



Effect of intercropping on the growth and productivity characteristics of three varieties of faba beans (*Vicia faba* L.).

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ABSTRACT

Field experiment was carried out at the research station of Field Crop Sciences Department/College of Agriculture/University of Diyala/Republic of Iraq for the season 2023/2024. This experiment included two factors. The first was three varieties of faba bean (local, Dutch Monash, and Spanish Fito). while second factor was the intercropping system (faba bean+onions, faba bean only). As for onions, the local variety was used. The experiment was conducted out according to a randomized complete block design (RCBD) with three replications. Results showed that the monocropping system (with faba bean only) was significantly superior in terms of the weight of 100 seeds, giving a value of 177 grams, while there were no differences between the monocropping and intercropping systems (faba bean+onions) in rest of the studied characteristics. Dutch Monash was superior in plant height (cm), number of seeds per pod, plant yield (g) and weight of 100 seeds (g) amounting to (34.3 cm, 4.7, 109.0 g, 306.0 g) respectively, whereas the local variety was superior in Characteristics of the number of branches per plant and the number of pods per plant, as the values reached (5.4, 6.7) respectively. The interaction between intercropping system and faba bean varieties had different effect on the growth of faba bean varieties. The Dutch Monash variety grown in the monocropping system presented the highest value for the plant height, which amounted to 34.3 cm, and the weight of 100 seeds amounted to 317.0 g. The same variety in the intercropping system provided the highest value of 5.0 seeds per pod. The local variety with the monocropping system was superior to the characteristics of the number of branches per plant, which was 6.1 and the number of pods per plant, which was 7.2. The Spanish variety, Fito, with the monocropping and intercropping systems, contributed the lowest values for all the studied traits.

Keywords: intercropping system, faba bean varieties, onions. productivity.

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INTRODUCTION

Due to its nutritional importance, Faba bean (*Vicia faba* L.) is considered one of the most important leguminous vegetables in the world. They are grown in various countries to obtain juicy, green pods and dry seeds. They are used as a basic food after the grasses began and as a fodder material successfully [1] . It contributes significantly to the balance of the diet because it contains the most important sources of vegetable protein. It contains approximately (25-30%) of protein rich in multiple amino acids, compared with animal protein. Therefore, in most of world countries, faba bean are called the meat of the poor people [2]. It is also characterized by containing carbohydrates, vitamins, fats and cellulose and is also used as a soil fertilizer. Beans are also important in improving soil properties through the process of fixing atmospheric nitrogen in the soil, as well as contributing to regulating the agricultural cycle, especially in areas that depend on rain, which are rain-fed areas [3]. The intercropping system is one of the agricultural schemes that ancient humans practised on instinct thousands of years ago to increase productivity. It is defined as planting two or more crops in one area in one growing season. Here begins the competition process between the intercropping crops for the various growth factors, and following the best breeding methods. Interfering with plants leads to an increase in yields [4]. It provides better crop resistance compared to monocropping in areas that suffer from thermal stresses such as low or high temperatures. It provides financial stability by reducing the need for pesticides. This reduces harmful environmental effects on humans and animals [5]. The intercropping system is used as an economic practice, especially in small farms in large parts of the world to produce food and fodder crops [6]. Intercropping between faba bean and onion improves the productivity and reduces the gap between human consumption and local production [7]. Intercropping between faba bean and onion (*Allium cepa* L.) is enhance significantly the total yield of faba bean by 13.51%, 16.55%, and 13.84% during 1st, 2nd, and 3rd seasons [8]. The research aims to identify the effect of the intercropping system on the growth and yield characteristics of faba bean, optimal utilization of the unit area, and comparison between varieties and their suitability for the intercropping system.

Table (1) Soil chemical and physical properties.

Characteristics	Unit	Value
Sand	g/kg	811
Slime	g/kg	129
Clay	g/kg	61
Cation exchange capacity	cmol/kg	15.40
Electrical conduction EC	deci-siemens/m	4.3
Soil PH	-	7.4
Organic matter	%	46
Gypsum	g/kg	0.142
Nitrogen	mlg/kg	27.5
Phosphors	mlg/kg	30.2
Potassium	mlg/kg	130.2
Soil texture		Sandy mixture

MATERIALS AND METHODS

The experiment was carried out at the research station of the Field Crop Sciences Department, College of Agriculture, University of Diyala, for the fall season 2023-2024. The chemical and physical properties of experiment soil were exposed in table (1). The experimental land was prepared using a rotary plow in a perpendicular manner, and the soil was smoothed using disc harrows. Levelling operations were carried out and the field was divided according to the randomized complete block design (RCBD) with three replicates. The planting was done on a patch, and the distance between one plot and another was 50 cm and between one plant and another was 20 cm. The length of each plot was 3 meters and the width was 30 centimeters. Each plot included 15 plants. The cultivation was carried out using an intercropping system of faba bean and onions, while three varieties of faba beans (Spanish Fito, Dutch Monash, and local Iraqi) and a local onion plant were used. Each experimental block included three replicates: one replicate for all varieties of faba bean only, one replicate for all varieties of faba bean + onions, and one replicate for local onion only. Superphosphate fertilizer was added during ploughing and land preparation at a rate of 40 kg/dunum [9]. Planting was then carried out on 23/10/2023 for the faba bean crop, with two seeds in each hole. After that, the germinated seed was monitored, and the experiment was watered, relying on irrigation. The plants were thinned, and one plant was left in the hole two weeks after emergence. In addition, manual hoeing and weeding operations were carried out to eliminate accompanying weeds. The following characteristics were studied: plant height (cm), number of branches/plant, pod length (cm), number of pods/plant, number of seeds/pod, weight of 100 seeds (g), and individual plant yield (g). The data for the studied traits were analyzed according to the design used (RCBD) using the statistical analysis program SAS, and the means were tested according to the Duncan multiple range test.

RESULTS and DISCUSSIONS

Plant height.

Plant height is one of the important indicators of vegetative growth, which in term depends on cell division and elongation. Table (2) shows that there are no significant differences between the averages of plant height in intercropping system. As for the varieties, the results of table (2) indicate that there are significant differences between the varieties, as the Dutch Monash outperformed the rest of the varieties by giving it a value of 34.3 cm. Varieties of faba bean differ among themselves in characteristics, and this is due to the difference in genetic structures in terms of their ability to grow and divide cells [10]. For the interaction between intercropping system and varieties, it was affected significantly, the Dutch variety Monash, with the monocropping and intercropping systems with onions, gave the highest average for the trait. Plant height was 35.2 and 33.3 cm, respectively. Compared to the rest of the intercropping system and varieties that gave the lowest average plant height of 31.1 cm. The differences between varieties in plant height are due, in term, to the different nature of gene expression between one variety and another [11].

Table (2) Effect of intercropping system and faba bean varieties and the interaction between them on the character of plant height (cm)

Varieties	Intercropping system		Means
	Faba bean + onions	Faba bean only	
Local	32.3b	31.5b	31.9b
Dutch	33.3ab	35.2a	34.3a
Monash			
Spanish Fito	31.2b	31.1b	31.1b

Means 32.2a 32.6a

No significant effect between the same letters on level 0.05

Pod length.

The results of table (3) indicate that there are no significant differences between the intercropping system, faba bean varieties and the interaction between them on pod length [12].

Table (3) Effect of intercropping system and faba bean varieties and the interaction between them on the character of pod length (cm)

Varieties	Intercropping system			Means
	Faba bean + onions		Faba bean only	
Local	18.7a		18.5a	18.6a
Dutch	18.1a		18.5a	18.3a
Monash				
Spanish Fito	18.5a		18.9a	18.7a
Means	18.4a		18.6a	

No significant effect between the same letters on level 0.05

Number of seeds/pod.

Number of seeds/pod is one of the characteristics associated with the variety. It is one of the most important components of the plant's yield, as the number of seeds in bean is affected by pollination and fertilization by the plant and the variety's ability to form the most significant number of carpels in the flower ovary. Results in table (4) shows no significant effect for the treatment of monocropping and intercropping systems on number of seeds per pod. Regarding the varieties, results of table (4) indicate that there are significant differences between the varieties for the trait, as the Dutch variety Monash outperformed the rest of the varieties by giving it a value of 4.7 seeds/pod. For the interaction between intercropping system and varieties, it was significantly affected, as the Dutch variety Monash had the highest averages number of seeds per pod 4.5 and 5.0 respectively in both monocropping and intercropping systems. While local variety with monocropping and intercropping systems had average number of seeds per pod, reaching 4.0, and 4.4, respectively. Compared to the rest of the intercropping system and varieties that gave the lowest average number of seeds per pod, which is consistent with [13]

Table (4) Effect of intercropping system and faba bean varieties and the interaction between them on the character of seeds/pod

Varieties	Intercropping system		Means
	Faba bean + onions	Faba bean only	
Local	4.4ab	4.0bc	4.2b
Dutch	5.0a	4.5ab	4.7a
Monash			
Spanish Fito	4.0bc	3.6bc	3.8b
Means	4.3a	4.0a	

No significant effect between the same letters on level 0.05

Number of branches/plant.

Branching is important in crop production and is considered a significant component of yield crops such as wheat. Faba bean varieties are affected by the genetic nature in determining the plant's ability to grow and branch and give the highest possible number of effective vegetative branches [14]. The results of Table 5 show that there was no significant effect on the average of the intercropping system. Results of the same table show that there was a significant effect among the bean varieties, as the local variety gave the highest average for the number of branches in the plant, amounting to 5.4, and it did not differ significantly from the Dutch variety Monash, which gave a value of 5.1. While the Spanish variety Fito gave the lowest average number of branches in the plant, amounting to 4.3. This difference may be due to the morphological and physiological differences and the nature of growth between the bean varieties and to the ability to stimulate branching [15]. Results found a significant effect between the intercropping system and varieties on the average number of branches per plant,

as the local cultivar with the monocropping system recorded the highest average of 6.1, and it did not differ significantly from the Dutch variety Monash in the intercropping system with onions, which gave a value of 5.5. While the Spanish variety Vito, with the monocropping and intercropping systems, gave the lowest rate of 4.3. These differences were explained based on their genetic origin [16].

Table (5) Effect of intercropping system and faba bean varieties and the interaction between them on the character of branches/plant

Varieties	Intercropping system				Means
	Faba onions	bean + only	Faba bean		
Local	4.8bc		6.1a		5.4a
Dutch Monash	5.5ab		4.8bc		5.1a
Spanish Fito	4.3dc		4.3dc		4.3b
Means	4.8a		5.1a		

No significant effect between the same letters on level 0.05

Number of pods/plant.

This characteristic is one of the basic components of yield in determining the amount of economic yield. The results of table (6) shows that there is no significant effect between the average the intercropping system for the characteristic of the number of pods per plant. Results of the same table indicates that there is a significant effect among the faba bean varieties, where the local variety gave the highest average for the same trait was 6.7, and the Spanish variety Fito gave the lowest average, reaching 3.5. The reason for the difference between the faba bean varieties is in number of pods per plant depending on the fruit pods that the plant forms. The reason for the superiority is due to the increase in the effective fertility rate in flowering for the local variety compared to the rest of the varieties, and this is consistent with the results shown by [17]. Results show a significant interaction between the intercropping system and varieties on the average number of pods per plant, as the local variety with monocropping and intercropping systems recorded the highest averages of 7.2 and 6.2, respectively. While the Spanish variety Fito, with the monocropping and intercropping systems, gave the lowest average, reaching 3.5. The reason for this discrepancy is due to differences in the number of branches in the plant [18].

Table (6) Effect of intercropping system and faba bean varieties and the interaction between them on the character of pods/plant

Varieties	Intercropping system				Means
	Faba onions	bean + only	Faba bean		
Local	6.2ab		7.2a		6.7a
Dutch Monash	5.3b		5.4b		5.3b
Spanish Fito	3.5c		3.5c		3.5c
Means	5.0a		5.4a		

No significant effect between the same letters on level 0.05

Individual plant yield.

The results of table (7) indicate that there is no significant effect between the average intercropping system and individual plant yield trait. Results of the same table indicate that there are significant differences among varieties for the same trait, as the Dutch variety Monash outperformed rest of varieties by giving it a value of 109.0 grams, and the Spanish variety Fito gave the lowest average of 53.7. Reason for the variation in yield is due to the differences in yield components of varieties, and this is consistent with [19]. The interaction between the intercropping system and varieties was affected significantly, as the Dutch variety Monash, with the monocropping and intercropping systems with onions, gave the highest average for the individual plant yield trait, reaching 106.3 and 111.8. g, respectively. Compared to the rest of the intercropping system and varieties that gave the lowest average. The reason for the superiority of the Dutch bean variety in competitive ability may be attributed to the high plant height and superiority in plant size, leaf area, and root system, which gave preference in exploiting

energy and food sources. This is consistent with [20] that the morphological form is one of the factors determining the success of the crop in an intercropping system.

Table (7) Effect of intercropping system and faba bean varieties and the interaction between them on the character on individual plant yield (g)

Varieties	Intercropping system			Means
	Faba bean + onions	Faba bean only	Faba bean	
Local	72.1bc		74.6b	73.4b
Dutch Monash	111.8a		106.3a	109.0a
Spanish Fito	51.5d		56.0dc	53.7c
Means	78.4a		79.0a	

No significant effect between the same letters on level 0.05

Weight of 100 seeds.

This trait is affected by the genetic nature of the variety and environmental conditions, which is important in distinguishing between bean varieties. This trait depends on the variety's ability to accumulate synthetic substances at the source (leaves) and transfer them to the downstream (seeds). The results of Table 8 show that there was a significant effect on the average intercropping system on the weight of 100 seeds. Where the monocropping system with only faba bean was superior to the intercropping system with faba bean + onions, giving it an average of 177.8 grams. Results of the same table shows that there were significant differences between varieties for the same trait, as Dutch variety Monash outperformed the rest of the varieties by giving it a value of 306.0 g, and Spanish variety Fito gave the lowest average, amounting to 63.0 g. The reason for the superiority was due to an increase in the leaf area of the variety, in addition to the variety's adaptability. In showing the maximum genetic potential for the trait, this is consistent with what was found [15]. Regarding the interaction between the intercropping system and varieties, it was affected significantly, as the Dutch variety Monash with the monocropping system gave the highest value, amounting to 317.0 g. While Spanish variety with the intercropping system gave the lowest average, amounting to 56.0 g. The significant effect achieved in the monocropping system may be attributed to the lack of competition for water and nutrients and exposure to the largest amount of light falling on the plant. Thus, increasing the products of the photosynthesis process, which reflected positively on the vegetative characteristics of the crop [21]. Intercropping led to increased competition between plants to absorb nutrients and water, while monocropping allows the roots to spread more freely and thus increases the amount of absorbed nutrients [22].

Table (8) Effect of intercropping system and faba bean varieties and the interaction between them on the character on the weight of 100 seeds (g)

Varieties	Intercropping system		Means
	Faba bean + onions	Faba bean only	
Local	112.3d	146.6c	129.4b
Dutch Monash	295.0b	317.0a	306.0a
Spanish Fito	56.0f	70.0e	63.0c
Means	154.4b	177.8a	

No significant effect between the same letters on level 0.05

pomegranate cultivars

Conclusion:

The results obtained in this study showed that there are no significant differences between monocropping (faba bean only) and intercropping (faba bean + onions) for most of the studied traits. The response of the faba bean to an intercropping system without any negative impact on their growth and yield. With the opportunity to increase yield of the experimental unit of faba bean and onions with the same growing requirements for water, tillage and fertilizer like the individual faba bean plants. In addition to improving soil properties, sustainability, and reducing the cost of the agricultural process. Dutch variety Monash excelled in most of the studied traits.

References:

- [1]. Al-Tahafy, S. A., H. A. Habib., and N. H. Azab., (2013). The effect of irrigation of different salinity and the addition of organic fertilizer Feed - Humi on the growth and yield of beans *Vicia faba* L.. Al-Furat Journal of Pure Sciences, 5 (4): 307-315.
 - [2]. Sabouh, M., M. L., H. M. Shaherli., and A. S. E. Dabo., (2011). Breeding field crops, practical part. Damascus University Publications. College of Agricultural Engineering. A. P. 117.
 - [3]. Abbas, S. H., (2012). Performance analysis of genotypes in faba bean under the influence of different levels of NPK fertilization, Kufa University Journal of Agricultural Sciences, 4(2): 305-318.
 - [4]. Tamado, T., L. Ohlander., and P. Milberg. (2002). Interference by the weed *Parthenium hysterophorus* L. with grain sorghum: influence of weed density and duration of competition. International Journal of Pest Management, 48(3): 183-188.
 - [5]. Lithourgidis, A. S.; C. A. Dordas.; C. A. Damalas. and D. Vlachostergios.(2011). Annual intercrops: an alternative pathway for sustainable agriculture. Australian journal of crop science, 5(4): 396-410.
 - [6]. Al-Alousi, A. A., & Elshahookie, M. M. (2006). Hybrid-inbred response of maize under sufficient and insufficient nitrogen: i. genetic-physiologic yield Components. Iraqi Journal of Agricultural Sciences, 73: (3) .75-48.
 - [7]. M.A. Abou-keriasha, Nadia M.A. E., and N.M.H. El-wakil. (2013). Effects of intercropping faba bean on onion and wheat with or without inoculated bacteria on yields of three crops. Egypt. J. Agron, 35. (2): 169-182.
 - [8]. Farghly, S., M.F. Mohamed, M.H.Z. El-Dekashey and D.H. El-Shuwaikh. (2021). Effect of intercropping systems on yield and its component in onion / faba bean crops. SVU-International Journal of Agricultural Sciences, 3, (3):, 205-231.
 - [9]. Badih, R. Sh. (2018). The effect of phosphate fertilization and organic matter and their interaction on the growth and yield of beans. Dhi Qar University Journal of Agricultural Research, 7(1): 169-180.
 - [10]. Awaad, H.A.(2002). Phenotypic and Genotypic stability of some faba bean (*Vicia faba* L.) varieties. Egypt. J. Plant Breed., 6 (1): 1-15.
 - [11]. Hendawey, M. H. and A.M.A. Younes (2013). Biochemical evaluation of some faba bean cultivars under rain fed conditions at El-Sheikh Zuwayid, Annals of Agricultural Science, 58(2): 183–193.
 - [12]. Al-Wagaa, A. H.; I. A. Al-Obadui.; H. K. Alfarttoosi. and N. R. Lahmod. (2018). Effect of different doses of glyphosate applied through rope-wickapplicator for the control of *Sorghum halepense* L. growing in pomegranate *Punica granatum* L. orchards. Res. on Crops 19 (4): 633-642.
 - [13]. Zidane, G. J., Omar N. A., and Ziad K. S. (2012). The effect of organic fertilization and intercropping of cowpea *Vigna sinensis* and sweet corn *Zea mays* var. regosa in growth characteristics, yield, and land exploitation rate. Daily Journal of Agricultural Sciences, 0(1): 118-111.
 - [14]. Al-Karkhi, F. D. A., and I. H. A. Al-Muaini. (2014). The effect of tillage and cultivation systems on the growth and yield of white maize (*Sorghum bicolor* L.) and mung beans (*Vigna radiate* L.). Al-Furat Journal of Agricultural Sciences, 6 (1): 135-143.
 - [15]. Kandil, A.A., A.E. Sharief and A.S.A. Mahmoud. (2011). Reduction of Flower Dropping in Some Faba Bean Cultivars by Growth Regulators Foliar Application, J. of App. Sci. Res., 7(12): 1883-1889.
 - [16]. Halil, A. M., and A. L. M. Ali (2019). The effect of plant density and thiamine spraying on some growth traits, yield and quality of four genotypes of faba beans, Al-Anbar Journal of Agricultural Sciences, 11(1): 11-28.
 - [17]. Al-Ani, Lana Jamal Waheed and Ziad Abdel-Jabbar Abdel-Hamid (2017). Response of several bean genotypes to the effect of plant densities, Anbar Journal of Agricultural Sciences, 15(1): 83-94.
 - [18]. Thalji, T. (2015). Agronomical Assessment of Faba Bean (*Vicia faba* L.) Cultivars on Seed Yield and Production Components under Different Ecological Conditions in Jordan, Aus. J. of App. Sci. 9(36) : 315-318.
 - [19]. Ibrahim, H.M. (2016). Performance of Some Faba Bean (*Vicia faba* L.) Cultivars Sown at Different Dates, Alexandria Sci. Exch. J., 37(2): 175-185.
 - [20]. Newton A. C., Begg G. S., Swanston J. S. (2009). Deployment of diversity for enhanced crop function // Annals of Applied Biology., 154: 309–322.
 - [21]. Hussein, H. T. (2016). The effect of adding sulfur and vitamin C on the yield and components of yellow corn. Al-Furat Journal of Agricultural Sciences, 8 (2): 190 – 200.
- Al-Shawk, R. H. J. (1985). The effect of planting distances and chemical fertilization levels on the yield and growth of anaki squash, Master's thesis. College of Agriculture, University of Baghdad. Iraq.

تأثير الزراعة المتداخلة في صفات نمو وانتاجية ثلاثة أصناف من الباقلاء (*Vicia faba* L.)

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الخلاصة

نفذت تجربة في حقل قسم علوم المحاصيل الحقلية / كلية الزراعة / جامعة ديالى للموسم الخريفي 2023\2024 بهدف دراسة تأثير نظم الزراعة في نمو وحاصل الباقلاء ، تضمنت التجربة عاملين ، الأول ثلاثة أصناف من الباقلاء (محلي وهولندي (موناش) واسباني (فيتو)) والعامل الثاني طريقة الزراعة (باقلاء + بصل ، باقلاء فقط) ، واستخدم تصميم القطاعات العشوائية الكاملة (RCBD) بثلاثة مكررات في تخطيط هذه التجربة ، اظهرت النتائج ان نظام الزراعة المفردة (باقلاء فقط) تفوق معنويا في صفة وزن 100 بذرة اذ اعطى قيمة 177 غم ، بينما لم تكن الفروقات بين نظام الزراعة المفردة والمتداخلة (باقلاء + بصل) معنوية في بقية الصفات المدروسة. وبينت النتائج ايضا ان الصنف الهولندي موناش تفوق في صفة ارتفاع النبات (سم) وعدد البذور / القرنة وحاصل النبات الفردي (غم) ووزن 100 بذرة (غم) بلغت (35.2 سم، 4.7، 109.0 غم، 306.0 غم) على التوالي، وتفوق الصنف المحلي في صفة عدد التفرعات/النبات وعدد القرينات/النبات اذ بلغت القيم (5.4، 6.7) فرع/نبات على التوالي. واطهرت التداخل بين طريقة الزراعة المتداخلة والاصناف تأثيرا معنويا، إذ حقق الصنف موناش في نظام الزراعة المتداخلة اعلى قيمة لصفة عدد البذور/القرنة بلغت 5.0 بذرة/قرنة، وتفوق الصنف المحلي بنظام الزراعة المفردة لصفات عدد التفرعات/النبات بلغ 6.1 وعدد القرينات/النبات بلغ 7.2. نستنتج مما تقدم انه لا توجد فروقات معنوية بين نظامي الزراعة المفردة والمتداخلة في جميع الصفات المدروسة فيما عدا وزن 100 بذرة. بينما لوحظ وجود تداخل معنوي بين نظام الزراعة المفردة والاصناف المستخدمة في هذا البحث.

الكلمات المفتاحية: طرائق الزراعة، الزراعة المتداخلة، اصناف الباقلاء، الانتاجية.