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Araştırma makalesi

The Influence of Organic Fertilizer Applications on Seed Yield And Some Quality Properties of Soybean Grown As Second Crop

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Abstract

It was aimed to determine the influence of some organic fertilizer applications (leonardite, cattle manure, sheep manure, poultry manure) on second crops soybean's seed yield and some quality properties with this research. Theresearch was conducted with Arısoy and Nova soybean varieties according to Stripe Plots at Randomized Complete Block design, with 8 replications at 40° 45' 48" latitude, 36° 26' 44" longitude coordinates which has partly continental climate in 2015. According to data's variance analysis, the effect of fertilizer applications on plant height was found significant (p≤ 0.05), while on first pod height, number of pods and stem per plant, seed yield per plant, weight of 1000 seeds, biological yield, seed yield, crude oil and protein content was found unsignificant. The highest seed yield was taken from poultry manure application (4.659 ton ha^{-1}) for Arısoy variety. The pod number per plant changed between 69.97–78.33 number $plant^{-1}$. While the highest 1000 seed weight was found for poultry manure application (200 g), the lowest (183.9 g) was obtanined from inorganic ferlitizer application. As a result, it was concluded that poultry manure could be used instead of inorganic manure for high seed yield for second crop soybean cultivation in regions where shows partly continental climate characteristics, but continue similar studies would be beneficial at different locations and at years.

Keywords: *Glycine max (L.) Merr., oil and protein, plant height, poultry manure, pod number.*

Özet

Soya (*Glycine max* (L.), ana ürün ve ikinci ürün olarak yetiştirilen, protein ve yağ içeriği bakımından önemli bir endüstri bitkisidir. Bu araştırmada ikinci ürün koşullarında bazı organik gübre uygulamalarının (leonardit, sığır gübresi, koyun gübresi, tavuk gübresi) soyanın tohum verimi ve bazı kalite kriterleri üzerine etkisinin belirlenmesi amaçlanmıştır. Araştırma, Arısoy ve Nova soya çeşitleri ile 2015 yılında, kısmen karasal iklim özelliği gösteren, 40° 45' 48" enlem, 36° 26' 44" boylam koordinatlarında, tesadüf bloklarında şerit parseller deneme desenine göre 8 tekrarlamalı kurulmuştur. Verilerin varyans analizine göre, gübre uygulamalarının bitki boyu üzerine etkisi önemli (p≤ 0.05), ilk bakla yüksekliği, bakla sayısı, dal sayısı, bitkide tohum verimi, 1000 tohum ağırlığı, biyolojik verim, tohum verimi, ham yağ ve protein oranı üzerine önemsiz olmuştur. En yüksek tohum verimi Arısoy çeşidinde tavuk gübresi (4.659 ton ha^{-1}) uygulamasından elde edilmiştir. Bitkide bakla sayısı 69.97–78.33 adet/bitki arasında değişmiştir. En yüksek 1000 tane ağırlığı tavuk gübresi uygulamasında (200g) bulunurken, en düşük inorganik gübre uygulamasında (183.9g) belirlenmiştir. Sonuç olarak, kısmen karasal iklim özelliği gösteren bölgelerde, ikinci ürün soya yetiştiriciliğinde, tavuk gübresinin yüksek tohum verimi için inorganik gübrelerin yerine

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kullanılabileceği, fakat farklı lokasyon ve yıllarda benzer çalışmaların sürdürülmesinin yararlı olacağı sonucuna varılmıştır.

Anahtar Kelimeler: *Bitki boyu, bakla sayısı, Glycine max (L.) Merr., tavuk gübresi, yağ ve protein.*

1. Introduction

Soybean is an important crop which is used for human and animal nutrition alongside different stemes of industry with36-40% protein, 18-24% oil, 26% carbonhydrate, 8% mineral substances in seeds [1]. Soybean oil is raw material for vegetable oil and margarine industry. It is rather rich in terms of crude protein when its oil-cake is compared with other oily seed's oil-cake. It is used as a thickener for production of lots of foodstuff because of involving lesithin [2]. Soybean oil-cake is value for feed content in poultry meat production because it becomes useful more quickly and effectively than other meals [3].

The production of soybean started in 1940s in Turkey. It was cultivated in Black Sea Region and Çukurova Region; but it could not compete with other agricultural products that have been cultivated in that region because of the given low unit price for soybean, and the intented rise of the production of it could not be reached [2]. Nowadays, 140 thousand tons soybean were cultivated in 35.294 ha area [4] in Turkey which has the suitable ecological conditions to cultivate soybean. However, Arıoğlu et al. (2020) [5] were stated that 2.83 million tons soybean and soybean products were imported because the amount of production was pretty inadequate for need soybean.

Optimum temperature is 25-30°C and need to 500-700 mm water during soybean growing. Being soil's pH between 6.2-6.8 is ideal for high seed yield and nodulation [6]. Besides, the most important condition to be successful at agricultural production is to increase soils' organic substance contents and to protect them. Unconscious chemical fertilizer applications for agricultural production, the misuse of agricultural soils cause to increase soil pollution, to decrease day by day the organic substance contents of agricultural soils which are low and they cause to decrease their yield [7, 8]. Organic fertilizers increase soil's organic substance content, and food elements intake by controlling its pH and make rich the soil in terms of macro and micro nutritions, like N, P, Ca and S; enhance field moister capacity [9, 10]. Organic fertilizers increase products' qualities and quantities without harming human health and environment [7]. Blood powder, horn and hoof powder, fish flour, bone flour, rock phosphate, wooden ash, poultry manure, cattle manure, green manures, vermicompost, horse manure, sheep manure are some of the resources for organic fertilizers [11].

The nutrition content of farmyard manures (cattle, horse, sheep etc.) which have been used by producers from of old change in terms of animal age, the content of fed forage, type of litter which is used the content of solid manure and urine, the condition of barn and reservation techniques [7]. Poultry manure is an organic manure which is rich in terms of nitrogen content, and its moisture content is low, its nutrient amount is high. The first year of poultry manure application, plants used 65% nitrogen, 50% phosphor, 75% potassium [12]. Leonardite applied to improve the structure of the soil; It is a dark brown or black mine that can easily dissolve in alkaline environments. It is formed as a result of the slow oxidation and chemical change of lignite coal in nature for millions of years. Leonardite is the basic raw material of humic acid. It is used as an organic soil improver for agriculture commonly [13].

In this research the combination of organic with chemical fertilizers are not included. The main objective of the study is to determine whether organic fertilizers as leonardite, cattle, sheep, poultry manures can be used instead of inorganic fertilizers for the cultivation of second crop soybean.

2. Material and Method

The Arısoy and Nova soybean varieties were used as material; they were at III. maturity group, became prominent in terms of yield under Black Sea climate conditions at previous studies [2, 14]. The Arısoy and Nova varieties's plant height is changed between 116 and 110 cm, their 1000 seed weight between 138 and 150 g, their seed yields between 4.34 kg ha^{-1} and 4.50 kg ha^{-1}, respectively [15].

In the experiment, cattle, sheep, poultry manures, leonardite and inorganic fertilizer application (control) were done. Leonardite was bought from Bitek Agriculture and Chemistry Company. Organic fertilizers as matured were supplied from surrounding livestock businesses. Organic fertilizers which were taken were analyzed, and they were applied into parcels after soil preparation were completed before a month from seed sowing. The chemical analysis of organic fertilizers was given at Table 1.

Tablo 1. The chemical contents of organic fertilizers that were used in the experiment

	pH	Organic Matter (%)	N (%)	P (%)	K (%)
Cattle Manure	8.2	37	1.1	0.7	0.4
Sheep Manure	7.1	35	2.0	0.6	0.8
Poultry Manure	6.5	53	3.1	2.3	1.8

The used as a soil improver, leonardite's pH was measured as 8.5, organic matter content 7%, total acid (humic+fulvic) 12%, soluble potassium oxide 2%. The soil of the experimental area was found slightly alkaline (pH 7.7), non-saline, calcareous at medium level (11.25%), pretty poor in terms of nitrogen (0.067%), was clay, and its available P_2O_5 was high (9.86 kg da^{-1}), its organic matter was little (1.3%), its available K_2O was high (70.42 kg da^{-1}).

Tablo 2. Climate data for many years (1960-2014) and 2015 for experimental periods; mean of temperature (oC), mean of moisture (%) and total rainfall (mm)

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Mean
2015	**Temperature (°C)**	10.7	18.6	21.1	23.7	25.6	23.7	15.9	9.5	14.1
	Moisture (%)	55.6	54.3	60.4	52.2	49.8	52.1	66.9	66.3	60.9
	Rainfull (mm)	37.4	49.7	93.0	8.5	21.3	12.6	49.4	14.2	465.7*
Many years	**Temperature (°C)**	13.6	17.9	21.6	24.1	24.0	20.1	14.7	8.6	13.7
	Moisture (%)	56.5	55.9	53.5	52.3	53.5	56.4	62.2	67.0	59.6
	Rainfull (mm)	56.4	51.3	37.9	14.8	9.3	20.5	35.9	44.6	459.0*

Source; Amasya Meteorology Directorate, * Shows the total annual precipitation

The region where the study has been conducted is generally dry and warm in summers, cool and rainy in winters, has partly continental climate characteristics. The experiment year (2015) and of long years' (1960-2014) the climate data were changed average

temperature between 14.1°C to 13.7°C, relative humidity between 60.9% to 59.6%, total rainfull between 465.7 mm to 459 mm, respectively (Table 2). Total rainfull was less than long years average in April, May, July in 2015, and as well as it was irregular in June and much than long years average. There was not significant differences seen between the averages of 2015 and long years in terms of temperature averages. The experiment were carried out at 235 altitude, 40° 45' 48" latitude and 36° 26' 44" longitude coordinates according to the Stripe Plots at Randomized Complete Block design, with 8 replications in Taşova province of Amasya city, at 2015. The experiment was consisted of 1.664 m^2, as 40 main parcels and 80 sub-parcels. The each sub-parcel was 17.5 m^2 and it was consist of 5 rows with a length of 5 m and row spacing was 70 cm and within row was 5-6 cm. Fertilizer applications were located into the main parcels, varieties were located into the sub parcels, 1.5 m distance was left among main parcels to prevent fertilizer confusion. The field soil, where the previous crop is paddy, was left to rest by plowing deeply in February, then it was processed again in May and prepared for planting.

Regarding the results of soil analysis, aiming to raise the organic substance content of the soil as 1 %, 3000 kg da^{-1} cattle manure, 2000 kg da^{-1} sheep manure (75% of cattle manure), 1500 kg da^{-1} poultry manure (50 % of cattle manure), leonardite which was used as an organic fertilizer by producers as 250 kg da^{-1} were applied. The explanations related with the leonardite will be defined as 'organic fertilizer' in this article due to producers use it for the purpose of organic fertilizer. Before a month from sowing, 52 kg $parcel^{-1}$ cattle manure, 35 kg $parcel^{-1}$ sheep manure, 26 kg $parcel^{-1}$ poultry manure, 4.3 kg $parcel^{-1}$ leonardite were applied and then were mixed within the soil by rotovator. Inorganic fertilizer applied in soybean cultivation was selected as control and 5 $kgda^{-1}$ pure N in the form of 21% ammonium sulfate was applied because of the pH highness of the region soils [1]. The seeds were sowed at 3-4 cm depth, after the seeds had been inoculated at a dose of 50 g kg-1 of seeds with a commercial inoculant of *Rhizobium brady japonicum* produced by Soil Fertilizer Central Research Institute (Ankara-Turkey) and containing $5x10^9$ colony forming units per gram [1,15], at June, 10th, 2015. Then, the drip irrigation system was installed and irrigation was done on the same day. The first 30 days after seedling emergence, once a week, then irrigation was done twice a week with the increase in temperatures, and when the pods completed their maturity and the leaves began to turn yellow, irrigation was stopped. Weed struggle was done twice in the experiment area. The harvest was completed in November, 5th, 2015. In the study, plant height, stem number per plant, biological yield, pod number per plant, seed yield per plant, first pod height according to Ay [2]. All measurements and observations were made on 10 plants selected from each plot. Yield per hectare was calculated by using parcel yields, crude protein and crude oil content were determined by Near Infrared Spectroscopy (NIRS) [16, 17] in Ondokuz Mayis University, Faculty of Agriculture, Field Crops' laboratory.

Statistical Analysis: The analysis of obtained data were analyzed according to Stripe Plots at Randomized Complete Block Design using MSTAT-C programme statistically, the differences between the averages were determined with LSD ($p \leq 0.05$) test [18, 19].

3. Result and Discussion

The study which was conducted to search for the effect of organic fertilizer applications for soybean grown as a second crop on seed yield and some quality properties, the effect of organic fertilizers on plant height was found significant ($p \leq 0.05$) statistically according to obtained data's variance analysis results, and the effect of organic fertilizers on all the other properties was found unsignificant. There were very significant

differences ($p \leq 0.01$) between varieties in terms of plant height, seed yield per plant, 1000 seed weight, seed yield per hectare, and the effect of variety x fertilizer interaction was unsignificant on the criteria examined (Table 3).

Although fertilizer applications give similar values in terms of mean plant height, the highest plant height was measured in poultry manure application (99.63 cm) and the lowest (91.78 cm) with inorganic fertilizer application. The mean plant height of Arısoy variety (99.67 cm) was longer than Nova variety (90.86 cm). The highest plant height in terms of variety x fertilizer interaction was measured with poultry manure and leonardite (102.4 cm and 101.95 cm, respectively) applications of Arısoy variety, the lowest (87.16 cm) with cattle manure application of Nova variety (Table 4).

Plant height is affected by environmental factors such as lighting time and temperature, as well as cultural processes such as sowing time, sowing frequency, cultural practices and irrigation [14, 21]. In soybeans grown under second crop conditions, due to light intensity and high temperature [22], the plants bloom early, so the plant height is shorter than the main crop conditions [23], Mekki and Ahmed [24], measured the highest plant height (113.50 cm) for soybean at biological + organic fertilizer combination, measured the lowest (93.25 cm) at only organic fertilizer application. İlker et al. [25], determined the plant height in Nova cultivar under main crop conditions as N-P-K (18-46-0) and farmyard manure applications 77.68-62.27 cm at the 1st year and 101.55-79.53 cm at the 2nd year, respectively, the plant height with the farmyard manure application was measured shorter than inorganic fertilizer application. In spite of that Singh et al. [26], determined the highest plant height (84.4 cm) with *Rhizobium bacteria* + Nitrogen bacteria + phosphorus dissolving bacteria + farmyard manure combinations. Chiezey and Odunze [27], measured plant height for soybean at poultry manure application as 60.6-70.3 cm at the doses of 0 t ha^{-1} and 1 t ha^{-1} respectively, Mandal et al. [28], measured the highest plant height (82 cm) in soybean with N-P-K + farm manure applications and they stated that the mixture of inorganic and organic fertilizers raised plant height. Yamika and Ikawati [29], who referred similar data measured the highest plant height (71.7 cm) for soybean at 225 kg ha^{-1} N-P-K + 0.5 tha^{-1}organic fertilizer application and stated that there were raises of plant height when organic fertilizer doses raised. Devi et al. [30], who analyzed different organic fertilizer and chemical fertilizers combinations for soybean determined the highest plant height (41.49 cm) at 30–45–15 kg ha^{-1} N-P-K + phosphate solvent bacteria + 1 t ha^{-1} vermicompost combination. Besides, plant height were measured as 32.70 cm with farmyard manure application, 33.34 cm with1 t ha^{-1} vermicompost application. Arslanoğlu and Aytaç [23] determined the plant height in the Erbaa and Suluova locations, which is very similar to the ecology in which this experiment was conducted, 62.98-76.11 cm and 91.20 - 81.32 cm, at the 1st and 2nd year and location, respectively. Yetgin and Arıoğlu [31], measured the plant height of Arısoy and Nova varieties as 94.53-108.5 cm, respectively, Bakal et al. [32], 108.8 - 110.7 cm respectively under second crop conditions. The plant height values obtained from this study were found higher than some researcher's findings [25-29]. Varieties' plant heights were found similar with Yetkin ve Arıoğlu's data [31] and shorter than

Table 3. The Summary of results of variance analysis (F values) of some organic fertilizer applications in second crops soybean (*Glycine max* (L.) Merr.) cultivation in terms of investigated criterias

Variations	DF	PH	FPH	PN	STM	SYP	TSW	BY	SY	CPC	COC
Repetition	7	10.4415**	15.587^{ns}	1.9074^{ns}	1.2184^{ns}	0.3898^{ns}	0.9058^{ns}	1.4477^{ns}	1.7710^{ns}	1.6817^{ns}	2.7364^{ns}
Fertilizer	4	3.6064*	1.975^{ns}	0.5375^{ns}	1.7715^{ns}	1.2572^{ns}	1.4983^{ns}	1.5749^{ns}	0.6597^{ns}	0.4129^{ns}	1.3473^{ns}
Error 1	28										
Variety	1	13.4773**	47.491**	0.0837^{ns}	1.1008^{ns}	10.3744**	22.0305**	5.3654^{ns}	14.7770**	0.0443^{ns}	0.4989^{ns}
Error 2	7										
VarietyxFertilizer	4	0.5142^{ns}	0.082^{ns}	0.6266^{ns}	0.3552^{ns}	0.0885^{ns}	1.2781^{ns}	1.3936^{ns}	1.7366^{ns}	0.3184^{ns}	0.1155^{ns}
ERROR	28										
CV%		6.38	12.22	11.29	9.91	11.55	9.97	16.78	11.67	1.74	1.73

^{ns}: not significant , *p≤ 0.05, ** p≤ 0.01 at statistically significant within error limits, Degrees of Freedom (DF), Plant Height (PH), First Pod Height (FPH), Pod Number (PN), Stem Number (STM), Seed Yield per Plant (SYP), 1000 Seed Weight (TSW), Biyological Yield (BY), Seed Yield (SY), Crude Protein Content (CPC), Crude Oil Content (COC)

Table 4. The effect on plant height (cm) and first pod height (cm), pod number (number parcel^{-1}) and stem number (numberparcel^{-1}) of some organic fertilizer applications in second crop soybean (*Glycine max* (L.) Merr.) cultivation

	Plant height (cm)			First pod height (cm)			Pod number (number plant^{-1})			Stem number (number plant^{-1})		
Fertilizers	Arısoy	Nova	Mean	Arısoy	Nova	Mean	Arısoy	Nova	Mean	Arısoy	Nova	Mean
Mineral fertilizer	96.08	87.48	91.78b	13.30	10.16	11.73	77.36	76.85	77.11	5.20	5.30	5.25
Leonardit	101.95	91.24	96.59ab	14.21	11.15	12.68	78.33	74.26	76.30	5.62	5.42	5.52
Cattle Manure	98.08	87.16	92.62b	12.91	9.91	11.41	69.97	74.01	72.02	5.23	5.31	5.27
Sheep Manure	99.85	91.59	95.72ab	13.43	10.84	12.13	76.50	76.70	76.60	5.21	5.45	5.33
Poultry Manure	102.40	96.85	99.63a	14.40	11.36	12.85	78.24	74.40	76.25	5.67	5.77	5.72
Mean	99.67a	90.86b		13.63a	10.68b		76.08	75.23		5.39	5.34	
LSD	8.39$_{(P \le 0.01)}$		4.83$_{(P \le 0.05)}$	1.49$_{(P \le 0.01)}$								

The figures bearing the same letter (s) do not differ significantly at p ≤ 0.05

Table 5. The effect on seed yield per plant (g plant^{-1}), 1000 seed weight (g), biyological yield (g plant^{-1}) and seed yield (ton ha^{-1}) of some organic fertilizer applications in second crop soybean (*Glycine max* (L.) Merr.) cultivation

	Seed Yield per Plant (g plant^{-1})			1000 Seed Weight (g)			Biyological Yield (g plant^{-1})			Seed Yield (ton ha^{-1})		
Fertilizers	Arısoy	Nova	Mean	Arısoy	Nova	*Mean*	Arısoy	Nova	Mean	Arısoy	Nova	Mean
Mineral fertilizer	34.25	30.25	32.25	197.3	170.5	183.9	102.8	93.0	97.9	4.554	3.403	3.979
Leonardit	32.50	28.50	30.50	187.6	188.3	187.9	122.8	92.1	107.4	4.247	3.799	4.023
Cattle Manure	35.50	32.00	33.25	209.6	185.6	197.6	99.9	95.9	97.9	4.431	4.020	4.226
Sheep Manure	33.00	30.50	31.75	198.9	187.0	192.9	108.6	96.9	102.7	4.390	3.959	4.174
Poultry Manure	36.50	33.50	35.00	208.1	191.9	200.0	126.4	106.9	116.7	4.659	3.915	4.287
Mean	34.4a	30.9b		200.3a	184.6b		112.1	97.0		4.456a	3.819 b	
LSD	2.49$_{(P \le 0.01)}$			11.71$_{(P \le 0.01)}$						579.7 $_{(P \le 0.01)}$		

The figures bearing the same letter (s) do not differ significantly at $p \le 0.01$

plant height which Bakal et al. [32] determined. In general, it can be said that the high contents of organic substance and nitrogen of poultry manure, leonardite's comprising of humic and pulvic acids in present study (Table 2) which promote growing cause plant height get longer providing plants' development rapidly. However, organic fertilizer applications and variety x fertilizer interaction were found unsignificant statistically in terms of first pod height. The mean first pod height was measured higher with poultry manure application than other fertilizer applications. The shortest first pod height (9.91cm) was measured with cattle manure application of Nova variety. The Arısoy variety (13.63 cm) was found higher than Nova variety (10.68 cm) (Table 3). First pod height is an important criteria for machine harvesting in soybean agriculture. It is affected from the genetic characteristic of variety, sowing frequency, sowing time, light exposure time and total temperature [2]. According to Bakal [32] and Arslanoğlu and Aytaç [23], the high temperatures that occur during the seedling period encourage early flowering and cause the first pods to form close to the soil surface. The seedling period of soybean grown as a second crop usually coincides with the warm period. It is desired that first pods grow at least at 10 cm above from soil surface for not being lost seed during harvest, and not being below of first pods under combine harvester's blade height [1]. The obtained data in present research showed connection with first pod height (6-11 cm) which was determined under main crop conditions in Central Anatolia region by Mert [33], whereas Yetgin and Arıoğlu [31] measured first pod heights as 12.4-22.17 cm respectively for Nova and Arısoy varities under Mediterranean Climate conditions. These values were found higher than our findings because of the difference of climate factors or sowing time. In the present study, first pod height stayed within optimum limits for harvest with machine at all fertilizer applications except cattle manure application for Nova variety.

The effect of fertilizer applications on pod number was found unsignificant and changed between 78.33 number plant^{-1} (leonardite application) to 69.97 number plant^{-1} (cattle manure application) of Arısoy variety (Table 4). Singh et al. [26], who measured pod number as 72.8 number plant^{-1} with farmyard manure application. Similar findings stated by Devi et al. [30] who determined the highest pod number (65.68 plant^{-1}) at the combination of chemical fertilizer + phosphate solvent bacteria +1 t ha^{-1} vermicompost. Same researchers measured pod as 28.52 number plant^{-1} with 5 t ha^{-1} farm manure application as 32.51 number plant-1 with 1 t ha^{-1} vermicompost. Nova and Arısoy varieties' mean pod numbers changed between 73.97 -56.10 number plant^{-1} [31], and 64.6-70.3 number plant^{-1} [32], under main crop condition at the studies conducted in Turkey.

There were not any effect of fertilizer applications on stem number for growth as a second crop soybean and all fertilizer applications gave similar results each other. Mean stem number measured higher (5.72 number plant^{-1}) with poultry manure than inorganic fertilizer application (5.25 number plant-1) and other applications (Table 4). Our findings showed connection with the results of İlker et al. [25] who determined stem number as 3.58 number plant $^{-1}$ of Nova variety at farmyard manure application at 1st year, as 4.80 number plant^{-1} at 2nd year, but were found higher than the results of Ay [2] who determined stem number as 2.91number plant^{-1} of Arısoy and as 3.9 number plant^{-1} of Nova under main crop conditions. The seed yield of plant of Arısoy was found higher at poultry manure (36.50 g) and cattle manure applications (35.50 g) than the other fertilizer applications. The lowest seed yield of plant was measured with leonardite application of Nova variety (28.50 g). The seed yield of Arısoy (34.4 g plant^{-1}) was found higher than Nova variety (30.9 g plant^{-1}) (Table 3. 3). The sufficient and regular nutrition of plants is one of the important factors that affect seed yield. Thus, in this study, poultry

manure was raised seed yield and supplied plants in terms of plant nutritions that they need to grow and develop during their vegetation because it has higher organic substance and N, P ve K contents than other organic fertilizers. It is stated that the seed yield of plant changed between 11.9 g to 17.6 g plant^{-1} in the conducted studies [34, 35]. In this study, the seed yield of plant was found higher than literature. However there was not found any significant difference between variety x fertilizer interaction and organic fertilizer applications in terms of 1000 seed weight, the highest 1000 seed weight determined for Arısoy with cattle manure (209.6 g) and poultry manure (208.1 g) applications, the lowest determined for Nova with inorganic fertilizer application. The 1000 seed weight of Arısoy (200.3 g) was found higher than Nova (184.6 g) (Table 3.3). The 1000 seed weight of soybean changes in terms of the characteristics of varieties' genotypes, environmental factors such as precipitation and temperature, sowing frequency, maintenance work, rhizobium bacteria inoculation and soil's nutrition condition. Whereas, Son et al. [36] determined the highest 100 seed weight (equals 10x100 seed weight) of soybean for compost+chemical fertilizer combination (16.83 g), they measured it as 15.90 g in the plants which were applied only barnyard manure. Singh et al. [26], determined the highest 100 seed weight at the combination of nitrogen bacteria + phosphorus dissolving bacteria + farm manure (12.69 g), and at only farm manure application (12.67 g) . Mandal et al. [28] measured the 1000 seed weight of soybean as 78.6 g for chemical application, as 87.5 g for chemical fertilizer+10 t ha^{-1} farm manure combination, Chiezey and Odunze [27] measured the 100 seed weight of soybean as 12.8 g for 1 t ha^{-1} poultry manure application, Devi et al. [30] measured the 100 seed weight as 12.68 g for 5 t ha^{-1} farm manure application, as 12.73 g for 1 t ha^{-1} vermicompost, and they stated that there was not any significant difference between fertilizer applications. Yetgin and Arıoğlu [31] measured the 1000 seed weight of Arısoy and Nova as 141–147.5 g under Mediterrian climate conditions, Kınacı [37], measured as 147.3–149.7 g, Mert [33] measured as 106.89- 188.07 g in Central Anatolia region respectively. In present study, however 1000 seed weight changed between 170.5-209.6 g, showed connection with Mert [33] finding, it was higher than literatures that mentioned above.

Although there was not found any significant difference between varieties, fertilizer applications and their interactions in terms of biological yield in present research. The leonardite (122.8 g plant^{-1})and poultry manure (126.4 g plant^{-1}) applications for Arısoy gave higher biological yield than the other fertilizer applications. The mean biological yield of Arısoy variety (112.1 g plant^{-1}) were higher than Nova variety (97.0 g plant^{-1}) (Table 5). Biological yield is affected by many factors such as the climatic conditions during the growing period, whether the plant is early or late maturity, the number of pods, the number of seeds, fertilizer [37, 38]. The findings obtained were higher than the data of Arslanoğlu and Aytaç [23] who determined the biological yield between 30.69 to 52.55 g plant^{-1} in Erbaa and Suluova conditions with similar climatic conditions, respectively. It was similar to the findings of Ay [2], who determined it as 109.58-112.08 g plant^{-1} in Arısoy and Nova varieties, respectively. This result may be due to the fact that poultry manure and leonardite encourage rapid growth and development of plants due to their nutrients. Although the effect of organic fertilizer applications on the seed yield of soybean were found unsignificant statistically, the highest seed yield was determined for poultry manure (4.287 ton ha^{-1}), cattle manure (4.226 ton ha^{-1}) and sheep manure (4.174 ton ha^{-1}) applications. The lowest seed yield was measured within organic application (3.979 ton ha^{-1}). While the highest seed yield at variety x fertilizer interaction was determined with Arısoy variety at poultry manure application (4.659 ton ha^{-1}), the lowest with Nova variety at inorganic fertilizer application (3.403 ton ha^{-1}). The seed yield of Arısoy variety (4.456 ton ha^{-1}) was found higher than Nova variety (3.819 ton ha^{-1}) (Table

3. 3). Ghosh et al. [40] stated that seed yield changed between 1.256-1.715 ton ha-1 in the study which they conducted with inorganic fertilizer and poultry manure combinations for soybean. Singh et al. [26] measured the highest seed yield with chemical fertilizer application (1,700 ton ha^{-1}),the lowest with farm manure application (1.300 ton ha^{-1}) and Chiezey and Odunze [27] determined seed yield as 1.967 ton ha^{-1} with poultry manure applications. Bhattacharyya et al. [41] and Bandyopadhyay et al. [42] reported that chemical fertilizers associated with organic fertilizers increased seed yield. İlker et al.[25] reported that seed yield changed between 1.467– 3.738 ton ha^{-1} with Nova at farm manure + chemical fertilizer applications. Devi et al. [30] determined 1.18 ton ha^{-1} seed yield with 5 ton ha^{-1} farm manure application, and 1.29 ton ha^{-1} seed yield with 1 ton ha^{-1} vermicompost. Arslanoglu and Aytaç [23] measured 1st and 2nd year seed yield as 2.111-2.959 ton ha^{-1} respectively, they carried out under main crop in Erbaa location and as 1.904-2.331 ton ha^{-1}, respectively in Suluova location. Bakal et al. [32] measured seed yield between 4.27-4.66 ton ha^{-1} under warm climate conditions. Kınacı [37] determined seed yield between 1.57-1.88 ton ha^{-1} with Nova and Arısoy varieties. Karagül et al. [43] determined seed yield as 322 kg $da^{-1}$for Arısoy variety. Our research result related to seed yields were found higher than yield values reported by some researchers [23, 25-30, 39-42]. The average seed yield of Arısoy was reported as 4.34 ton ha^{-1}, the average seed yield of Nova was reported as 4.50 ton ha^{-1} under main crop conditions in Turkey [15]. In the present study, although soybean was cultivated as second crop, the seed yield of Arısoy was found close or above the average of Turkey for all applications.

Table 6. The effect on crude protein (%) and oil content (%) of some organic fertilizer applications in second crop soybean (*Glycine max* (L.) Merr.) cultivation

	Crude Protein Content(%)			Crude Oil Content (%)		
Fertilizers	**Arısoy**	**Nova**	**Mean**	**Arısoy**	**Nova**	**Mean**
Mineral fertilizer	45.62	45.68	45.65	20.11	20.02	20.06
Leonardit	46.09	45.68	45.89	20.05	20.04	20.05
Cattle Manure	45.78	45.81	45.80	20.18	20.12	20.15
Sheep Manure	45.62	45.39	45.51	20.38	20.28	20.33
Poultry Manure	45.42	45.58	45.50	20.32	20.15	20.24
Mean	45.71	45.63		20.21	20.12	

There was not found any significant difference among fertilizer applications, soybean varieties and their interactions in terms of mean crude protein and mean crude oil content the highest crude protein content was measured with leonardite application (46.09%) and the lowest with poultry manure application (45.42%) at Arısoy variety. Obtained findings in terms of crude oil content was similar with crude protein content (Table 6). As regard to Arıoğlu [1] determined that the protein content of soybean changed between 36 to 40% and the oil content changed from 18 to 24%. In present study, crude protein contents were higher than the values that researcher reported, but crude oil contents were within reported limits. In different studies, protein contents changed between 49.69% to 34.40%, and crude oil contents changed between 26.62% to 16.28%. The researchers reported that there was not significant effect of organic fertilizer applications on crude protein and oil contents [24, 30]. Breeding organizations of varieties reported the average crude protein content of Nova and Arısoy soybean variety were 43% and % 37, respectively and average crude oil contents were 18% and 19% [15]. High temperatures at the seed filling period effect the protein and oil content

of seed [14, 32, 44]. In the present study, whereas the protein and oil contents of Nova variety remained within the limits that determined, the protein and oil contents of Arısoy were found higher than the value reported by breeding organization [15].

4. Conclusion

In this research conducted to determine the effects of some organic fertilizers (cattle, sheep, poultry and leonardite) on seed yield and some quality properties of soybean grown as second crop (*Glycine max* (L.) Merr.); poultry applications gave higher data than inorganic fertilizer applications in terms of seed yield per plant, 1000 seed weight and seed yield. This effect seen in poultry manure may be due to the fact that it provides of N, P, K nutrients needed during the development-growth and seed filling period, as well as having the ideal pH value for the intake of nutrients. As a result, it was concluded that in second crop soybean cultivation, poultry manure can be used instead of inorganic fertilizers for high seed yield, but one-year data is not sufficient for this recommendation, so it would be beneficial to conduct similar studies in different locations and different years.

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Conflict of interest

The authors declare no conflict of interest.

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