highest number of pods was obtained in the HG2 fertilizer application at 172.80 number per plant, and the lowest in SG3 fertilizer application at 132.03 80 number per plant. Bulut (2013) reported that organic fertilizer applications in bean - Bacteria and no-Bacteria conditions affected the number of pods per plant, and the mean number of pods was found to be between 6.13 and 8.23 80 number of pods per plant, and the highest was obtained from chicken manure application.

Table 3
Variance analysis of the seed per plant and seed yield of the bean genotypes that received organic and chemical fertilizers

Genotype	Chemical and Organic Fertilizers								Mean	
	Control		Chemical Fertilizers		Cow Manure		Sheep Manure			
Seed per Plant (number)										
PV2001	53,78		130,29		91,23		65,00		85,07	
Riberia	57,93		127,00		83,42		80,43		87,20	
PV2002	44,93		126,62		90,20		77,09		84,71	
PV2003	58,40		126,19		87,26		82,55		88,60	
Mean	53,76	c	127,52	a	88,03	b	76,27	b	86,39	
Seed Yield (kg da^{-1})										
PV2001	122,35		240,79		173,13		157,86		173,53	a
Riberia	96,38		225,03		153,52		146,64		155,39	b
PV2002	119,56		246,86		170,96		187,16		181,14	a
PV2003	128,93		245,23		156,65		163,04		173,46	a
Mean	116,81	c	239,48	a	163,57	b	163,68	b	170,88	

*: The differences between the means denoted by the same letter were not statistically significant.
Seed per Plant: $LSD_{Fertilizer}$: 14.63; Seed yield: $LSD_{Fertilizer}$: 18.73, $LSD_{Genotype}$: 14.09

The variation of the pods per plant of the genotypes used in the trial according to different fertilizer applications was statistically insignificant (Table 1). As an average of the fertilizer applications, the highest the pods per plant was obtained at 20.13 number from the Riberia genotype. This was followed by seeds per plant of PV2003 (20.05 number) and PV2001 (19.66 number) genotypes, in decreasing order. The lowest pods per plant was obtained at 18.92 number from the PV2002 genotype (Table 2). Other researchers working on this subject obtained similar results (Ceyhan, 2004; Ülker and Ceyhan, 2008a; Varankaya and Ceyhan, 2012; Kepildek and Ceyhan, 2021).

3.3. Number of Seeds per Plant

According to the analysis of variance, the effects of organic and chemical fertilizers applied to bean genotypes on the number of seed per plant were found to be statistically significant at the level of 1% level (Table 1). According to Table 3, the maximum number of seeds per plant was obtained from chemical fertilizer with 127.52 number, and at least 53.76 number from control application. According to the results of the LSD test, chemical fertilizer was found to be in the first group (group a), cow and sheep manure in the second group (group b), and control application in the third group (group c) (Table 3). Bulut (2013) reported that the effects of grafting and fertilizer applications on the number of seeds per plant were important, and the mean value of the fertilizers varied between 25.08 - 34.76 mumber per plant. Aldemir (2019), on the other hand, reported that he obtained the least seed yield from the control plot, as in our study.

According to the results of the analysis of variance, the effects of four different bean varieties that received organic and chemical fertilizers on the number of seed per plant were statistically insignificant at the 1% level (Table 3). According to Table 3, it was determined that the highest number of seeds per plant was in the PV2003 genotype with 88.60, and the least average number of seeds was in the PV2002 variety with 84.71 (Table 3). Aldemir (2019) reported that the fertilizers that received different chickpea cultivars had a significant effect on the number of seed per plant and that 44.83 in the Gökçe variety, 39.24 in the Azkan variety, and 31.83 in Aydın 92 variety. According to the results of the present study, this result was different.

3.4. Seeed Yield

According to the results of the analysis of variance, the difference between the seed yield of organic and chemical fertilizers that were applied to four different bean genotypes was found to be statistically significant at the 1% level (Table 1). According to Table 3, the maximum seed yield was in chemical fertilizer with 239.48 kg da^{-1}, and the control application with the least 116.81 kg da^{-1}. According to the results of the LSD test, it was determined that chemical fertilizer was in the first group (group a), sheep and cow manure in the second group (group b), and control application was in the third group (group c) (Table 3). Gül (2018) reported that they obtained the highest seed yield in soybean plants with chicken manure and Bulut (2013) reported that they obtained the highest seed yield in bean plants with chicken manure with 141.33 kg da^{-1}.

According to the analysis of variance because of the study, it was found that the difference in seed yield between four different bean varieties, which received organic and chemical fertilizers, was significant at the level of 1% level (Table 1). In the study, it was found that the maximum seed yield was 181.14 kg da^{-1} in the PV2002 genotype, and the least seed yield was 155.39 kg da^{-1} in the Riberia genotype (Table 3). According to the LSD test results, PV2001, PV2002, and PV2003 genotypes were in the first group (group a), and the Riberia genotype was in the second group (group b) (Table 3). Aldemir (2019) reported that different fertilizer applications in the chickpea plant affected the seed yield in three different chickpea cultivars significantly and obtained a similar result to our analysis results. Göksu

(2012), because of his study on peas, reported that the fertilizers did not have effects on the cultivars and contradicted our result.

3.5. Weight of Hundred Seed

According to the results of the analysis of variance, the difference between the hundred-seed weight of organic and chemical fertilizers applied to four different bean genotypes was found to be statistically significant at the rate of 1% level (Table 1). When Table 4 is examined, the mean 100-seed weight in the parcels with sheep manure was the highest at 40.91 g. The lowest was obtained from the control plots with 36.32 g (Table 4). According to the results of the LSD test, sheep manure was in the first group (group a), cow manure was in the second group (group ab), chemical fertilizer was in the third group (group b), and control application was in the fourth group (group c) (Table 4). Göksu (2012) obtained the highest values in terms of hundred seed weight and yield in pea plants with manure application, Bulut (2013), on the other hand, reported that the mean values of fertilizer application in bean plants were between 27.43-28.73 g and the highest weight was 28.73 g from chicken manure application.

Table 4
Variance analysis of the weight of hundred seed and protein ratio of the bean genotypes that received organic and chemical fertilizers

Genotype	Chemical and Organic Fertilizers								Mean	
	Control		Chemical Fertilizers		Cow Manure		Sheep Manure			
Weight of Hundred Seed (g)										
PV2001	32,43	b	36,71	f	36,53	f	37,68	ef	35,84	c
Riberia	37,53	ef	38,72	de	39,19	de	40,49	cd	38,98	b
PV2002	38,90	de	38,95	de	41,60	bc	41,36	c	40,20	ab
PV2003	36,44	f	39,91	cd	43,45	ab	44,12	a	40,98	b
Mean	36,32	c	38,57	b	40,20	ab	40,91	a	39,00	
Protein Ratio (%)										
PV2001	27,36		27,88		26,65		28,49		27,60	a
Riberia	28,72		27,14		25,97		27,22		27,26	ab
PV2002	26,79		26,42		25,92		25,95		26,27	b
PV2003	27,07		25,55		27,39		25,95		26,49	b
Mean	27,49		26,75		26,48		26,91		26,91	

*: The differences between the means denoted by the same letter were not statistically significant.
Weight of hundred seed: $LSD_{Fertilizer}$: 1.71, $LSD_{Genotype}$: 1.30, $LSD_{Genotype\ x\ Fertilizer}$: 1.91; Protein ratio: $LSD_{Genotype}$: 2.22

According to the results of the trial, the difference between genotypes in terms of the hundred-seed weight of bean genotypes applied with organic and chemical fertilizers was found to be significant at the 5% level (Table 1). According to Table 4, it was found that the PV2003 genotype had the highest seed yield at 40.98 g, and the PV2001 genotype had the least at 35.84 g. According to the LSD test, the PV2002 genotype was in the first group (group ab), Riberia and PV2003 were in the second group (group b), and PV2001 was in the third group (group c) (Table 4). Aldemir (2019) reported that the hundred-seed weight of Gökçe and Azkan cultivars were higher than that of the Aydın 92 cultivar when the chickpea cultivars were compared.

According to the results of the analysis of variance, the difference between the hundred-seed weight of the cultivar x fertilizer interaction was statistically significant at the 5% level (Table 4). When Table 4 was examined, it was found that the highest hundred-seed weight was 44.12 g from sheep manure application with the PV2003 genotype. It was determined that the parcels that had the least weight were 36.53 g of chemical fertilizer of the PV2001 genotype (Table 4). In their study, Elsiddig et al. (1998) reported that organic matter applications applied to chickpea plants increased the hundred-seed weight.

3.6. Protein Ratio: According to the test results, it was found that organic and chemical fertilizers were statistically insignificant in terms of protein ratios (Table 1). As seen in Table 4, it was found that the highest protein rate was in the control application at 27.49%, and the lowest was in the cow manure at 26.48% (Table 4). Göksu (2012) reported that as a result of the applications in peas, the values varied between 21.15% and 24.07%, the highest value was obtained from 1 NP application, and the lowest values were obtained from control and bacteria applications. Bulut (2013) reported that the protein ratio in seed applications is between 18.28% and 21.05% as a result of fertilizer applications, the highest protein ratio is obtained in the chicken application and the lowest in the control application. Gül (2018), on the other hand, reported that the highest crude protein ratio was obtained from leonardite (45.89%) application in soybean organic fertilizer applications and the lowest from chicken manure application (45.5%).

According to the results of the analysis of variance, the effects of organic and chemical fertilizers applied to four different bean genotypes on the protein ratio were found to be statistically significant at the 1% level (Table 1). Among the four different bean genotypes used in the trial, PV2001 had the highest protein rate at 27.66% and the lowest protein rate was PV2002 with 26.27% (Table 4). According to the results of the LSD test, the

PV2001 genotype was found in the first group (group a), the Riberia genotype in the second group (group ab), and the PV2002 and PV2003 genotypes in the third group (group b) (Table 4). Gül (2018) reported that the crude protein ratio in the soybean plant was 45.71% in the Arısoy variety and 45.63% in the Nova variety and that the Arısoy variety had a higher value. Aldemir (2019) reported the effect of chickpea varieties on protein ratio as significant. Other researchers working on this subject obtained similar results (Ceyhan, 2004; Ülker and Ceyhan, 2008b; Varankaya and Ceyhan, 2012; Kepildek and Ceyhan, 2021).

4. Conclusions

The reactions of the bean lines used in the study to chemical fertilizer and some organic fertilizer applications showed differences. As a result, when the results obtained in this one-year study were examined, it was found that cow and sheep manure could be used in organic bean cultivation.

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6. References

Akgün H (2018). Leonardit ve Organik Deniz Yosunu Gübrelerinin Fasulye Bitkisinin Gelişimi ile Toprağın Fiziko-kimyasal Özelliklerine Etkisi, Giresun Üniversitesi Fen Bilimleri Enstitüsü, , Giresun, 82.

Aldemir B (2019). Nohut (*Cicer arietinum L.*) Tarımında Gül Posası, Ahır Gübresi ve Bakteri Aşılamanın Verim ve Bazı Verim Öğelerine Etkisi, Isparta Uygulamalı Bilimler Üniversitesi Lisansüstü Eğitim Enstitüsü, Isparta, 51.

Başdemir F, Türk Z, İpekeşen S, Tunç M, Eliş S ve Bicer BT (2020). Bazı Bakla (*Vicia faba L.*) Çeşitlerinde Gübre Uygulamalarının Verim ve Verim Unsurlarına Etkisi, Türk Tarım ve Doğa Bilimleri Dergisi, 7 (3), 749-456.

Bulut N (2013). Aşılı Aşısız Koşullarda Fasulyede *(Phaseolus vulgaris L.*) Organik Gübrelerin Verim ve Verim Öğeleri Üzerine Etkisi, Yüzüncü Yıl Üniversitesi Fen Bilimleri Enstitüsü, Van, 47.

Ceyhan E (2004). Effect of Sowing Dates on Some Yield Components and Yield of Dry Bean *(Phaseolus vulgaris L.*) Cultivars, Turkish Journal of Field Crops, 9 (2), 87-95.

Elsiddig A, Lsheikh E, Ekhlas M ve Mohamedzein M (1998). Effect of Biologial, Organic and Chemical Fertilizers on Yield, Hydration Coefficient, Cookability, Mineral Composition of Groundnut Seeds, Food Chemistry, 63, 253-257.

Erdönmez HK (2020). Kahramanmaraş Şartlarında Farklı Gübre Formlarının Soya Fasulyesinin (*Glycine mx. (L.) Merrill*) Verim ve Kalite Unsuları Üzerine Etkisi, Kahramanmaraş Sütçü İmam Üniversitesi Fen Bilimleri Enstitüsü, 50.

FAO (2022). Crops and Livestock Products, https://www.fao.org/faostat/en/#data/QCL/visualize, [26/07/2022].

Göksu E (2012). Bezelye (*Pisum sativum L.)*'de Kimyasal, Organik ve Mikrobiyal Gübrelemenin Verim ve Verim Özelliklerine Etkileri, Uludağ Üniversitesi Fen Bilimleri Enstitüsü, Bursa, 124.

Gül S (2018). II. Ürün Olarak Yeetiştirilen Soyada (*Glycine max. (L.) Merr.*) Organik Gübre Uygulamalarının Verim Unsurları ve Bazı Kalite Kriterleri Üzerine Etkisi, Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü, Samsun, 62.

Kaya AR ve Erdönmez HK (2020). Farklı Kökenli Gübre Form ve Dozlarının Soya Fasulyesinin (*Glycine max. (L.) Merrill*) Tohum Çimlenmesi ve Fide Gelişimi Üzerine Etkisi, Türk Doğa ve Fen Dergisi, 9 (Özel Sayı), 73-79.

Şehirali S (1998). Yemeklik Tane Baklagiller, Ankara, Ankara Üniversitesi Tarla Bitkileri Yayınları, p. 21-25.

Ülker M ve Ceyhan E (2008a). Orta Anadolu Ekolojik Şartlarında Yetiştirilen Fasulye (*Phaseolus vulgaris L.*) Genotiplerinin Protein ve Bazı Mineral Oranlarının Belirlenmesi, S.Ü. Ziraat Fakültesi Dergisi, 22 (46), 90-97.

Ülker M ve Ceyhan E (2008b). Orta Anadolu Ekolojik Şartlarında Yetiştirilen Fasulye (*Phaseolus vulgaris L.*) Genotiplerinin Bazı Tarımsal Özelliklerinin Belirlenmesi, S.Ü. Ziraat Fakültesi Dergisi, 22 (46), 77-89.

Varankaya S ve Ceyhan E (2012). Yozgat Ekolojik Şartlarında Yetiştirilen Fasulye *(Phaseolus vulgaris L.)* Genotiplerinin Bazı Tarımsal Özelliklerinin Belirlenmesi, Selçuk Tarım ve Gıda Bilimleri Dergisi, 26 (1), 27-33.

Yurtsever N (1984). Deneysel İstatistik Metotları, Ankara, Tarım Orman ve Köyişleri Bakanlığı Köy Hizmetleri Genel Müdürlüğü, p.