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Research Article

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The Effect of Organic and Inorganic Fertilization on The Yield and Some Yield Components of Lentil (*Lens culinaris* Medic.) In Van Conditions

Abstract

The study was conducted to determine effects of organic and inorganic fertilization on the yield and some yield components in lentil cultivars in 2014-15 growing seasons in Van. The experiment was laid out in a factorial randomised block design with three replications. The study was conducted to determine effects of different fertilizer sources (Control, DAP, Chicken manure and sheep manure) on the yield and some yield components in two lentil cultivars (Özbek and Kafkas). In the study were investigated the plant height, first pod height, branch number per plant, pod and seed number per plant, seed number per pod, biological yield, seed yield per unit, harvest index, 1000-seed weight and protein ratio in seed. The highest seed yield was obtained from chicken manure application of Özbek cultivar with 157.6 kg da^{-1}.

Keywords

Lentil, variety, organic, inorganic fertilization, yield

INTRODUCTION

Since lentil is an early and one-year plant that is resistant to drought, cold and high temperatures, not very selective in terms of soil demand, it enters a crop rotation with wheat in dry agricultural areas. Since it provides high income for farmers in dry farming areas, it has been one of the most grown plants in fallow land starting from the 1970s. Leguminous plants grown for green fertilization fix nitrogen in organic form from the atmosphere through the rhizobium bacteria in their roots (Coskun and Bengisu, 2021). Since some lentil varieties are resistant to drought and cold, they are grown for winter even in harsh winter regions of our country (Çiftçi, 1996) and play an important role in narrowing fallow land (Güngör, 1991). The most important indication that the fallow lands cannot be adequately evaluated in the province of Van is still the existence of 101 113 ha fallow lands throughout the province (TUIK, 2019). Intensive studies have been carried out in recent years to increase lentil production in Van, and as a result of these studies, it has been determined that some lentil varieties adapt to the winter conditions of the region and have high yield potential. Lentils are an important resource in meeting the protein needs of people, especially in underdeveloped and developing countries (Düzgün and Toğay 2021). It is a well-known fact that increasing crop production and farmers' income depends on increasing productivity, and one of the most effective ways to improve productivity is to use the right fertilizer. Although the share of fertilizers in productivity increase varies according to conditions, it is generally stated to be around 50%. Among the aims of organic agriculture is to enrich biological diversity, biological cycle and biological activity in the soil in order to ensure the social, ecological and economic sustainability of natural systems (Saman et al., 2008). Organic matter plays an important role in the vitality and productivity of the soil. The effect of organic matter can be direct or indirect. Organic matter plays an indirect role as a source of plant nutrients by directly affecting the physical and chemical properties of the soil. Excessive chemical fertilization used in agriculture causes some nutrients to decrease and some to accumulate excessively. The best way to keep the organic matter in the soil at the maximum level is organic fertilization (Son et al., 2004). Turkey lacks the raw materials necessary for the production of chemical fertilizers. In Turkey, most of the major inputs are imported for the production of fertilizer. Despite this, as a result of unconscious use of fertilizers and pesticides, pollution in surface groundwater is increasing day by day. For this reason, it is very important to raise the awareness of the farmer. The use of inorganic fertilizers should be regulated, taking into account the import. Promoting the use of organic fertilizers by considering the needs of soils and plants is very important for our country and our farmers. In this study, it was aimed to investigate the effects of chemical and various organic fertilizers on yield and some yield components in Özbek and Kafkas varieties adapted to the region.

MATERIAL and METHODS

The research was conducted in the experimental fields of the Faculty of Agriculture of Yüzüncü Yıl University during the 2014-2015 growing season. Özbek and Kafkas lentil varieties were used as plant material in the experiment. Kafkas: Breeded by the Field Crops Central Research Institute, this variety is wintery, early and cold-resistant. The grain crust color is brown and black patterned, the cotyledon color is red, and the grain weight is 35-37 g. Özbek: Breeded by the Field Crops Central Research Institute, this variety is wintery, early and resistant to cold. The grain shell color is gray, the cotyledon color is red, and the grain weight is 34-36 g. In the experiment, chicken (2.87% N, 2.35% K and 2.90% P) and sheep (0.85% N, 0.66% K and 0.14% P) fertilizers were used as an organic fertilizer source for

lentil varieties and DAP (18% N and 46% P) as an inorganic fertilizer source. P) fertilizer was given. The province of Van, where the study was conducted, is located in the Eastern Anatolia Region, in a basin surrounded by mountains and Lake Van to the west. The altitude of the province is 1725 m above sea level and it is located at 38^0 25 'north latitude and 43^0 21' east longitude.

Table 1. Average of long years and some climatic data for 2014-15 growing season in Van province (TSMS, 2015)

	Precipitaion (mm)		Avarage Temp. (C^O)		Relative humidity (%)	
Months	14-15	LTA	14-15	LTA	14-15	LTA
October	76.0	48.7	11.4	10.5	64.4	58.9
November	67.0	51.5	3.6	4.7	64.8	67.1
December	50.3	42.0	2.3	-0.7	76.2	72.5
January	48.2	46.2	-2.0	-1.8	69.3	70.8
February	11.2	82.0	-0.7	-0.6	66.9	71.8
March	121.7	40.8	3.5	3.8	66.4	66.5
April	58.2	51.5	8.8	9.9	55.1	52.7
May	62.3	35.0	13.6	14.6	56.5	53.6
June	6.2	16.0	20.0	19.2	41.3	43.3
Total	501.1	367.7				
Avarage			6.87	4.48	62.3	61.58

The climate data for the months covering the period in which the experiment was carried out and the average of long years are given in Table 1. In the region where the research was conducted, the annual precipitation amount related to the average of long years in the growing season is 367.7 mm, the average temperature is 4.48 ° C, the average relative humidity is 61.58%. The amount of rainfall in the 2014-15 growing season is 501.1 mm. The average temperature was 6.87 ^{0}C and the average relative humidity was 62.3%, which was above the average for many years (TSMS, 2015).

Table 2. Some physical and chemical analysis results of the trial area soil

Depth (cm)	Teksture	pH (1:2.5)	Lime (%)	Phosohorus (ppm)	Potassium (ppm)	Organic Matter (%)	Total Salt (%)
0-20	Loam	8.88	6.6	8.9	70	1.89	0.01

According to the soil analysis results, soil samples taken from 0-20 cm depth of the research area have loamy texture, with strong alkaline reaction, low organic matter content, medium lime in terms of lime content, salt-free phosphorus content was found to be medium while sufficient potassium content. The experiment was carried out with three replications according to the factorial randomised block design There are 24 parcels in the trial. Each parcel consists of 5 rows. Row spacing is 20 cm. Parcel area; 1m x 5 m = 5 m^2. The amount of seed to be thrown into the parcel was determined, corresponding to 350 seeds per m^2. 1 ton per decare sheep and chicken manures were applied to the lentil varieties used in the experiment. As an inorganic fertilizer, DAP fertilizer was applied at a rate of 14 kg per decare. All operations were

carried out on areas of 0.6 m x 4 m = 2.4 m² by excluding the plants in the 5 rows forming the parcel in harvest, one row on each side and 50 cm from the row heads as edge effect. The sowing process was done manually on October 25, 2014 by opening lines with a marker. In the experimental area, weed control was carried out twice, before and after flowering. The harvest was done by hand on June 26, 2015. The measurement, counting and blending processes of the harvested plants were carried out with great care in the laboratory and the average values were taken. Irrigation was not carried out as this experiment was intended to investigate the effects of different organic fertilizers on yield and yield components of lentils in the dry agricultural areas of the region. In determining the differences between the different organic fertilizers in terms of yield and yield components in the lentil variety tested in the study, the factorial trial design in the random blocks was used by the variance analysis method, while the Duncan (5%) Multiple Comparison Test (Düzgüneş et al., 1987) and Costat package programs. has been utilized.

RESULTS and DISCUSSION

The values obtained in the study were subjected to variance analysis. Averages of factor levels in terms of characters examined were applied according to Duncan (5%) Test. When Table 3 is examined, the average plant height of the fertilizers applied in lentils varied between 29.53-33.33 cm. The highest plant height was obtained from chicken manure application with 33.33 cm, and the lowest plant height was obtained from control plots with 29.53 cm. Toğay et al. (2005), in their study using different nitrogen doses and four different nitrogen forms in lentils, they obtained the highest plant height from organic nitrogen, Zeidan (2007) found that organic fertilizers increased the plant size in Egypt, Janmohammadi et al. (2015) reported in their study in Iran that farm manure gives higher plant height values than foliar fertilizers.

Table 3. Averages of the varieties and fertilizers examined in the study

Plant features	Varieties		Fertilizer Applications			
	Kafkas	Özbek	Control	DAP	Chicken manure	Sheep manure
Plant height (cm)	30.48 b	31.68 a	29.53 c	30.81 b	33.33 a	30.65 b
First pod height (cm)	9.70 b	10.85 a	9.23 c	10.05 b	11.41 a	10.43 b
Num. of branch(units/plant)	2.59 b	2.82 a	2.40 c	2.73 b	3.03 a	2.66 b
Num. of pod per plant(units/plant)	17.52 b	23.07 a	17.68 c	19.76 b	23.45 a	20.30 b
Num. of seed per plant(units/plant)	23.24 b	34.77 a	24.03 c	28.56 b	35.23 a	28.20 b
Grain yield (kg/da)	116.0 b	137.1 a	111.3 c	122.3 b	145.1 a	127.3 b
Biological yield (kg/da)	340.7 b	378.9 a	339.1 c	352.3 bc	387.3 a	360.6 b
Harvest index (%)	33.9 b	36.1 a	32.8 c	34.6 b	37.4 a	35.2 b
1000 seed weight (g)	34.6 a	33.6 b	32.8 c	33.8 b	35.9 a	33.8 b
Protein ratio (%)	23.41 a	22.44 b	21.68 c	22.75 b	24.36 a	22.91 b

When the plant height of lentils is evaluated in terms of varieties, it was observed that the Özbek variety with 31.68 cm is higher than the Kafkas variety with 30.48 cm. Karadeniz and Toğay (2009) stated that Özbek and Kafkas varieties were in the same group in terms of plant height in the lentil adaptation study they conducted under Mardin Kızıltepe conditions. Kaplan (2015) stated in the adaptation study he conducted under Van conditions that Özbek variety gave higher plant height value than Kafkas variety. The findings of the researchers are similar to the findings obtained in this study. As can be seen in Table 2, the average first pod height of the applied fertilizers varied between 9.23-11.41 cm. In terms of first pod height, the highest value among the fertilizers was obtained from chicken manure application with 11.41 cm, while the lowest value was obtained from control plots with 9.23 cm. While Bulut (2013) investigated the effect of organic fertilizers on beans in vaccinated and unvaccinated conditions in Van, he reported that the highest first pod height was obtained from chicken manure application and the lowest value was obtained from control plots. Janmohammadi et al. (2015), in their study in Iran, reported that farm manure gives higher first pod height values than foliar fertilizers. The average height of the first pod of the cultivars was 9.70 cm in the Kafkas variety, while it was 10.85 cm in the Özbek variety. First pod height is a feature that is primarily affected by the genetic structure of the plant. Generally, tall plants with large vegetative parts also have high initial pod height values. Although the first pod height is a feature that is primarily affected by the genetic structure, environmental conditions also significantly affect the first pod height. In this study, the Özbek variety gave higher values in terms of both plant height and first pod height compared to the Kafkas variety. In the adaptation study conducted by Kaplan (2015) under Van conditions, it was reported that Özbek variety had higher first pod height than Kafkas variety. In the study, when the effect of fertilizers on the number of branches in the plant was examined, the lowest value was obtained from control plots with 2.40 pieces / plant, while the highest value was obtained from chicken manure application with 3.03 pieces / plant. Zeidan (2007) found that organic fertilizer application increases the number of branches, Saket et al. (2014) stated that the applied organic fertilizers (Farm, chicken, compost and vermicompost) increased the number of branches but there was no difference between them. The results obtained in this study and the results of the researchers are partially similar. When the varieties are examined in terms of the number of branches in the plant, it is seen that the Kafkas variety, which gives 2.59 branches / plant branches, is lower than the Özbek variety with 2.82 branches / plant. Branching in lentils varies depending on the genotype and environmental conditions as well as the cultivation methods. As seen in Table 2, the average number of pods per plant of the fertilizers applied varied between 17.68 and 23.45 pieces / plant. While the highest number of pods in the plant was obtained from chicken manure application with 23.45 pieces / plant, the lowest value was obtained from control plots with 17.68 pieces / plant. Saket et al. (2014) stated that the highest number of pods in the plant was obtained from farm manure application, and Zeidan (2007) stated that as the amount of organic fertilizer applied increased, the number of pods per plant increased. While the average number of pods per plant belonging to the varieties was 17.52 per plant in the Kafkas variety, it was 23.07 per plant in the Özbek variety. While Karadeniz and Toğay (2009) reported that in terms of the number of pods per plant in the lentil adaptation study conducted under Mardin Kızıltepe conditions, Kafkas variety gave higher pod number than the Özbek variety, while Kaplan (2015) had a higher pod number than the Kafkas variety in the adaptation

study conducted under Van conditions. has been reported. The difference between the studies carried out is thought to be due to ecological factors and the applied fertilization. The average grain number of organic and inorganic fertilizers per plant varied between 24.03-35.23 units / plant. While the highest grain number was obtained from chicken manure application with 35.23 pieces / plant, the lowest value was obtained from control plots with 24.03 pieces / plant. The difference between sheep manure and DAP was statistically insignificant. Bulut (2013), in his study in Van, where he investigated the effect of organic fertilizers on beans in Rhizobium inoculated and uninoculated conditions, reported that the highest number of grains in the plant was obtained from chicken manure application and the lowest value was obtained from control plots. The number of grain in the plant, which is a quantitative character, is directly related to the number of pods per plant, as well as it is significantly affected by climate and soil conditions. The average number of grain in the plant obtained from the varieties was 23.24 pieces / plant in the Kafkas variety, while it was 34.77 in the Özbek variety. In the adaptation study of Kaplan (2015) conducted under Van conditions, he reported that the average number of seeds per plant of lentil varieties varied between 19.41-37.33, and that the Özbek variety was in the same group with the variety with the highest grain number. The findings of the researchers and the findings obtained in this study are in agreement. The average grain yield per unit area of organic and inorganic fertilization in lentils varied between 111.3-145.1 kg / da. While the highest grain yield per unit area was obtained from chicken manure application with 145.3 kg / da, the lowest value was obtained from control plots with 111.3 kg / da. While the value obtained from sheep manure ranked second, the difference with DAP was found to be statistically insignificant. Toğay et al. (2005) that the highest grain yield in lentils is obtained from ammonium sulphate fertilizer, followed by organic nitrogen fertilizer, Moraditochaee et al. (2014) found that the highest grain yield was obtained from 25 tons / ha sheep manure and bio fertilizer applied with 25 kg / ha nitrogen and Janmohammadi et al. (2015), again in their study in Iran, reported that the highest grain yield was obtained from farm manure applied together with salicylic acid. The average grain yield per unit area obtained from the cultivars was 116.0-137.1 kg / da, while the Kafkas variety yielded a unit area of 116.0 kg / da, while the Özbek variety yielded 137.1 kg / ha unit area. In the adaptation study conducted by Kaplan (2015) in Van conditions in 2013-14 growing season, Özbek variety yielded 105.6 kg / da Kafkas variety and 86.3 kg / da unit area. Although the varieties are the same, it is thought that the reason for the different yields is that the rainfall in the year when the researcher was conducted was much lower than the rainfall in the year in which this study was conducted, and the organic fertilizers used in this study also caused an increase in yield, especially with precipitation. As can be seen from the Table 2, biological yield averages of organic and inorganic fertilization in lentils varied between 339.1-387.3 kg / da. While the highest biological yield was obtained from chicken manure application with 387.3 kg / da, the lowest value was obtained from control plots with 339.1 kg / da. Moraditochaee et al. (2014) in Iran, the highest grain yield was obtained from 25 ton / ha sheep manure and bio fertilizer applied with 25 kg / ha nitrogen and 25 ton / ha farm manure and bio fertilizer applied with 25 kg / ha nitrogen. Saket et al. (2014) reported that there was no difference in biological yield between organic fertilizers used in lentils, and Zeidan (2007) reported that the highest hay yield was obtained from the highest dose of organic fertilizer. When the biological yield averages obtained from the cultivars were examined, the average biological yield of the Kafkas variety was found to be lower than the Özbek variety with an average biological yield of 340.7 kg

/ da and 378.9 kg / da. Türk and Koç (2003) reported that biological yield averages varied between 179.618 - 236.319 kg / da, while Karadeniz and Toğay (2009) reported that the average biological yield varied between 140.46-420.03 kg / da. Average harvest index of organic and inorganic fertilizers varied between 32.8-37.4%. While the highest harvest index was obtained from chicken manure application with 37.4%, the lowest value was obtained from control plots with 32.8%. Sheep manure and DAP followed the chicken manure, respectively. Togay et al. (2005) reported that they obtained the highest harvest index from organic nitrogen in their study using different nitrogen doses and four different nitrogen forms in lentils, Saket et al. They reported that it was obtained from the application of vermicompost and chicken manure. While the average harvest index obtained from the cultivars was 33.9% in the Kafkas variety, it was 36.1% in the Özbek variety. Demirhan (2006), in his study with 16 lentil varieties in Siirt conditions, the average harvest index is 25.1-38.72%. In his adaptation study conducted by Kaplan (2015) under Van conditions, he reported that the harvest index of lentil varieties varied between 31.5-37.0%, and that the Kafkas variety showed a lower harvest index than the Özbek variety. The findings obtained are parallel to the findings of the researchers. As can be seen in Table 4.2 the average 1000 seeds weight of organic and inorganic fertilizers varied between 32.8-35.9 g. While the highest 1000 seeds weight was obtained from chicken manure application with 35.9 g, the lowest value was obtained from control plots with 32.8 g. There was no statistical difference between sheep manure and DAP, which ranked second. Zeidan (2007) reported that organic fertilization in lentils increased a 1000 seeds weight, and Saket et al. (2014) reported that chemical fertilizers gave higher 1000 seeds weight values than organic fertilizers in their study of the effect of organic and inorganic fertilization on yield parameters in lentils. The findings obtained are parallel to the findings of the researchers. While the average 1000 seeds weight obtained from varieties was 33.6 g in Kafkas variety, it was 34.6 g in Özbek variety. Though the 1000 seeds weight is a characteristic of varieties, it can be affected by environmental conditions. Çölkesen et al. (2005) reported in their studies in Kahramanmaraş and Şanlıurfa that the weight values of 1000 seeds take different values in different locations in the same varieties. Demirhan (2006) reported in his study on lentils that the weight of thousand grains varied between 26.25-65.5 g. As seen in Table 2 the average protein ratio of organic and inorganic fertilizers in the grain varied between 21.68-24.36%. While the highest protein ratio in the grain was obtained from chicken manure application with 24.36%, the lowest value was obtained from control plots with 21.68%. There was no statistical difference between sheep manure and DAP, which ranked second. Seth et al. (2008) reported that chicken manure increases the nitrogen content in the plant, Keshavarz et al. (2012) stated that the highest nitrogen content in the grain is obtained from sheep manure applied with 25% nitrogen, Moraditochaee et al. (2014) reported that sheep and cow manure applied together with nitrogenous manure increased the nitrogen content in the grain. The findings of the researchers and the results obtained in this study are similar While the average protein ratio in the grain obtained from the cultivars was 23.41% in the Kafkas variety, it was 22.44% in the Özbek variety. Although the ratio of protein in the grain is a characteristic of varieties, it can be affected by environmental conditions.

CONCLUSION

In this research, the effects of inorganic and organic fertilizers on yield and some yield components in Özbek and Kafkas varieties adapted to the region were investigated. Inorganic fertilizers, which are used extensively and unconsciously, except for their economic aspect, cause significant

damage to the plant and the environment, especially the soil. These damages take a long time to recover and sometimes it is not possible to compensate. The fact that the chemical inputs used within the framework of efficiency enhancement efforts were of a size that could threaten health caused consumer preference to change again. In this context, the organic agriculture system, which increases food safety, has been developed within the scope of agricultural production. All the characteristics discussed in the study were influenced by inorganic and organic fertilizer applications in significant ways. With the help of organic fertilizers to be used in this study, the possibilities of reducing dependence on chemical fertilizers and recycling of organic materials that are increasingly consumed due to intensive agriculture were investigated. In addition to these, in this study, the differences between chemical fertilization and the effects of different organic fertilizer sources on yield and some yield elements in lentils were revealed. As a result, taking into account the other characteristics discussed in the study, Özbek variety and 1 ton chicken fertilization per decare can be recommended for lentil cultivation in Van.

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