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EFFECT OF ORGANIC AND BIOFERTILIZATION SYSTEMS ON FLOWERING AND ABSCISSION ATTRIBUTES AND PRODUCTIVITY OF SOME FABA BEAN CULTIVARS

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ABSTRACT: *Flowers and pods abscission of faba bean cultivars is one of the serious problems causing a reduction of faba bean yield. Two field experiments were conducted at the Experimental Farm, Sers El-Laian Agricultural Research Station, Agricultural Research Center, Egypt, to investigate the effect of organic and biofertilization systems with compost and/or biofertilizers on production and abscission of flowers and pods/ plant and yield of three faba bean (Vicia faba L.) cultivars (Giza 3, Giza 716 and Nubaria 1) during the successive winter seasons of 2009/2010 and 2010/2011. The obtained results could be summarized as follows:*

1- *Giza 716 cultivar produced the highest number of flowers/plant, while Nubaria 1 cultivar produced the lowest one in both seasons. However, Giza 3 cultivar surpassed the other tested cultivars in number of setting pods/plant and produced the lowest percentages of flowers, setting pods and total abscissions per plant than other cultivars in both seasons. Also, data showed that Giza 3 cultivar produced the highest number of pods/plant and seed yield per plant and fed, while Nubaria 1 surpassed the other cultivars in number of seeds/pod, 100-seed weight and straw and biological yields/fed in both seasons.*
2- *The highest numbers of flowers and setting pods/plant and the lowest abscission percentages were obtained by the application of 6 ton compost + bio followed by 4 ton compost + bio treatment in both seasons. Moreover, compost and biofertilization application especially at the highest rate caused a significant increase in all yield and its components characters compared to unfertilized plants.*
3- *The interaction between cultivars and fertilization systems were found to be significant for all characters under study. The data showed that the highest values of numbers of flowers and setting pods/plant were obtained from fertilized Giza 3 cultivar with 6 ton compost + bio, while the lowest ones obtained from unfertilized Nubaria 1 plants. On the other hand, the lowest values of abscission were recorded mostly when fertilized Giza 3 plants with 4 ton compost + bio or 6 ton compost + bio. Also, fertilized Giza 3 plants with 6 ton compost + bio surpassed the other treatments in increasing the number of pods/plant and seed yield per plant and fed. However, fertilized Nubaria 1 plants with 6 ton compost + bio produced the highest values of number of seeds/pod, 100- seed weight, seed weight/pod and straw and biological yields/fed.*
4- *It could be concluded that fertilizing Giza 3 cultivar with 6 ton compost + bio in the first season and 4 ton compost + bio in the second one were the most effective treatments for reducing abscission problems and maximizing the seed yield of faba bean.*

Key words: *Faba bean, Cultivars, Compost, Biofertilizers, Flowers, Abscission, Yield.*

INTRODUCTION

Faba bean (*Vicia faba* L.) belongs to the family Fabaceae, is a crop with several benefits. It is important for soil fertility, human and animal feeding which is considered as the rich source of low cost protein and carbohydrate (Daur *et al*., 2008). In Egypt, the cultivated area of faba bean was approximately 200,000 fed with an average productivity of 1.33 ton /fed. However, the yield of faba bean is low in spite of its numerous advantages. Faba bean production in Egypt is still limited and fails to face the local increasing consumption of the crop. To satisfy the national requirement of faba bean, either the area could be increased or the high yielding cultivars should be grown as recorded by Ali (2005), Attia and Mohamed (2007) and Abdelhamid *et al.* (2010). The increase in yield could be the more effective way by improved cultivars and applying recommended fertilization systems.

Plant nutrients are essential for plant development and yield. Application of organic and biofertilization is very important for faba bean because it supplies plants with a part of nutrients requirements, saves a great amount of mineral fertilizers and reduces environmental pollution and production costs. The extensive use of chemical led to increase both production cost and environmental pollution leading to many health hazard problems. Composting is the most important methods for increasing agricultural output by raising the level of soil fertility, due to (a) long term improvement of structural stability, (b) moisture retention and (c) the supply of plant nutrients. Also, Faba bean seed treated with microbial inoculates such as N_2-fixing bacteria could supply the plants with a part of nitrogen required during different growth stages and increase seed yield and its components as well as seed protein content. Phosphate dissolving bacteria is considered as a biological fertilizer which had an important role in the solubility of phosphorus. Potassium mobilizing bacteria is capable of mobilizing potassium in accessible form in soils. Organic and biofertilizers are the most advanced biotechnology to improve the growth, nodulation and yield (El-Brollosy *et al.*, 2002; Ahmed *et al.*, 2004; Rizk *et al.,* 2006 and Abou-Zaid, 2012).

Flowers and setting pods abscission of faba bean cultivars is one of the serious problems causing a reduction of faba bean yield. Therefore, plant physiologists and breeders were studying intensively the problem of abscission, in order to find a solution for reducing the high abscission percentages (Ali, 2005). Yield is a complex character determined by several variables that affect plant development through growth stages. Hence, it is essential to detect the characters having the great influence on yield and their relative contribution to variation of yield cultivars. The capability of efficient partitioning between the vegetative and reproductive parts may produce high economic yield (Maola, 2005). Flowers and pods abscission is also a great barrier in high yield potentials.

Therefore, the aim of this investigation was conducted to study the effect of organic enrichment on flowering and abscission attributes and yield and its components of some faba bean cultivars under organic agriculture rules.

MATERIALS AND METHODS

Experimental site and treatments:

Two field experiments were conducted at the Experimental Farm, Sers El-Laian Agricultural Research Station, Agricultural Research Center, Egypt, to investigate the effect of organic enrichment with compost and/or biofertilizers on flowering and abscission attributes and yield of faba bean (*Vicia faba* L.) cultivars during the successive winter seasons of 2009/2010 and 2010/2011. The experiment included eighteen treatments in each growing season which were the combination of three cultivars and six fertilization systems which are as follows:

A- Cultivars.

1- Giza 3
2- Giza 716
3- Nubaria 1

B- Fertilization systems.

1- Unfertilized (Control).
2- Biofertilizers.
3- Compost at a rate of 4 ton/fed.
4- Compost at a rate of 6 ton/fed.
5- Compost at a rate of 4 ton/fed + biofertilizers.
6- Compost at a rate of 6 ton/fed + biofertilizers.

Mixture of microorganisms were used as biofertilizers treatment which are:

(a) *Azotobacter chroococcum, Azospirillum brasilense* and *Rhizobium leguminosarum* biovar viciae as N_2-fixing bacteria.
(b) *Bacillus megaterium* var. *phosphaticum* as phosphate dissolving bacteria.
(c) *Bacillus circulans* as potassium release bacteria.

The Treatments were arranged at random in a split plot design with three replications. The main plots were allocated for cultivars. However, the sub-plots were devoted for the fertilization systems.

The tested cultivars seeds were obtained from the Legumes Crops Research Section, Field Crops Research Institute, ARC, Egypt. Compost used in this study was obtained from El-Khalil Factory for Compost at El-Khtatba province, El-Beheira Governorate, Egypt.

Crop management under organic agriculture rules

The experimental field was ploughed and pulverized after harvesting maize to preparation the seed bed. Then, the soil was ridged into rows 60 cm width and divided plots. Each experimental plot including five rows, each row 3.5 m long. The plot area was 10.5 m^2. Seeds were sown on 1^{st} and 5^{th} November in first and second seasons, respectively. Twenty days after sowing, plants were thinned to two plants /hill on one side of the ridge and one plant/hill on the other side of the ridge with 20 cm between hills to produce 105000 plants/fed. The experiment in the second season was repeated in the same field plots of first season to observation the residual effect of compost and biofertilizers application.

In all experimental plots, faba bean seeds were treated with Clean Root contains *Bacillus subtilis* (30×10^6 c.f.u. /1 g.) Faba bean seeds were wetted using 5% sucrose solution and mixed with Clean Root at a rate of 10 g./1kg of seeds. Also, In the tested biofertilizer treatments only the seeds were inoculated with microorganisms mixed at a rate of 40 g. of inocula / kg seeds. Bacterial preparations used were obtained from Central Laboratory of Organic Agriculture, A.R.C., Giza, Egypt. Treated seeds were left to dry in shadow then sowed directly.

To protect all plants against sucking insects (aphids and white fly), all experimental plots were treated with Anti-insect produced by C.L.O.A as a biocide contains *Beauveria bassiana*. Anti-insect was used at the rate of 1 liter/200 liter of water. The treatment was sprayed three times, the first one was 35 days after sowing and repeated every 15 days.

To avoid any interference of any other non target factors all plants were treated against fungal diseases. Treatments were carried out using the biological preparation (Blight stop) contains *Trichoderma harzianum* (30×10^6 c.f.u/ml) produced by C.L.O.A. The Blight stop was used at the rate of 1liter/200 liter of water. The treatment was sprayed at 50 days after sowing and repeated every 15 day till end flowering stage.

All cultural practices, other than treatment variables, were performed as recommended for the area according to organic agriculture rules.

Soil and compost analysis

Soil samples were randomly taken from the experimental field before planting at 30 cm depth. The mechanical and chemical analysis of the soil according to Jackson (1973) and Page *et al.* (1982) are presented in Table (1). Chemical and microbial analyses of the mature compost used in experiments are presented in Table (2).

Plant measurements:

1- Flowering and abscission attributes

Since commence of flowering, six guarded plants of three successive hills were marked at random in each experimental plot. Number of flowers and setting pods were measured during the flowering period of 2 days intervals beginning the blooming of the first flower until the end of flowering period. The following characters were recorded:

1- Number of flowers/plant.
2- Number of setting pods (young pods)/plant.

Table (1): Some mechanical and chemical properties of the experimental soil.

Characters		Seasons	
		2009/2010	2010/2011
Total $CaCO_3$ (%)		2.20	1.61
Organic matter (%)		1.31	1.42
pH (1:2.5)		7.50	7.10
EC (dS m^{-1})		1.41	1.38
Particle size distribution (%)	Fine sand	53.2	52.7
	Coarse sand	1.8	2.6
	Silt	26.0	25.3
	Clay	19.0	19.4
Texture class		Sandy loam	Sandy loam
Cations (meq $100g^{-1}$)	Ca^{++}	8.04	8.22
	Mg^{++}	5.26	5.30
	Na^{+}	0.61	0.20
	K^{+}	0.19	0.16
Anions (meq $100g^{-1}$)	Cl^{-}	6.00	4.30
	HCO_3^{-}	1.60	1.20
	SO_4^{--}	6.50	8.38
Available nutrients (%)	N	0.23	0.28
	P	0.25	0.30
	K	0.51	0.62

Table (2): Chemical and microbial analyses of the mature compost used.

Characters	Value
Color	Dark brown
Bulk density (kg m^{-3})	600
Moisture content (%)	27.0
Water holding compacting (%)	250
pH (1:10 suspension)	7.15
EC (1:10 suspension)	5.10
O.M (%)	37.4
O.C (%)	21.1
Ash (%)	65.2
Total N (%)	1.30
Total P (%)	0.87
Total K (%)	0.95
C / N ratio	16:1
Available N (NH_4^{+}) (mg kg^{-1})	290
Available N (NO_3^{-}) (mg kg^{-1})	330
Available P (mg kg^{-1})	215
Available K (mg kg^{-1})	380
DTPA – extractable (Fe) (mg kg^{-1})	270
DTPA – extractable (Mn) (mg kg^{-1})	90
DTPA – extractable (Zn) (mg kg^{-1})	70
DTPA – extractable (Cu) (mg kg^{-1})	35
Nematode	NIL
Total E. coli	NIL
Weed Seed	NIL

3- Flowers abscission /plant (%) =
[(Number of flowers /plant- Number of setting pods /plant)/ Number of flowers /plant] x 100

4- Setting pods abscission /plant (%) =
[(Number of setting pods /plant- Number of pods at harvest /plant)/ Number of setting pods /plant] x 100

5- Total abscission /plant (%) =
[(Number of flowers /plant- Number of pods at harvest/plant)/ Number of flowers /plant] x 100

2- Yield and its components:

At harvest, six guarded plants were taken at random from each experimental plot to estimate individual plant characters. However, seed, straw and biological yields of the middle area (4 m^2) of plot were estimated and converted to ton/fed. The following characters were recorded:

1- Number of pods/plant.
2- Number of seeds/pod.
3- 100-seed weight (g).
4- Seed yield /plant (g).
5- Seed yield / fed (ton).
6- Straw yield /fed (ton).
7- Biological yield/ fed (ton).

Statistical analysis:

All measurements data during the two seasons in this study were analyzed according the methods described by Snedecor and Cochran (1980). The differences among the means of different treatments were tested using the Least Significant Differences (LSD) at probability 5%. Statistical analysis was done using the CoStat package program, version 6.311 (cohort software, USA).

RESULTS AND DISCUSSION

1. Flowering and abscission attributes:

1. A- Effect of cultivars differences

The differences among the three tested faba bean cultivars in their total flowers and setting pods numbers and abscission percentages are shown in Table (3). Flowering and abscission characters show high variation in faba bean plants which is dependent on the genetic traits of cultivars. Giza 716 cultivar produced the highest number of flowers/plant in both seasons. This increase resulting from Giza 716 cultivar amounted to 33.15 and 37.14 % more than Nubaria 1 cultivar in the first and second seasons, respectively. Moreover, it could be noticed that Giza 3 cultivar had the greatest number of setting pods/plant followed by Giza 716 in both seasons. On the other hand, Nubaria 1 cultivar recorded the lowest mean values of flowers and setting pods numbers in both seasons.

Concerning abscission, Giza 3 gave lower percentages of flowers, setting pods and total abscission than Nubaria 1 and Giza 716 cultivars in a descending order in both seasons. As an average of the two seasons, the decrease in the total abscission /plant resulting from Giza 3 cultivar amounted to 4.18 and 5.83% less than Nubaria 1 and Giza 716 cultivars, respectively. These results may be due to the differences in the amounts of hormones among the tested cultivars. Physiological mechanisms of flowers and pods abscission are hormonally which might involved in changing flowering pattern and abscission. In this connection, Ibrahim *et al.* (1995) found that total abscission percentage was much higher in faba bean cultivar Giza 402 than that in Giza 461 by at least 8% as a result to a lower level of IAA at abscission period. Similar results were obtained by Shams *et al.* (2001), Abdul Galil *et al.* (2003), Ali (2005) and Kandil *et al.* (2011) who found variation between faba bean cultivars in the numbers of flowers and setting pods/plant and flower, setting pods and total abscission percentages.

1. B- Effect of compost and biofertilization systems

The data in Table (3) demonstrate that total number of flowers and setting pods/plant were increased by application of the tested compost and biofertilizers either separately or mixed as compared with unfertilized plants in the two seasons. The data show that the highest increase in the number of flowers and setting pods/plant were recorded by the application of 6 ton compost + bio followed by 4 ton compost +

Table 3

bio without significant differences among them in both seasons for flowers number/plant. On the other hand, the lowest values of both traits were recorded by the unfertilized plants. In this respect, many researchers found that numbers of flowers and setting pods/ plant were increased by application of organic fertilizer (El- Shikha and Gaafar, 2006) and biofertilizers (El-Wakeil and El-Sebai, 2007 and Hewedy, 2011).

The data in the same table declare that the differences in percentages of flowers, pods and total abscission were reached the level of significance in the two seasons. Application of compost and biofertilizers either separately or mixed significantly reduced the abscission percentages compared to control. It could be noticed that application of 6 ton compost + bio followed by 4 ton compost + bio produced the lowest different abscission percentages compared to other fertilized and unfertilized plants in both seasons. These results may be due to the fact that, the hormonal balance of plant probably changed with nutritional intensity. Thus, the promoting effect of compost and /or bio on enhancing flower and setting pods production as well as decreasing the abscission of flowers and pods, mainly attributed to that application of compost and/or bio supplying the plants with its necessary nutrients such as N which is a component of IAA which inhibits abscission, and cytokinins which mobilize nutrients to developing pods and thereby help prevent senescence and decrease ABA content in leaves. Also, P and K elements can change the cytokinin level and have a similar positive effect on photohormone content in the plant like N fertilization (Addicott, 1970). These results are in agreement with those obtained by El- Shikha and Gaafar (2006).

1.C- Effect of cultivars x fertilization systems

With regard to the interaction between cultivars and fertilization systems for numbers of flowers and setting pods /plant, the data in Table (3) show that the highest values of both traits were obtained from fertilized Giza 3 plants with 6 ton compost + bio. Also, addition of 4 ton compost + bio was more effective in increasing number of flowers/plant of Giza 716 cultivar. On the other hand, the lowest flowers and setting pods numbers were obtained from the unfertilized Nubaria 1 plants.

Significant differences could be detected between the two factors with regard to the abscission percentages in both seasons. It is obvious that the lowest values of flowers abscission were recorded when fertilized Giza 3 plants with 4 ton compost + bio or 6 ton compost without significant differences between them in both seasons. However, addition of 6 ton compost + bio to Giza 3 cultivar was effective treatment for decreasing setting pods abscission percentage compared to the rest treatments. Concerning total abscission (flowers and pods), the lowest values were obtained when fertilized Giza 3 plants with 4 ton compost + bio followed by 6 ton compost + bio in both seasons. On the other side, unfertilized Giza 716 plants gave the highest values of flowers, setting pods and total abscission percentages. These results are fairly true in the two seasons.

2. Yield and its components:

2. A- Effect of cultivars differences

Mean performances of the investigated faba bean cultivars for yield and its components in the two seasons are presented in Table (4). With regard to number of pods/plant, significant differences were recorded among the tested faba bean cultivars in both seasons. Giza 3 was the most superior one and Nubaria 1 cultivar was the most inferior one, while Giza 716 was in between in this respect. This was true in both seasons. The superiority of Giza 3 cultivar in the number of pods/plant could be attributed to a greater number of setting pods production and / or decreases the percentages of flowers, pods and total abscission during flowering and poding period (See Table 3). As an average of the two seasons, Giza 3 produced number of pods per plant amounted to 33.98 and 60.71 % more than Giza 716 and Nubaria 1 cultivars, respectively. In this respect, other researchers found significant variation

Table 4

among some faba bean cultivars in the number of pods/plant in favors of Giza 402 cultivar (Saad and El-Kholy, 2000), Giza 429 cultivar (Mekky *et al.,* 2003), Giza 3 cultivar (Afifi *et al*., 2005), Misr 1 cultivar (Ali, 2005), Nubaria 1 cultivar (Bakry *et al.,* 2011) and Giza 716 cultivar (Kandil *et al*., 2011).

Number of seeds/pod and 100-seed weight were remarkably influenced by cultivars variation in both seasons. It is worth noting that, Nubaria 1 cultivar significantly surpassed Giza 3 and Giza 716 cultivars in this concern. The differences among the tested cultivars might be attributed to the variation among cultivars in their vegetative growth characters and sink capacity. In this respect, other investigators found high variation among some faba bean cultivars in number of seeds/pod (Saad and El-Kholy, 2000 and Kandil *et al*., 2011) and 100-seed weight (Shams *et al*., 2001; Afifi *et al.,* 2005 and Ali, 2005).

Significant differences could be detected among the three tested cultivars with regard to seed yield/plant in both seasons (Table 4). It is obvious that Giza 3 gave the highest values followed by Giza 716 and Nubaria 1 cultivars. From the obtained data, Giza 3 cultivar excelled Giza 716 and Nubaria 1 cultivars in seed yield /plant by 16.87 and 38.22 % in the first season and by 17.87 and 33.97 % in the second season, respectively. The superiority of Giza 3 cultivar in seed yield/plant could be attributed to its superiority in total number of pods/plant and decrease the abscission percentages. In this concern, many researchers found superiority of some faba bean cultivars in seed yield/plant such as Giza 429 cultivar (Mekky *et al.,* 2003), Sakha1 (Mohamed and El-Abbas, 2005), Nubaria 1 (Bakry *et al.,* 2011), Giza 716 (Kandil *et al.,* 2011) and Giza 3 (Porass *et al*., 2011).

Data shown in Table (4) indicate clearly that the three tested cultivars significantly differed in their seed yield/fed in both seasons. Giza 3 cultivar was higher in seed yield than Giza 716 and Nubaria 1. The differences between Giza 716 and Nubaria 1 cultivars were found to be significant in the two seasons. The superiority of Giza 3 cultivar in seed yield/fed could be related to its superiority in number of pods and seed yield/plant. Other investigators found cultivars variation in seed yield/fed in favor of Giza Blanka cultivar (Shams *et al.,* 2001), Sakha 1 (Mohamed and El-Abbas, 2005) Nubaria1 (Bakry *et al.,* 2011) and Giza 3 (Porass *et al*., 2011).

Straw and biological yields/fed values showed that significant differences were detected among faba bean cultivars in both seasons. Nubaria 1 cultivar had the maximum values of straw and biological yield/fed, while Giza 3 cultivar was the lesser one in this respect. These results hold fairly true in the two seasons. The superiority of Nubaria 1 in straw and biological yields/fed might be due to its higher numbers of branches and leaves during vegetative stage. It means that, the cultivar which having much straw yield at harvest decrease the proportion of dry matter partitioned to seeds at maturity, while increased the dry matter remaining in the temporary sinks (stem and other non seed tissues) at harvest. In this respect, other investigators found cultivars variation in straw and biological yields/fed in favor of Giza Blanka (Saad and El-Kholy, 2000), Giza 461 (Afifi *et al.,* 2005), Nubaria1 and Misr 1 (Ali, 2005) and Nubaria 1 (Bakry *et al.,* 2011).

2. B- Effect of compost and biofertilization systems

Data in Table (4) show that significant difference in the number of pods/ plant was detected due to fertilization systems. The highest significant values of the number of pods per plant were recorded when the plants were fertilized with 6 ton compost+bio followed by 4 ton compost+bio. On the other hand, the unfertilized plants produced the lowest number of pods/ plant. This superiority may be attributed to a greater amount of assimilates which contributed to dry matter accumulation and this in turn increased the number of pods/plants as a result of mixed treatment (compost + bio) which increased nutrients uptake and decrease abscission percentages than the individual treatment or unfertilized plants. In this respect, similar results were obtained by other researchers who found that number of pods/plant was increased by fertilization with biofertilizers (Mohamed, 2000; Mekhemer *et al*., 2005 and Hewedy, 2011), compost (Abdul Galil *et al*., 2003 and Mahmoud, 2011) and compost + bio (Mohamed and El-Ganaini, 2003 and Rizk *et al.,* 2006).

Significant differences could be detected among the fertilization systems with regard to number of seeds/pod and 100-seed weight in both seasons (Table 4). It is obvious generally that the application of 6 ton compost+bio treatment produced the best results for two traits, while the unfertilized plants gave the lowest values. It could be suggested that the translocation of photoasesimilate from the vegetative plant tissues to the seeds was much affected by plant nutrition status which leads to the promotion of cell division, build up of storage capacity and attractive power of metabolic to sink tissues (Mengel and Kirkby, 1987). In this regard, other researchers reported the importance of fertilization for enhancing number of seeds/pod (Mohamed and El-Ganaini, 2003 and Abdel – Wahab and Said, 2004) and 100-seed weight (Ahmed *et al*., 2004; Rizk *et al.,* 2006 and Ali, 2010) as compared with unfertilized legume plants.

The data in the same Table show that seed yield/plant was significantly enhanced by the application of all tested fertilization systems as compared with unfertilized plants in the both seasons. It is worthy to mention that the application of 6 ton compost+bio caused greater increase in seed yield per plant than that obtained by the rest fertilization systems. Application of 4 ton compost+bio ranked as a second in this respect. Therefore, the increase in seed yield per plant under fertilization treatments found herein was logic, because of the increase in its components and decrease the abscission percentages as previously discussed. In this regard, Similar results were obtained by other researchers who found that seed yield / plant was increased by bio inoculation (Radwan and Mohamed, 2005 and Hewedy, 2011), compost (Abdul Galil *et al*., 2008 and Mahmoud, 2011) and mixed compost plus biofertilizer (Mohamed and El- Ganaini, 2003 and Ahmed *et al*., 2004) compared to unfertilized plants.

The response of seed yield/fed to the tested fertilization systems is shown in Table (4). Significant increase in seed yield/fed was obtained by the application of all tested fertilization treatments more than the control treatment in the two growing seasons. The highest seed yield/fed was recorded when the plants received the mixed 6 ton compost+bio followed by 4 ton compost+bio treatment. As an average of the two seasons, it can be notice that the plants were fertilized with 6 ton compost+bio and 4 ton compost+bio caused an increasing in total seed yield/fed amounted to 45.54 and 36.93 % more than the unfertilized plants, respectively. Similar results were recorded by other researchers who found that seed yield / fed was increased by bio inoculation (Sadek, 2010 and Badawi *et al*., 2011), compost (Hellal *et al*., 2009 and Porass *et al*., 2011) and mixed compost + bio (El-Brollosy *et al*., 2002; Abdel – Wahab and Said, 2004 and Rizk *et al.*, 2006) compared to unfertilized plants.

Straw and biological yields/fed exhibited positive response to compost and biofertilization application in both seasons. The highest values of both traits were obtained by application of 6 ton compost+bio followed by 4 ton compost+bio treatment which differ significantly compared to control which ranked the last. The superiority of mixed treatment (compost + bio) in straw and biological yields/fed might be due to its roles in improvement the vegetative development. The organic fertilizer has appositive impact on nutrients availability for the growth and development plants (Ghanem *et al*., 2006). Also, inoculation plants with biofertilizers could improve the growth due to their rhizosphere intensification, N_2-fixing, phosphate dissolving, endogenous hormones production; encourage photosynthesis and assimilation and antimicrobial substance production that could be useful against pathogenic microorganisms (Abdelaziz *et al*., 2007). These results are confirmed by several faba bean investigators who found that straw and biological yields/fed were enhanced by bio inoculation (Mehana and Abdul Wahid, 2000; Mekhemer *et al*., 2005 and Radwan and Mohamed, 2005), compost (Hellal *et al*., 2009 and Gomaa *et al.,* 2010) and mixed compost + bio (Ghanem *et al.,* 2006 and Zaki *et al.,* 2008) compared to unfertilized plants.

2. C- Effect of cultivars x fertilization systems

Concerning number of pods/plant, it is evident from Table (4) that there was a considerable amount of variation among the tested fertilization systems and cultivars in both seasons. It is evident that the application of 6 ton compost + bio to Giza 3 cultivar gave the highest pods number compared to other treatments especially unfertilized Nubaria 1 plants which produced the lowest one in both seasons. These findings are in harmony with those obtained by Abdel – Wahab and Said (2004).

It could be mentioned also from the presented data in the same table that fertilization faba bean cultivars with different compost and/or biofertilizers significantly increased number of seeds/pod and 100-seed weight in both seasons. Fertilized Nubaria 1 plants with 6 ton compost + bio found to be the most effective combination for producing more above mentioned characters. Meanwhile, unfertilized Giza 3 plants ranked lastly in this respect. These findings are in harmony with those obtained by Abdelhamid *et al.* (2004) who found that number of seeds/pod was increased by sowing Assiut-8 cultivar under compost fertilization as compared with other treatments. However, Abdel – Wahab and Said (2004) indicated that planting Giza Blanka cultivar under compost plus biofertilizer application increased 100-seed weight compared to other treatments.

Data in Table (4) show that seed yield per plant and fed were significantly affected by the interaction between cultivars and fertilization systems in both seasons. Giza 3 cultivar produced the highest seed yield when fertilized with 6 ton compost + bio followed by 4 ton compost + bio without significant difference between them in the second season. Applying 4 ton compost + biofertilizers was enough to satisfy nutrients requirements in the second season, this may be due to the residual nutrients from first season. On the other hand, the lowest seed yield per plant and fed were recorded by unfertilized Nubaria 1 plants. These results are in line with those obtained by Porass *et al.* (2011).

With regard to straw and biological yields /fed, the data in the same table show that application of 6 ton compost+bio to Nubaria 1 plants produced the highest values of the two traits compared to the rest treatments in the two seasons. However, Giza 716 recorded the second rank by applying the same previous fertilization treatment. Meanwhile, Giza 3 plants which did not receive any compost or biofertilization gave the minimum values of both traits. These results are in accordance with those obtained by Mohamed and El-Abbas (2005) and El-Banna *et al*. (2009).

Conclusion

The results of study showed that with improved nutrition, flowers and pods production were enhanced while abscission was reduced. Therefore, faba bean grower must be careful about select the cultivar which achieves more flowers and pods production and lowest abscission. It could be concluded that fertilizing Giza 3 cultivar with 6 ton compost + bio in the first season and 4 ton compost + bio in the second one were the most effective treatments for reducing abscission problems and maximizing the seed yield of faba bean.

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تأثير نظم التسميد العضوي والحيوي على صفات التزهير والتساقط والإنتاجية لبعض أصناف الفول البلدي

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الملخص العربى

يعتبر تساقط الازهار والقرون أحد أهم المشاكل التى تواجه زراعة أصناف الفول البلدى لذا أجريت تجربتان حقليتان بالمزرعة البحثية لمحطة البحوث الزراعية بسرس الليان – مركز البحوث الزراعية بمصر خلال موسمى الزراعة 2010/2009، 2011/2010 بهدف دراسة تأثير نظم التسميد العضوى والحيوى على انتاج وتساقط الازهار والقرون ، الصفات المحصولية لثلاثة أصناف من الفول البلدى (جيزة 3 ، جيزة 716 ، نوبارية 1) . ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى :

1-تفوق الصنف جيزة 716 فى اعطاء أفضل قيم عدد الازهار على النبات واحتل صنف نوبارية 1 المرتبة الأخيرة ، فى حين تفوق الصنف جيزة 3 عن بقية الأصناف فى عدد القرون العاقدة على النبات واعطاء أقل نسبة تساقط لكل من الازهار والقرون والكلى للنبات وذلك خلال موسمى الزراعة. هذا وقد أظهر الصنف جيزة

3 تفوقه عن باقى الأصناف الأخرى فى عدد القرون للنبات و محصول البذور للنبات والفدان فى حين تفوق الصنف نوبارية 1 فى عدد بذور القرن ، وزن 100 بذرة ، محصول القش والبيولوجى للفدان .

2-تحققت أفضل نتائج عدد الازهار و القرون العاقدة على النبات وأقل نسبة تساقط لكل من الأزهار والقرون والكلى للنبات عندما سمدت النباتات بمعدل 6 طن كمبوست + حيوى تبعتها المعاملة 4 طن كمبوست + حيوى وذلك خلال موسمى الزراعة. علاوة على ذلك أدى زيادة معدل اضافة الكمبوست مقترنا بالتلقيح الحيوى الى إحداث زيادة معنوية لجميع الصفات المحصولية .

3-تشير نتائج التفاعل بين العوامل المختبرة (الأصناف ونظم التسميد العضوى والحيوى) إلى تأثر جميع الصفات المدروسة تأثرا معنويا بهذا التفاعل حيث أعطى الصنف جيزة 3 أعلى قيم عدد الازهار والقرون العاقدة على النبات عندما سمدت النباتات بمعدل 6 طن كمبوست + حيوى بينما تحققت أقل القيم بزراعة الصنف نوبارية 1 بدون تسميد. وعلى الجانب الآخر حقق الصنف جيزة 3 عامة أقل نسبة تساقط لكل من الأزهار والقرون عند التسميد بمعدل 4 طن كمبوست + حيوى أو بمعدل 6 طن كمبوست + حيوى. هذا وقد تفوقت نباتات الصنف جيزة 3 المسمدة بمعدل 6 طن كمبوست + حيوى فى زيادة عدد القرون على النبات ومحصول البذور للنبات والفدان فى حين تفوقت نباتات الصنف نوبارية 1 المسمدة بنفس المعدل السابق فى زيادة عدد بذور القرن ، وزن 100 بذرة ، محصول القش والبيولوجى للفدان.

4-توصى الدراسة بزراعة الصنف جيزة 3 تحت معدل تسميد 6 طن كمبوست + حيوى فى العام الأول ، 4 طن كمبوست + حيوى فى العام الثانى وذلك للحد من تساقط الازهار والقرون علاوة على تعظيم انتاجية محصول بذور الفول البلدى .

Table (3): Flowering characters of faba bean cultivars as affected by fertilization systems and their interaction during 2009/2010 (S1) and 2010/2011 (S2) seasons.

Cultivars (A)	Fertilization (B)	Flowers number/plant		Setting pods number/plant		Flowers abscission (%)		Setting pods abscission (%)		Total abscission (%)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Giza 3		130.06	132.23	37.05	39.27	71.38	70.13	42.08	40.58	83.34	82.19
Giza 716		135.35	140.92	32.00	34.13	76.42	75.80	50.37	49.10	88.17	87.59
Nubaria 1		101.65	102.76	25.18	27.02	75.31	73.73	47.09	46.98	86.79	85.95
	Control	115.58	121.39	27.65	30.49	76.16	74.89	52.12	50.91	88.42	87.50
	Biofertilizers	121.54	124.65	29.84	33.41	75.57	73.24	49.20	46.78	87.45	85.61
	4 ton compost	118.68	123.85	28.95	32.74	75.76	73.65	50.00	47.66	87.72	86.04
	6 ton compost	123.50	126.73	31.98	34.04	74.18	73.15	45.68	45.88	85.87	85.30
	4 ton compost +bio	126.90	127.05	34.83	34.95	72.53	72.40	41.28	41.34	83.78	83.70
	6 ton compost +bio	127.91	128.17	35.21	35.23	72.00	72.04	40.79	40.74	83.35	83.28
Giza 3	Control	120.71	125.74	33.47	36.24	72.29	71.18	48.19	44.69	85.57	84.04
	Biofertilizers	127.04	129.36	35.48	39.27	72.11	69.69	44.33	41.84	84.43	82.32
	4 ton compost	125.41	129.79	35.19	39.13	71.98	69.89	44.26	41.23	84.36	82.26
	6 ton compost	128.36	130.80	37.64	40.05	70.71	69.42	41.94	40.70	82.95	81.81
	4 ton compost +bio	131.95	131.31	39.73	39.96	69.91	69.56	37.06	38.39	81.06	81.23
	6 ton compost +bio	146.87	146.34	40.77	41.01	71.28	71.00	36.68	36.61	81.70	81.47
Giza 716	Control	128.70	137.14	27.57	30.84	78.63	77.53	55.98	54.95	90.49	89.84
	Biofertilizers	134.91	140.64	30.54	34.10	77.40	75.78	52.60	50.06	89.21	87.83
	4 ton compost	131.04	138.83	29.43	33.46	77.57	75.93	54.72	51.06	89.76	88.15
	6 ton compost	138.15	144.00	32.75	34.72	76.35	75.94	48.99	49.39	87.90	87.73
	4 ton compost +bio	142.56	145.33	35.77	35.85	74.93	75.36	45.28	44.18	86.25	86.19
	6 ton compost +bio	136.71	139.59	35.94	35.82	73.61	74.24	44.65	44.96	85.39	85.76
Nubaria 1	Control	97.32	101.30	21.89	24.40	77.58	75.94	52.19	53.08	89.20	88.63
	Biofertilizers	102.67	103.94	23.48	26.85	77.20	74.23	50.68	48.43	88.71	86.66
	4 ton compost	99.59	102.92	22.23	25.63	77.73	75.14	51.03	50.70	89.04	87.71
	6 ton compost	103.99	105.38	25.54	27.36	75.48	74.09	46.10	47.57	86.76	86.37
	4 ton compost +bio	106.18	104.49	28.98	29.06	72.74	72.23	41.51	41.43	84.04	83.70
	6 ton compost +bio	100.15	98.57	28.96	28.85	71.11	70.78	41.03	40.65	82.96	82.62
	LSD : A	2.45	2.43	0.04	0.02	0.43	0.44	0.23	0.02	0.26	0.27
	B	2.78	2.75	0.05	0.03	0.48	0.49	0.22	0.06	0.29	0.31
	AB	4.85	4.82	0.07	0.04	0.84	0.86	0.39	0.11	0.52	0.55

Table (4): Yield and its components of faba bean cultivars as affected by fertilization systems and their interaction during 2009/2010 (S1) and 2010/2011 (S2) seasons.

Cultivars	Fertilization (B)	No. of pods /plant		No. of seeds/ pod		100-seed weight (g.)		Seed yield /plant (g.)		Seed yield /fed (ton)		Straw yield / fed (ton)		Biological yield / fed (ton)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Giza 3		21.65	23.47	3.39	3.53	67.76	72.58	35.19	43.34	2.16	2.29	2.70	2.65	4.86	4.94
Giza 716		16.12	17.56	3.85	3.98	79.35	83.98	30.11	36.77	1.86	2.06	3.03	2.90	4.89	4.96
Nubaria 1		13.54	14.53	4.21	4.33	98.13	101.32	25.46	32.35	1.71	1.83	3.24	3.17	4.95	5.00
	Control	13.47	15.24	3.42	3.56	79.71	83.32	20.44	29.55	1.56	1.69	2.34	2.19	3.90	3.88
	Biofertilizers	15.38	18.05	3.90	3.75	81.38	85.48	26.98	37.83	1.80	1.98	3.05	2.68	4.85	4.66
	4 ton compost	14.73	17.45	3.55	3.82	80.60	84.40	22.81	35.76	1.66	1.79	2.51	2.38	4.17	4.17
	6 ton compost	17.52	18.69	3.82	4.01	82.16	86.50	31.42	39.24	1.92	2.27	2.69	2.94	4.61	5.21
	4 ton compost +bio	20.55	20.65	4.07	4.14	82.80	87.32	36.59	40.82	2.14	2.31	3.43	3.44	5.57	5.75
	6 ton compost +bio	20.98	21.04	4.14	4.38	83.83	87.72	43.28	41.72	2.39	2.33	3.91	3.81	6.30	6.14
Giza 3	Control	17.50	20.14	3.07	3.10	65.76	69.95	24.81	34.52	1.82	1.95	2.05	1.98	3.87	3.93
	Biofertilizers	19.84	22.95	3.42	3.30	67.46	72.05	31.62	43.80	2.13	2.26	2.70	2.45	4.83	4.71
	4 ton compost	19.68	23.11	3.19	3.43	66.62	71.71	26.83	41.09	1.89	2.07	2.26	2.13	4.15	4.20
	6 ton compost	21.95	23.86	3.41	3.60	68.09	73.10	36.53	45.11	2.16	2.43	2.42	2.68	4.58	5.11
	4 ton compost +bio	25.03	24.71	3.58	3.76	68.69	74.08	41.81	47.20	2.40	2.50	3.07	3.10	5.47	5.60
	6 ton compost +bio	25.88	26.07	3.69	4.00	69.94	74.59	49.49	48.29	2.57	2.54	3.73	3.56	6.29	6.10
Giza 716	Control	12.30	13.97	3.39	3.61	77.15	81.36	20.97	30.08	1.49	1.66	2.34	2.17	3.83	3.83
	Biofertilizers	14.62	17.17	3.92	3.79	78.97	83.43	26.58	36.66	1.70	1.98	3.11	2.63	4.80	4.60
	4 ton compost	13.47	16.51	3.54	3.84	78.01	83.44	23.05	35.43	1.60	1.75	2.55	2.41	4.15	4.16
	6 ton compost	16.76	17.76	3.81	4.05	79.90	84.42	31.96	38.44	1.87	2.32	2.72	2.93	4.59	5.25
	4 ton compost +bio	19.64	20.12	4.18	4.17	80.62	85.47	35.63	39.95	2.15	2.34	3.51	3.44	5.66	5.78
	6 ton compost +bio	19.94	19.83	4.25	4.41	81.46	85.76	42.47	40.08	2.36	2.33	3.93	3.80	6.29	6.13
Nubaria 1	Control	10.61	11.66	3.80	3.97	96.22	98.66	15.52	24.06	1.38	1.45	2.62	2.42	4.01	3.87
	Biofertilizers	11.68	14.01	4.34	4.17	97.71	100.90	22.72	33.04	1.57	1.69	3.36	2.98	4.93	4.67
	4 ton compost	11.02	12.75	3.94	4.21	97.16	101.06	18.55	30.74	1.50	1.55	2.73	2.62	4.23	4.17
	6 ton compost	13.84	14.46	4.24	4.38	98.50	101.99	25.77	34.17	1.74	2.06	2.93	3.20	4.67	5.27
	4 ton compost +bio	17.00	17.12	4.46	4.51	99.10	102.42	32.33	35.30	1.86	2.08	3.72	3.76	5.58	5.85
	6 ton compost +bio	17.12	17.23	4.50	4.74	100.10	102.81	37.86	36.79	2.23	2.13	4.10	4.08	6.33	6.21
	LSD : A	0.08	0.02	0.02	0.01	0.10	0.04	0.36	0.80	0.01	0.02	0.02	0.02	0.02	0.03
	B	0.09	0.03	0.02	0.02	0.15	0.04	0.09	0.11	0.05	0.07	0.02	0.02	0.02	0.03
	AB	0.15	0.04	0.08	0.04	0.26	0.07	0.93	1.34	0.08	0.09	0.03	0.09	0.05	0.05