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Effect of Conventional and Organic Farming on Morphological and Agronomic Characteristics of Common Bean (*Phaseolus vulgaris* L.)

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ABSTRACT

This research was carried out during the 2016-2017 growing season at Bayburt University, Food and Agriculture and Livestock Application and Research Center (40°24'05.7"N 40°08'31.3"E). In the research determined morphological and agronomic characteristics of organic and conventionally grown common beans (*Phaseolus vulgaris* L.) genotypes. In the study, 13 local bean genotypes and 3 registered varieties (Onceler-98, Aras-98 and Gungor) were used. A randomized complete block design was organized as a split parcel trial design with three replication. Common bean which was organic and conventionally grown, plant height, first pod height, stem diameter, pod width, pod length, pod number per plant, seed number per pod, 1000 seed weight, seed yield parameters were measured. It has been determined that there were significant differences in some traits between the genotypes. According to the results obtained from study, the Petekli local bean genotype has the same statistical group as the common bean cultivars (Gungor, Onceler-98, Aydintepe) in terms of seed yield. On the other hand there was no significant difference between organic and conventional farming methods in terms of seed yield.

1. Introduction

In terms of harvest area and production, *Phaseolus vulgaris* have the highest values in the world (FAO, 2016). Beans; it has an important in human nutrition with high protein content as dry seed as well as fresh consumption (Singh, 2001).

In the world, the agricultural area is 4.9 billion hectares. On the other hand, there are 51 million hectares of area used for organic farming (FAO, 2015). Organic farming has expanded in recent years and it is a sustainable alternative to conventional agricultural systems (Biao *et al*., 2003; Avery, 2007).

There are definitions of organic farming, is known as ecological agriculture (Gosling *et al*., 2006). Organic and sustainable agriculture is an important subject in agriculture (Escobar and Hue, 2007). For organic products in the Europe, USA and other developed countries of the world, the market amount is very small. But demand for organic products is growing rapidly (Thompson, 1998).

Organic farming system avoids the use of synthetic fertilizers, pesticides and other chemicals. Glodowska and Krawczyk (2017) reported that conventionally grown plants tend to involve more heavy metals. Conventional agriculture is a system that is trying to get more yield. Chemicals such as agricultural pesticides, synthetic fertilizers are used in conventional agriculture in order to increase yield. On the other hand organic agriculture is more sustainable than conventional agriculture (Okudum et al. 2017). It is shown that under drought conditions, crops in organically managed systems produce higher yields than conventionally (Stanhill, 1998).

Geherman *et al.* (2003) reported that there was no significant difference between organic and traditional agriculture in terms of the botanical properties. Woese *et al.* (1997) pointed that two production systems had similar qualitative characteristics.

The aim of this study determination of 13 local bean genotypes and 3 common bean cultivars (Onceler-98, Aras-98 and Gungor) in terms of morphological and agronomic characteristics. The other main objective was to put forward the differences between organic and conventional agriculture.

2. Material and Methods

This research was carried out on the determination of the effects of conventional and organic farming conditions on morphological and agronomic characteristics in common bean (*Phaseolus vulgaris* L.) genotypes. There were 13 local genotypes which are obtained from Erzurum and Bayburt (Ardicli, Numanpasa, Bademli, Tekpinar, Tepecik, Petekli, Cakmakli, Degirmenli, Oztoprak, Catakbahce, Koprukoy, Madenkopru Aydintepe) and 3 common bean cultivars (Onceler-98, Aras-98 and Gungor) in this study.

In the study, the distance between the rows were determined as 0.5 m, 4 rows on each parcel, parcel length was 5 m, area of each parcel was 10 m^2 (4 x 0.5 x 5m) and 3 replication were planted (Girgel, 2013). The all treatment was consist of 48 parcels. Experiment area where organic work was carried out; at the beginning of sowing, 5 tons of burned farm (cattle) manure was given homogeneously with fertilizer dispenser. After that, the plow and cultivator were pulled and then the treatment area was ready to plant.

During the trial, organic farming principles (Shiva *et al.* 2004) were followed and chemical application was not

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carried out. Pure nitrogen 4 kg per decare chemical fertilization has been done with the fieldwork in which the conventional work was carried out. The plants were sprayed with Malathion 20 E.C prior to the flowering stage. Plant height (cm), stem diameter (mm), first pod height (cm), pod length (mm), pod width (mm), pod number per plant (number/plant), seed number per pod (seed/pod), 1000 seed weight (g), seed yield (kg/da) parameters were collected according to Girgel (2013).

Data collected from the study were statistically analyzed by using SAS package program (SAS, 2004). Organic agriculture compared to conventional agriculture and common bean genotypes were also compared. On the other hand mean separation was performed by Least Significant Difference (LSD) test (Duzgunes *et al.* 1983).

3. Results and Discussion

In the research, differences between genotypes were found to be significant for all features except first pod height and seed number per pod characteristics. The statistical analysis results (ANOVA) were given in Table 1 and Table 3. The difference between farming methods was statistically significant in terms of stem diameter, first pod height, pod length and 1000 seed weight. Moreover for the stem diameter, first pod height, pod number per plant, and seed number per pod features Farming MethodsXCultivar interactions were found statistically significant. On the other, averages and statistical groups for genotypes were given in Table 2 and Table 4. In the table 5, averages were given according to farming methods.

It is found that the highest value in terms of plant height was obtained from genotype Numanpasa (50.067 cm). However, there were various values in the same statistic group (Table 1 and 2). And the lowest value was gained from Tepecik genotype (38.183 cm). The difference between the varieties in terms of plant height was a result of genetic structure. It has been reported that different plant height values were obtained according to genotypes (Yaman and Sepetoglu, 1997; Madakbas et al., 2004). And similar results were gained by Miles et al (2015).

Aras-98 genotype had the highest value at stem diameter (6.9230 mm). The lowest stem diameter was Aydintepe genotype (5.4353mm). However, there were multiple values in the same statistic group (Table 1 and 2).

There was no significant differences between genotypes with regard to first pod height (Table 1 and 2). In terms of the pod length, Gungor genotype had the highest value (107.466 mm). The lowest value was obtained from Catakbahce (88.609). The length of the pod varies with the genetics of the genotypes. Similar results have been reported (Elkoca and Kantar, 2004; Balkaya and Ergun, 2007).

The Oztoprak variety had the largest pod (14.9580 mm). On the other Onceler-98 cultivar had narrowest pod (12.7630 mm). Similar results were observed by Balkaya and Ergun (2007).

The highest values of pod number per plant were found from Onceler-98 and Gungor genotypes (23.450 and 23.133, respectively). Otherwise the lowest were found from Madenkopru and Tekpinar genotypes (11.433 and 11.533, respectively) (Table 3 and 4).

There was no significant difference between genotypes in point of seed number per plant (Table 3 and 4).

Degirmenli and Tepecik genotypes had the highest values in terms of 1000 seed weight (548.15 and 541.52 g, respectively). On the other hand Cakmakli genotype had lowest value (402.80 g).

In terms of seed yield Gungor, Onceler-98, Aydintepe and Petekli genotypes had highest values (207.33, 198.67, 194.67 and 189.17 kg/da, respectively) (Table 3 and 4). Similar results were obtained by Westermann *et al*. (2011).The seed yield difference between the genotypes was a result of genetic structure. It has been reported that different yield values were obtained according to genotypes (Madakbas *et al*., 2004.). These results were in the same line with those of Abubaker *et al*. (2006) and Flavin (2016).

Statistically significant characteristics were examined in terms of growing method; in organic farming, the stem diameter and pod length was higher than conventional farm (Table 5). But conventional farming values were higher than organic farming such as first pod height and 1000 seed weight. It was reported that the plant height was shorter in organic farming (Petrovic *et al*., 2016). First pod height was less in organic agriculture than in conventional agriculture. Similar results were indicated by Petrovic *et al*. (2016).

There was no significant a difference between farming methods with regard to seed yield (Table 5). But conventional farming (169.646 kg/da) had higher score than organic farming (158.750 kg/da). It was reported that the seed yield per plant was lower in organic farming than conventional farming (Petrovic *et al*. 2016). Researchers reported that there was no difference between yield values in organic and conventional agriculture (Ulukan *et al*., 2010). On the other hand it was reported that organic yields were lower than conventional (Lotter, 2003; Avery, 2007; Connor, 2008; Cavigelli et al., 2009; De Ponti *et al*., 2012; Seufert *et al*., 2012; Forster *et al* 2013; Ferro *et al*., 2017; Suja *et al*., 2017).

4. Conclusion

According to the results obtained from the study, the Petekli local bean genotype has the same statistical group as the standard bean varieties (Gungor, Onceler-98, Aydintepe) in terms of seed yield. It was considered to be the standard varieties in the future. There was no significant difference between organic and conventional farming methods. Both farming systems are recommended to be farmed.

Table 1. The summary of variance analysis for plant height, stem diameter, first pod height, pod length, pod width.

Source	DF	Mean Square				
		Plant Height	Stem Diameter	First Pod Height	Pod Length	Pod Width
Replication	2	17.6363	1.2647	13.2987	76.4184	0.3552
Farming Methods	1	1956.6204	37.3426*	582.8739*	877.7885*	20.0412
Error 1	2	266.2051	1.0537	15.0446	40.57421	3.2479
Cultivar	15	67.0195*	1.1754**	3.41598	189.9363*	1.8713*
FM X Cv	15	52.2393	1.2693	6.3315*	157.0804	1.17544
Error 2	60	29.6837	0.4389	3.1838	98.6611	0.9486
Corrected Total	95					

Table 2. Averages and statistical groups of plant height, stem diameter, first pod height, pod length, pod width for genotypes.

Genotype	Plant Height (cm)	Stem Diameter (mm)	First Pod Height (cm)	Pod Length (mm)	Pod Width (mm)
1. Ardicli	46.650 BAC	6.1305 BDAC	11.233	101.137 BAC	14.0660 BDAC
2. Numanpasa	50.067 A	5.7117 DC	12.233	89.143 C	13.6183 BDAC
3. Bademli	44.300 BDAC	5.5633 D	11.533	98.025 BAC	14.5030 BA
4. Tekpinar	39.317 DC	5.8500 BDC	11.533	94.487 BAC	14.2940 BAC
5. Tepecik	38.183 D	5.6987 DC	11.333	93.969 BAC	13.7703 BDAC
6. Petekli	40.433 DC	5.6387 D	10.733	93.250 BC	13.7600 BDAC
7. Cakmakli	43.000 BDAC	5.9270 BDC	11.667	103.760 BA	13.9460 BDAC
8. Degirmenli	46.600 BAC	5.7542 DC	14.000	98.373 BAC	13.9527 BDAC
9. Oztoprak	43.917 BDAC	5.6755 D	11.300	91.334 BC	14.9580 A
10. Catakbahce	42.100 BDC	5.4815 D	12.142	88.609 C	13.5102 BDC
11. Koprukoy	46.567 BAC	5.5910 D	11.033	92.662 BC	14.4823 BA
12. Madenkopru	48.000 BA	5.9440 BDC	11.833	95.499 BAC	13.9673 BDAC
13. Aydintepe	42.883 BDAC	5.4353 D	11.433	94.856 BAC	14.2863 BAC
14. Aras-98	45.800 BAC	6.9230 A	12.200	101.553 BAC	12.9920 DC
15. Gungor	42.817 BDAC	6.6517 BA	11.467	107.466 A	13.5397 BDC
16. Onceler-98	40.000 DC	6.5740 BAC	11.033	104.743 BA	12.7630 D
Mean	43.789	5.9093	11.669	96.804	13.9006

Table 3. The summary of variance analysis for pod number per plant, seed number per pod, 1000 seed weight, seed yield.

Source	DF	Mean Square			
		Pod Number Per Plant	Seed Number Per Pod	1000 Seed Weight	Seed Yield
Replication	2	105.4251	0.0403	32. 1642	2023.3229
Farming Methods	1	36.0150	3.9204	11427.3522*	2849.2604
Error 1	2	10.4103	3.8207	472.5037	7935.3854
Cultivar	15	80.8566**	0.7217	7909.8445**	3426.4270**
FM X Cv	15	20.2874*	1.1868**	1002.1238	46.5937
Error 2	60	8.732042	0.3967	1595.2424	413.6875
Corrected Total	95				

Table 4. Averages and statistical groups of pod number per plant, seed number per pod, 1000 seed weight, seed yield for genotypes.

Genotype	Pod Number Per Plant (number/plant)	Seed Number Per Pod (seed/pod)	1000 Seed Weight (g)	Seed Yield (kg/da)
1. Ardicli	17.017 BC	4.5000	474.71 BCD	146.00 FGH
2. Numanpasa	16.050 BCD	4.2167	459.41 CD	149.17 FGH
3. Bademli	12.167 DE	4.4500	483.98 BCD	136.00 H
4. Tekpinar	11.533 E	3.9833	506.34 ABC	138.33 H
5. Tepecik	12.383 DE	4.3833	541.52 A	154.50 EFGH
6. Petekli	15.333 BCDE	4.4500	475.37 BCD	189.17 ABCD
7. Cakmakli	15.167 BCDE	5.0000	402.80 E	168.00 DEF
8. Degirmenli	12.317 DE	4.4500	548.15 A	140.33 GH
9. Oztoprak	17.667 BC	4.3667	478.26 BCD	157.00 EFGH
10. Catakbahce	16.033 BCD	4.6333	460.43 CD	179.83 BCDE
11. Koprukoy	14.283 CDE	4.4333	498.68 ABC	165.33 DEFG
12.Madenkopru	11.433 E	4.8500	518.77 AB	133.50 H
13. Aydintepe	18.550 B	5.1167	439.40 DE	194.67 ABC
14. Aras-98	15.650 BCD	4.6500	476.18 BCD	169.33 CDEF
15. Gungor	23.133 A	4.9333	484.30 BCD	207.33 A
16. Onceler-98	23.450 A	5.2833	461.60 CD	198.67 AB
Mean	15.760	4.6062	481.86	164.19

Table 5. Averages and statistical groups of all parameters for farming methods.

Measurement Parameters	Organic Farm	Conventional Farm
Plant Height	39.275	48.304
Stem Diameter	6.5331 A	5.2857 B
First Pod Height	9.2052 B	14.1333 A
Pod Length	99.828 A	93.780 B
Pod Width	14.3575	13.4437
Pod Number Per Plant	15.1479	16.3729
Seed Number Per Pod	4.4042	4.8083
1000 Seed Weight	470.957 B	492.778 A
Seed Yield	158.75	169.646

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