



Determination of Grain Yield and Yield-Related Characteristics of Some Faba Bean (*Vicia faba* L.) Cultivars in Çukurova Ecological Conditions

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Abstract. Faba bean (*Vicia faba* L.) has high nutritional value and it can be use for food human and livestock and as green manure. The aim of this study was determine the grain yield and yield-related characteristics of some faba bean (*Vicia faba* L.) cultivars. This study was carried out in experiment area of the Field Crop Department, Faculty of Agriculture at Çukurova University during the 2021/2022 growing period. The study was established according to the randomized blocks experiment design with 3 replications and 12 faba bean cultivars were used as materials. As a result of the study, the maturity period was 154-160 days, the number of branches per plant was 2.3-3.4, the grain weight per plant was 13.8-26.2 g plant⁻¹ and 100 grain weight varied between 98.0-134.4 g. The lowest dry grain yield was found in the Luz de Otona cultivar with 1495 kg ha⁻¹, while the highest dry grain yield was obtained from Hara cultivar with 3286 kg ha⁻¹. It has been concluded that Hara, Filiz ve Gölyaka cultivars are promising in the Çukurova region conditions in terms of dry grain production.

Keywords: Faba Bean, Cultivars, *Vicia faba* L., Grain Yield, Yield Components.

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1 Introduction

Faba bean (*Vicia faba* L.) is the fifth cultivated dry legume after dry bean, dry cowpea, chickpea and dry pea in the World [1]. It is a plant that can be adapted to wide areas in terms of ecological conditions and it has high nutritional value [2] Asia contential is the first ranking for planted area of faba bean, followed by Africa and Europe [1]. In terms of dry grain production Europe ranks first, while Africa continent holds the second place [1]. Faba bean has a high amount of protein, minerals, and vitamins. However,

it contains compound such as oligosaccharide, lectin, convicine, vicine that negatively affected for human food [3; 4]. It fixes high amount air nitrogen by rhizobium bacteria in the nodules formed in the root [5; 6]. So, faba bean cultivation is very important in the crop rotation for increasing organic matter and nitrogen [7; 8]. Faba bean can be use as green manure, vegetable and in livestock feed. Its dry grain production is spreading Aegean, Marmara and Mediterranean region of Turkey. Generally, cultivars with big grains are preferred in faba bean cultivation in Turkey, and these cultivars are suitable both green and dry consumption [9] High grain yield can be achieved by cultivation of suitable cultivars to ecological conditions. Depending on the decrease in temperature in the development period it can generally survive down to -4°C without snow cover and die in -10°C [10]. Faba bean requires regular water throughout the growing period.

The annual requirement for faba bean is 600-1000 mm, and their sensitivity to diseases and pests increases in excessive rainfall in growing periods [11]. It can be grown as winter stage under rainy conditions in Mediterranean [12]. Planting area, production and grain yield of dry faba bean are 24038 ha, 6580 ton and 2740 kg ha^{-1} respectively in Turkey [13]. However, it is possible to increase the dry grain production its suitable cultivars of in coastal region of Turkey. As in cultivation of crop determining suitable faba bean cultivars for the growing area is a very important factor in increasing production.

The aim of this study was to determine the grain yield and yield components of some faba bean (*Vicia faba* L.) cultivars under Mediterranean climate conditions of Turkey.

2 Material and Method

This study was carried out in the research area of the Department of Field Crops, Faculty of Agriculture, University of Çukurova, Adana, Turkey during the winter seasons of 2021/2022. Adana had a typical Mediterranean climate. The total precipitation was 685 mm between November and May. The minimum temperature (-1.9°C) was found in January while maximum temperature (36.9°C) was found in May.

Meteorological values of Adana in experiment year were given (Table 1.)

Table 1. Meteorological values of Adana for experimental year.

Meteo-logical Parameters	Min Temperature ($^{\circ}\text{C}$)	Max Temperature ($^{\circ}\text{C}$)	Mean Temperature ($^{\circ}\text{C}$)	Relatively Humidity (%)	Total Rainfall (mm)
Months	2021/22	2021/22	2021/22	2021/22	2021/22
November	9.7	32.1	17.4	66.5	48.8
December	1.1	22.6	11.9	66.7	219.4
January	-1.9	21.2	8.9	66.2	235.0

February	4.4	22.8	12.4	71.8	74.4
March	-1.4	26.1	10.9	58.5	103.8
April	9.8	34.2	20.0	57.2	2.6
May	12.0	36.9	22.8	61.8	1.0

The texture of the experiment soil was loam. The values of pH and lime content, organic matter content were 7.64 and 32.7 % and 1.46 % respectively. Soil properties of experiment area were given in Table 2.

Table 2. Properties of experimental soil.

Year	Clay %	Silt %	Sandy %	Texture %	pH	Lime %	Organic Matter %	Phosphorus mg kg ⁻¹
2021/22	21.9	42.6	35.5	Tim	7.64	32.7	1.46	12.4

In this study, 12 registered faba bean cultivars provided by different institutes and organizations were used as a material. These cultivars were Eresen 87, Salkım, Filiz- 99, Kıtık- 2003, Histal, Luz de Otona, Reina Mora, Gölyaka, Hara, Sevilla, Emiralem, Sorgun.

The experiment was conducted in a randomized complete blocks experimental design (RCBD) with three replications. Each cultivar was sown in 5 rows, 4 m in length, with 45 cm inter row spacing and intra row spacing of 10 cm on 20 December 2021. Plot area was 11.25 m² (5 x 2.25 m). Harvesting was applied in the three rows after eliminating border rows. Harvested plot area was 5.4 m² (4 x 1.35 m). Fertilizer applied at a rate of 30 kg N ha⁻¹ and 70 P₂O₅ kg ha⁻¹ before seeding. Individual ten plants were randomly selected from each plot.

Days to flowering, plant height (cm), first podding height (cm), number of primary branches, number of pods per plant, number of grains per plant, seed weight per plant (g), 100-grains weight (g), grain yield (kg ha⁻¹) were recorded.

3 Results and Discussion

Flowering duration, plant height and first podding height are presented in Table 3.

Table 3. The effects of cultivars on flowering duration, plant height, first podding height.

Cultivars	Flowering duration (date)	Plant height (cm)	First podding height (cm)
Hara	76	83.6 ab ¹	31.6 ab ¹
Filiz-99	78	87.9 a	31.5 ab
Emiralem	77	72.3 bcd	29.8 ab
Eresen-87	76	77.0 abc	27.6 bc
Sorgun	76	80.1 abc	35.7 a
Kitik-2003	77	79.1 abc	30.0 ab
Gölyaka	72	75.0 abc	26.7 bc
Salkim	80	79.9 abc	34.0 a
Sevilla	78	61.8 de	23.1 c
Histal	76	68.2 cd	35.5 a
Reina Mora	75	51.5 e	21.6 c
Luz de Otona	71	54.2 e	25.2 bc
Mean	76	72.6	29.3
C.V. (%)	3.7	9.7	11.4

¹Means within a column and line for each trait followed by the same letters are not significantly different for Duncan's multiple range test ($p < 0.05^*$, $p \leq 0.01^{**}$).

There were not significant differences among the cultivars for flowering duration (Table 3). The obtained values varied from 71 days (Luz de Otona) to 80 days (Salkim). The results were in accordance with the findings by [14] (78.0-85.0) and [15] (78.1-79.0). On the other hand, [16] indicated that flowering period varied between 56.08-64.7 days. Flowering duration may vary genotype and ecological conditions. In case of water deficiency in plants become stressed and pass to generative stage in a shorter time [11].

Plant height was significantly affected by the cultivars (Table 3). The highest value in terms of plant height was recorded in Filiz-99 with 87.9 cm, followed by Hara while the lowest value was obtained from Reina Mora with 51.5 cm. Similar results were reported by [17] (82.0-95.0 cm), [18] (40.0-97.6 cm), [19] (55.80-84.27 cm), [20] (76.9-81.2cm). As can be seen that plant height can be affected cultivars and ecological conditions.

Differences among the cultivars for first podding height were found to be significant (Table 3). Obtained values for mentioned trait varied from 21.6 cm (Reina Mora) to 35.7 cm (Sorgun). Previous studies reported that first podding height was recorded between 13.8-19.6 cm [21], 21.6-24.7 cm [20].

Number of pods per plant, number of grains per plant and 100 grain weight are exhibited in Table 4.

Table 4. The effects of cultivars number of pods per plant, number of grains per plant and 100 grain weight.

Cultivars	Pods per plant (per/plant)	Grains per plant (per/plant)	100 grain weight (g)
Hara	6.2 bcd ¹	24.2 bcd ¹	110.2 cd ¹
Filiz -99	6.8 abc	21.2 bc	128.7 ab
Emiralem	5.6 cd	21.5 bc	102.1 ef
Eresen-87	6.4 abcd	16.3 defg	133.1 ab
Sorgun	5.0 de	18.7 cde	127.0 b
Kıtık-2003	8.1 a	20.3 bcd	127.5 ab
Gölyaka	7.9 a	26.4 a	105.2 de
Salkım	6.5 abcd	17.8 cdef	131.8 ab
Sevilla	3.5 ef	11.8 gh	112.9 c
Hıstal	2.7 f	9.7 h	134.4 a
Reina Mora	3.2 f	13.8 fgh	111.1 cd
Luz de Otona	4.0 ef	14.1 efgh	98.0 f
Mean	5.5	18.0	118.5
C.V.(%)	16.4	14.1	3.1

¹Means within a column and line for each trait followed by the same letters are not significantly different for Duncan's multiple range test ($p < 0.05^*$, $p \leq 0.01^{**}$).

Number of pods per plant was influenced by cultivars at a significant level (Table 4). Number of pods per plant ranged between 2.7 (Hıstal) and 8.1 (Kıtık) depending on cultivars. Similar to our findings [20] Erten (2023) reported that pods per plant varied between 4.5 and 7.0. However, some earlier studies reported that pods per plant varied between 27.10-40.47 [22] and 5.80-15.72 [23]. The observed various values in pods per plant may be due to differences in plant material, ecological conditions and growing techniques. Number of pods per plant was negatively affected by low temperatures occurred during the flowering and pod setting period in some legumes [24].

Differences among the cultivars for number of grains per plant was significant (Table 4). The highest value for number of grains per pod was found by Gölyaka with 26.4, while the lowest one was obtained from Hıstal with 9.7. [9] reported that number of grains per plant varied between 26.49 and 40. On the other hand [25] indicated that grains per plant was ranging from 18.26 to 33.99. It was shown that grains per plant was might be due to different environmental conditions, genotypes and growing season. [26] reported that low temperatures occurring in the flowering period create unfavourable conditions for pollination.

Differences among the cultivars in terms of 100-grain weight were significant (Table 4). 100-grain weight varied between 98.0 g (Luz de Otona) and 134.4 g (Hıstal). Similar results reported that by Mıdık [25] (2019) who indicated that was the highest 100 grain weight value of 129 g in the Sakız variety. On the other hand, [16] exhibited that 100 grain weight was between 131.10-164.90 g. However, various studies reported that 100-grain weight varied from 94.35 g to 150.56 g [28; 23; 19]. These studies showed

that 100-grain weight of faba bean may vary depending on genotypes and ecological conditions.

Grain weight per plant, grain yield and harvest index are given in Table 5.

Table 5. The effects of cultivars of grain weight per plant, grain yield and harvest index.

Cultivars	Grain weight /plant (g)	Grain yield (kg ha ⁻¹)	Harvest Index (%)
Hara	23.4 a ¹	3286 a ¹	49.8 abc ¹
Filiz-99	25.0 a	3001 ab	48.0 bc
Emiralem	20.0 ab	2503 bc	48.3 bc
Eresen-87	23.3 a	2657 ab	49.9 abc
Sorgun	22.1 a	2698 ab	45.7 c
Kıttık-2003	25.1 a	2771 ab	49.1 abc
Gölyaka	26.2 a	3144 ab	50.2 abc
Salkım	22.5 a	2829 ab	48.6 bc
Sevilla	15.0 bc	2047 cd	52.8 ab
Histal	14.9 bc	1910 cd	45.2 c
Reina Mora	15.5 bc	1891 cd	54.8 a
Luz de Otona	13.8 c	1495 d	50.4 abc
Mean	20.6	2519	49.4
C.V. (%)	15.7	13.5	6.0

¹Means within a column and line for each trait followed by the same letters are not significantly different for Duncan's multiple range test ($p < 0.05^*$, $p \leq 0.01^{**}$).

Grain weight per plant was significantly affected by cultivars (Table 5). Gölyaka had the highest grain weight per plant with 26.2 g followed by Kıttık-2003 with 25.1 g while the lowest one was found for Luz de Otona with 13.8 g. Previous studies showed that grain weight per plant varied between 27.95 and 32.86 g [15], 3.57-11.03 g [29] 20.29 and 35.76 g [30]. Grain weight per plant may vary depending on factors such as temperature and rainfall during the flowering and pod setting period.

Grain yield was significantly affected by cultivars (Table 5). Hara had the greatest grain yield with 3286 kg ha⁻¹, whereas the lowest value was found in Luz de Otona with 1495 kg ha⁻¹. Earliest study showed that grain yield varied between 1538.8-1940.0 kg ha⁻¹ [28]. 1870-2410 kg ha⁻¹ [31], 2321-3137 kg ha⁻¹ [12], 1883- 2171 kg ha⁻¹ [20]. Similar results indicated that by [32] who reported that seed yield varied from 2580 kg ha⁻¹ to 3210 kg ha⁻¹ and [23] who reported that seed yield varied from 2414.4 to 3178 kg ha⁻¹. As can be seen from these results, grain yield may vary depending on genotypes, ecological conditions and growing techniques. Some studies reported that low and high temperature during the flowering caused yield losses in faba bean [33; 28; 24; 34].

Harvest index was significantly influenced by cultivars (Table 5). The highest harvest index was found for Reina Mora with 54.8%, while the lowest value was obtained from Histal with 45.2% followed by Sorgun with 45.7%. The harvest index of Hara that is

the greatest grain yield was found to be 49.8% . The findings obtained in present study were higher than the findings stated by [20] who reported that harvest index varied from 23.2 to 37.7%.

4 Conclusion

It has been concluded that Hara, Filiz ve Gölyaka cultivars are promising in terms of dry grain production in the Mediterranean climate conditions in Turkey. However, the mentioned study should be continued in the future years to obtain definitive results.

References

1. FAO. <https://www.fao.org/faostat/en/#data/QCL> (Last accessed 2025/07/14)
2. Torres, A.M., Roman, B., Avila, C.M., Satovic, Z., Rubiales, D., Sillero, J.C., Cubero, J.I. ve Moreno, M.T.: Faba bean breeding for resistance against biotic stresses: towards application of marker technology. *Euphytica*. **147**, 67-80. (2006)
3. Pekşen, E., Artık, C.: Determination of Plant Characteristics and Seed Yield of Some Local Faba Bean (*Vicia faba* L.) Populations. *Journal of Agricultural Sciences*, **12**(2), 166-174 (2006)
4. Osman, A.M., Hassan, A.B., Osman, G.A., Mohammed, N., Rushdi, M.A., Diab, E.E., Babiker, E.E.: Effects of gamma irradiation and/or cooking on nutritional quality of faba bean (*Vicia faba* L.) cultivars seeds. *Journal of Food Science and Technology*, **51**(8), 1554-1560 (2014).
5. Erincik, Ö.: Susceptibility of Commercial Faba Bean Cultivars to *Ascochyta fabae* Speg., the Causal Agent of Faba Bean Antracnose. *Journal of the Faculty of Agriculture, Adnan Menderes University*. **7**(1): 95-98. (In Turkish) (2010).
6. Yıldırım, S., ve Özaslan Parlak, A.: Forage Yield, Quality of Triticale Intercrops with Faba Bean, Pea and Vetch at Varying Seeding Ratios. *ÇOMÜ Journal of Agriculture Faculty*, **4**(1): 77-83. (In Turkish). (2016).
8. Kün, E., Çiftçi, C.Y., Birsin, M. A., Ülger, A. C., Karahan, S., Zencirci, N., Öktem, A., Güler, M., Yılmaz, N., ve Atak, M.: Production of Cereals and Edible Grain Legumes. Union of Chambers of Turkish Engineers and Architects (TMMOB) Chamber of Agricultural Engineers 6th National Agricultural Engineering Technical Congress of Turkey. Volume 1, 367-407. (In Turkish). (2005).
9. Köpke, U., ve Nemecek, T.: Ecological services of faba bean. *Field Crops Research*, **115**(3), 217–233. (2010).
10. Köseoğlu, C.: A Research About the Influence of Bean Species on Yield and the Characteristics About Yield on Different Planting Dates in Çukurova Region. Master Thesis. Çukurova University, Department of Field Crops Institute of Natural and Applied Sciences. Adana. 40p. (In Turkish). (2006)

11. Bayraktar, K.: Vegetable Growing, Volume II. Publications of Ege University, Faculty of Agriculture Number:169. Ege University Press. (In Turkish). 1970.
12. Pekşen, E., ve Gülümser, A.: Comparison of Faba Bean (*Vicia faba* L.) Genotypes Sown in Autumn And Spring for Some Plant Characters and Seed Yield. Journal of Faculty of Agriculture Ondokuz Mayıs University, **22**(1), 79-85. (In Turkish). (2007).
13. Ton A, Karaköy T., Anlarsal A.E., Türkeri M.: Genetic diversity for agro- morphological characters and nutritional composition of some local faba bean (*Vicia faba* L.) genotypes. Turkish Journal Agriculture and Forestry, **45**, 301-312. (2021)
14. TÜİK. <http://www.tuik.gov.tr> (Last accessed 2025/07/15).
15. Türkeri, M.: Determining Some Morphological and Agronomical Characters of Broad Bean (*Vicia faba* L.) Landraces Collected from Turkey. PhD Thesis. Çukurova University, Department of Field Crops Institute of Natural And Applied Sciences. Adana. 107p. (In Turkish). (2016).
16. Çabar, Y.E.: Investigation of Effects Different Plant Density Implementation on Yield and Yield Components of faba (*Vicia faba* L.) Varieties in Kahramanmaraş Conditions. Msc Thesis. Sütçü İmam University, Department of Field Crops Institute of Natural and Applied Sciences, Kahramanmaraş, 94p. (In Turkish). (2018).
17. Demir, R.: The Effect of Different Range and Ray Distances on The Yield and Quality of Broad Beans (*Vicia faba* L.) in Conditions of Şanlıurfa Province. Sütçü İmam University, Department of Field Crops Institute of Natural and Applied Sciences, Kahramanmaraş, 35 p. (In Turkish). (2019).
18. Cevheri, A.C. ve Avcıoğlu, R.: An Investigation on Benefit Possibilities from Legume-Ceraa Mixtures as Winter Second Crop. Phd Thesis. Ege University. Department of Field Crops Institute of Natural and Applied Sciences, 155p. (Unpublished) (2004).
19. Karaköy, T., Baloch, F. S., Toklu, F., ve Özkan, H.: Variation for selected morphological and quality-related traits among 178 faba bean landraces collected from Turkey. Plant Genetic Resources, **12**(1), 5-13. (2014).
20. Erol, O.: Adaptation of Some Broad Bean (*Vicia faba* L.) Varieties in Kayseri Ecological Conditions. Master Thesis. Erciyes University, Department of Field Crops Institute of Natural and Applied Sciences. Kayseri. 63p. (In Turkish). (2023).
21. Erten, H.: Effects of Different Phosphorus Fertilizer Doses on Yield and Some Quality Characteristics of Faba Bean (*Vicia faba* L.). Aydın Adnan Menderes University. Institute of Science and Technology, Department of Field Crops. Aydın, 85p. (In Turkish). (2023)
22. İdikut, L., Çölkesen M. Demir R. Zulkadir, G., Şahin M.D., ve Kanbur N., Osmanoğlu A.: Investigation of Different Intrarow Plant Distance Effects on Faba Bean Varieties in Sanlıurfa Conditions. 1. International Gap Agriculture & Livestock Congress 25-27 April 2018. pp. 572-579. Şanlıurfa, Turkey. (In Turkish). (2018).
23. Pekşen, A., Pekşen, E., Artık, C.: Determination of Plant Characteristics and Green Pod Yield of Some Faba Bean (*Vicia faba* L.) Populations. Journal. of Faculty of Agriculture. Ondokuz Mayıs University., **21**(2), 225-230. (In Turkish). (2006).
24. Koç, S.: A Study on The Determination of Yield and Yield Components of Bean (*Vicia faba* L.) Genotypes Grown in Tekirdağ Conditions. Master Thesis. Namık Kemal Univesity. Graduate School of Natural and Applied Sciences Department of Field Crops. Tekirdağ, 56p. (In Turkish). (2016).
25. Stoddard, F. L., Hovinen, S., Kontturi, M., Lindström, K., Nykänen, A.: Legumes in Finnish agriculture: history, present status and future prospects. Agricultural and Food Science. **18**, 191-205. (2009).
26. Köse, M.: Determining of adaptations of faba bean (*Vicia faba* L.) populations collected from different provinces to Bilecik Conditions. Master Thesis. Sakarya University of Applied

- Sciences, Graduate School of Education, Department of Field Crops. 62p. (In Turkish). (2022).
27. Aguilera-Diaz, C., ve Recalde-Manrique, L.: Effects of Plant Density and Inorganic Nitrogen Fertilizer on Field Beans (*Vicia faba* L.). *The Journal of Agricultural Science*, 125(1), 87-93. (1995).
 28. Mıdık, Eyibilir. İ.: Selection for Faba Bean (*Vicia faba* L.) Populations Containing Low Tannin for Yield and Agronomical Characteristics in Antalya Conditions. Master Thesis. Akdeniz University, Department of Field Crops. Institute of Natural and Applied Sciences. Antalya. 50p. (In Turkish). (2019).
 29. Baydemir, M. H.: A Study on the Influence of The Different Sowing Dates upon Yield and the Yield Components on Some Type of The Broad Beans in The Conditions Of Kahramanmaraş (*Vicia faba* L.) Master Thesis. Kahramanmaraş Sütçü İmam University Institute of Natural and Applied Sciences Department of Field Crops. Kahramanmaraş, 44p. (2008).
 30. Beşer, E.: Effect of Different Dose and Application Time of Cycocel on Yield and Yield Components in Faba Bean (*Vicia faba* L.). Master Thesis. Ankara University. Department of Field Crops Institute of Natural and Applied Sciences. Adana. 47p. (In Turkish). (2000).
 31. Thalji, T. Effect of plant density on seed yield and agronomic characters of faba bean (*Vicia faba* L.) under green house conditions. *Bioscience Research*, 7(1), 22– 25. (2010).
 32. Başdemir, F., Türk Z., İpekşen, S., Tunç M., Eliş, S., ve Biçer, B. T., 2020. Effect of Fertilizer Treatments on Yield and Yield Components of Some Faba Bean (*Vicia faba* L.). *Turkish Journal of Agricultural and Natural Sciences*. 7(3), 749-756. (In Turkish).
 33. Karadavut, U., Palta, C., Kavurmacı, Z., ve Bölek, Y., 2010. Some grain yield parameters of multi-environmental trials in faba bean (*Vicia faba* L.) genotypes. *International Journal of Agriculture And Biology*, 12(2), 217-220. (2010).
 34. Şehirali, S.: *Food Legumes*. Ankara University Faculty of Agriculture Publications, 314p. (In Turkish). (1988).
 35. Lavania, D., Siddiqui, M. H., Al-Whaibi, M. H., Singh, A. K., Kumar, R., Grover, A.: Genetic approaches for breeding heat stress tolerance in faba bean (*Vicia faba* L.). *Acta Physiologiae Plantarum*, 37(1737), 1-9. (2015).

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