Egypt. J. Plant Breed. 20(3):529 – 540 (2016)

PERFORMANCE OF THREE FABA BEAN VARIETIES UNDER SALINE CONDITIONS

N.A. Khalil, W.A. Al-Murshidy, Eman A.M. and R.A. Badawy
Agron. Dept., Faculty of Agri., Cairo Univ., Giza, Egypt.

ABSTRACT

Two field experiments were carried out at the Desert Experimental Station of the Faculty of Agriculture, Cairo University in Wadi El-Natroon, El-Beheira Governorate, Egypt, during the two winter seasons of 2013/14 and 2014/15 to study the performance of three faba bean varieties (Sakha-1, Sakha-2 and Nubaria-2) as affected by three levels of calcium nutrition (0, 1 and 2 g Ca/liter) under two plant densities (26 and 54 plants/m^2). A split-spilt plot design with four replications was used. The main plots consisted of calcium levels, sub-plots were allocated to varieties, while sub-sub plots were devoted to plant densities. The results obtained could be summarized as follows: the best performance of the three varieties was obtained from treatment by 2g Ca/L which recorded the highest number of branches, pods and seeds/plant, seed index, seed yield/feddan and harvest index. While, seed yield was significantly increased with increasing plant density from 26 to 54 plants/m^2. In general, Sakha-1 cv. recorded the highest seed yield/feddan. The interaction between calcium nutrition and varieties had a significant effect on number of pods/plant, number of seeds/plant and seed index in both seasons. The highest seed yield/ feddan was obtained from calcium application at 2 g/liter combined with Sakha-1 and 54 plants/m^2.

Key words: ***Faba bean, Vicia faba, Salinity, Calcium, Plant Density, Variety.***

INTRODUCTION

Faba bean (*Vicia faba* L.) is the most important annual pulse crop grown in Egypt. The adoption of improved cultivars performed better under different plant densities plays an important role for increasing seed production. Also salinity is one of the main factors that limit the productivity of faba bean.

Salinity is one of the main factors that limit the productivity of faba bean. Salinity problem in Egypt has a special importance for both of the old cultivated area and the newly reclaimed soils (Hellal *et al* 2012). Ahmed (2003) reported that 60% of the cultivated lands of Northern Delta region, 20% of the Southern Delta and Middle Egyptian region and 25% of the Upper Egypt region are salt-affected soils.

Saxena *et al* (1994) stated that problems of adverse salinity conditions are more complex than drought in crop × soil × climate interaction and must give a research attention to understanding of crop responses to these soil conditions. The major constraints for plant growth and productivity are ion toxicity with excessive uptake of mainly Cl^- and Na^+, as well as, nutrients imbalance caused by disturbed uptake of essential mineral nutrients (Hu and Schmidhalter 2005). Salt in soil water inhibits plant growth and it reduces the plant's ability to take up water. The salt in the soil solution reduces leaf growth and root growth (Munns 2003). Continuing efforts must be taken to apply the best practices to alleviate salinity effects. It is well known that Ca^{2+} alleviates the adverse effects of

salinity on many plant species (Munns 2002). Properly adequate levels of calcium will keep Na and Cl out of the cell. This function is extremely critical for the development of strong root cells and selectivity of Ca over Na at the root level (Hayward and Spurr 1944).

Faba bean variable plant densities can affect differently the growth, yield and components of various cultivars (Mokhtar 2001, Abd Alla and Omran and 2002, Hussein *et al* 2002 and Abdel Latif 2008)

Besides, there is a tendency to start with higher planting seed density to avoid lost plants, which may be a considerable than required for insuring reliable yield production. On the other hand, number of pods and seeds per plant decreased with increasing densities (Hussein *et al* 1999 and Ibrahem 2000). Seed yield per feddan increased with increasing plant density (Hussein *et al* 1999, Ibrahem 2000, Mohamed, 2000 and Abd Alla and Omran 2002), biological yield per feddan (Hussein *et al* 1999, Ibrahem 2000 and Mohamed 2000) and harvest index (Mohamed 2000) have the same trend. In contrast, plant density had insignificant effect on 100-seed weight (Abdel-Aziz 1999, Ibrahem 2000 and Abd Alla and Omran 2002).

However, the optimum number of plants at harvest for each variety is not well known. Generally, Karadavut *et al* (2010) showed that significant differences between varieties in faba bean characters. Also, marked variations among cultivars were noticed in number of branches per plant (Abou-Taleb 2002), number of pods /plant (Mohamed 2000, Hussein *et al* 2002 and Nassif, 2002), number of seeds/plant (Mohamed 2000 and Hussein *et al* 2002), seed index (Bakheit *et al* 2001 and Nassif, 2002) seed yield/feddan (Bakheit *et al* 2001). Moreover, cultivars had no effect on number of pods and seeds/plant (Bakheit *et al* 2001 and Abd Alla and Omran *et al* 2002), branches/plant (Nassif 2002), harvest index (Nassif 2002), and seed yield (Nassif 2002). On the other hand, faba bean varieties varied in its salinity tolerance.

Changes in plant density significantly affected performance of faba bean varieties (Matthews *et al* 2008). While, they recorded significant effect on seed yield/fed due to the interaction between faba bean varieties × plant densities.

Thus, the main objectives of this research were to examine the effects of Ca application and determine the optimum plant density for three varieties of faba bean under saline conditions.

MATERIALS AND METHODS

Two field experiments were laid out under drip irrigation in the Desert Experimental Station, Fac. of Agric., and Cairo Univ. in Wadi El-Natroon, El-Beheira Governorate, Egypt, during 2013/14 and 2014 /15 seasons. Soil of the experimental site was sandy, saline and poor in

nutrients, as well as, organic matter. Irrigation water was saline. There were little differences in the soil properties between the two years of the study.

Each experiment included 18 treatments, which were the combinations of:

1. Three Calcium levels, *viz.*, 0, 1 and 2g/L. in the form of chelated-ca.
2. Three varieties, *i.e.*, Sakha-1, Sakha-2 and Nubaria-2.
3. Two plant densities, *i.e.*,
   a. Twenty-six plant/m^2 obtained by seeding two seeds in hills spaced 30 cm apart on both sides of the ridge (50 cm width).
   b. Fifty-four plant/m^2 obtained by seeding two seeds in hills spaced 15 cm apart on both sides of the ridge.

The experimental design was a spilt-spilt plot design in randomized complete blocks arrangement, with four replications. The main plots were devoted to the Calcium levels. Sub-plots were allocated to the varieties, while, sub-sub plots to the plant densities. Each sub-sub plot consisted of three rows of 3 m in length and 0.50 m in width with an area of 4.5 m2.

All cultural practices were conducted according to the recommendations of ARC, Ministry of Agriculture concerning faba bean production.

Studied characters

At harvest, ten guarded plants were randomly taken from each sub-sub plot to estimate the following traits: number of branches, number of pods/plant, weight of seeds/plant, and seed index. In addition, seed yield (ard. fed^{-1}) was weighed from the whole area of each sub-sub plot and adjusted to yield per feddan. Harvest index (%) was calculated by divided seed yield $ha.^{-1}$ on biological yield $fed.^{-1}$ * 100 (feddan=4200m^2, ardab=155kg).

Data obtained from each season were statistically analyzed according to procedures outlined by Steel *et al* (1997) using MSTAT-C Computer packages (Freed *et al* 1989). The differences between treatment means were compared by least significant differences test (LSD) at 0.05 level of probability.

RESULTS AND DISCUSSION

Effect of calcium nutrition

Results in Table (1) indicated that calcium nutrition had a significant effect on number of branches, pods/plant and number of seed/plant, as well as, seed yield/fed and harvest index in both seasons but seed index was insignificant in second season.

The highest number of pods/plant was recorded by calcium as foliar application 2gm/L. in both seasons (Table 1). Such increase may be due to the important role of calcium in plant growth and nutrition, as well as in cell wall deposition.

Table 1. Yield and yield components of three faba bean varieties as affected by planting dates during 2013/14 and 2014/15 seasons.

Calcium (g/L)	No. of branches/ plant		No. of pods/plant		No. of seeds/plant		Seed index (g)		Seed yield (ardab/fed)		Harvest index%	
	seasons		seasons		seasons		seasons		seasons		seasons	
	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15
0	2.24	2.27	9.89	8.78	24.98	22.05	87.81	89.56	7.80	6.92	32.6	32.10
1	2.90	2.56	10.05	9.03	25.76	23.78	93.33	91.57	7.90	7.07	33.0	32.61
3	2.93	2.72	10.93	9.77	29.87	27.80	89.65	91.74	8.49	7.82	34.3	34.01
LSD 0.05	0.29	0.21	0.35	0.37	0.49	0.43	2.53	ns	0.43	0.32	2.35	2.09

Ns = non-significant

These findings are in harmony with those obtained by Ahmad and Jabeen (2005), Munns and Tester (2008), Hellal *et al.* (2012 and 2015).

Data in Table (1) indicated that the highest number of seeds/plant was obtained by calcium foliar application of 2 g/L in both seasons. Such increase may be due to increase in number of pods/plant. Similar findings were obtained by Ahmad and Jabeen (2005) and Munns and Tester (2008).

In addition, data showed that the highest seed yield was recorded from calcium application of 2 g/L. Such increase may be due to increasing in yield components, meanwhile the lowest seed yield was recorded with zero Ca in both seasons. Such decrease may be due to salinity effect and decreasing yield components. These results are in general agreement with those obtained by Hellal *et al* (2015 and 2012), Ahmad and Jabeen (2005) and Munns and Tester (2008).

Data in Table (1) indicated that the 2g Ca/L recorded the highest harvest index in both seasons.

Effect of cultivars

Data in Table (2) showed the effects of cultivars on number of branches, pods and seeds/plant, as well as, seed index, seed yield/fed and harvest index of faba bean in 2013/14 and 2014/15 seasons.

It is clear from the results in Table (2) that Sakha-1 surpassed other cultivar in number of branches/plant in season 2013/14, while there was no significant differences in season 2014/15.

Results showed that Sakha-1 surpassed all other cultivars in number of pods/plant, number of seeds/plant, seed yield/fed and harvest index in the both seasons. Nubaria-2 had the highest seed index in both seasons.

Genotypic differences for studied characteristics were also recorded by El-Tuhami and Hussien (1986), Weil and Khalil (1986) and Abdalla *et al* (2000).

Table 2. Yield and yield components of three faba bean varieties during 2013/14 and 2014/15 seasons.

Varieties	No. of branches/ plant		No. of pods/plant		No. of seeds/plant		Seed index (g)		Seed yield (ardab/fed)		Harvest index %	
	seasons		seasons		seasons		seasons		seasons		seasons	
	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15
Sakha-1	2.38	2.38	11.97	9.86	32.12	28.03	86.10	88.17	9.05	8.02	39.66	35.93
Sakha-2	2.76	2.56	9.88	8.92	25.43	23.91	84.89	85.93	7.61	6.96	29.16	31.30
Nubria-2	2.93	2.60	9.03	8.78	23.05	21.68	99.79	98.78	7.54	6.84	30.98	31.50
LSD 0.05	0.28	ns	0.34	0.36	0.49	0.43	2.53	2.23	0.43	0.32	1.06	2.09

Ns = non-significant

Effect of plant densities

Data in Table (2) indicated significant effects of plant density on number of branches, pods and seeds/plant, as well as, seed yield/fed and harvest index of faba bean during 2013/14 and 2014/15 seasons.

Data indicated that the lowest plant density (26 plants/m^2) gave the highest number of branches/plant in both seasons. This result may be due to the better chance for each plant to get nutrients, sunshine and light due to less plant competition within hills. Generally, these results are on line with those of Ibrahem (2000), Mohamed (2000), Bakheit *et al* (2001), Mokhtar (2001) and Abd Alla and Omran (2002).

Results in Table (2) showed that number of pods/plant was significantly increased with decreased plant density from 54 to 26 plants/m^2 in both seasons. The greatest number of pods/plant was recorded from plant density 26 plants/m^2 in both seasons. The reduction in number of pods/plant with increasing plant density may be due to plant competition in hills. These results go in line with those of Mohamed (2000), Bakheit *et al* (2001), Mokhtar (2001), Abd Alla and Omran (2002) and Abdel Latif (2008).

It is clear from the results in Table (3) the number of seed/plant differed significantly due to plant density. The three faba bean cultivars showed its superiority under lower density in number of branches/plan, number of pods/plant and number of seed/plant in both seasons. The present findings coincided with those reported by Abo-Shetaia (1990), Metwally (1997) and Abdel-Aziz and Shalaby (1999)

Data in Table (3) showed that plant density had insignificant effect on seed index during 2012/13, 2013/14 and 2014/15 seasons.

Table 3. Yield and yield components of three faba bean varieties as affected by plant density during 2013/14 and 2014/15 seasons.

Density (plants/ m^2)	No. of branches/ plant		No. of pods/plant		No. of seeds/plant		Seed index (g)		Seed yield (ardab/fed)		Harvest index %	
	seasons		seasons		seasons		seasons		seasons		seasons	
	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15
26	3.11	2.66	11.31	9.89	29.68	26.40	90.32	91.36	7.21	6.55	31.15	32.09
54	2.27	2.37	9.27	8.38	24.05	22.56	90.21	90.56	8.92	7.99	35.38	33.72
LSD 0.05	0.23	0.17	0.28	0.29	0.40	0.35	ns	ns	0.35	0.26	0.87	ns

Ns = non-significant

These results are not in harmony with those obtained by Attia *et al* (1987), EL-Fieshawy and Fayed (1990), Ashmawy *et al* (1998), Bakheit *et al* (2001) and Mokhtar (2001). On the contrary, Amer *et al* (1992) and Abdel-Aziz and Shalaby (1999).

Present results indicated that seed yield increased significantly with increasing plant density from 26 to 54 plant /m^2 in both seasons. The highest seed yield per feddan recorded from plant density 54 plant/m^2 in both seasons (8.92 and 7.99 ardab/feddan), respectively. This result may be due to the increase in plant number that compensated the reduction in seed yield/plant. Similar trends were obtained by, Caballero (1987), Nassib *et al* (1988), Abo-Shetaia (1990) , Singh *et al* (1992) and Hussein *et al* (1995).

Results showed that plant density has a significant effect on harvest index in the first season only. The highest harvest index was obtained from the highest plant density (54 plants/m^2) in 2013/14 season.

Effect of the interactions

The interaction between calcium dose and variety (Table 4) had insignificant effect on number of branches per plant in both seasons, but had a significant effect on number of pods and seeds per plant and seed index in both seasons, meanwhile, seed yield/feddan and harvest index in the second season only. The highest number of pods/plant, number of seeds/plant, seed yield/feddan and harvest index were obtained from calcium dose 2gm/L combined with Sakha-1.

The interaction between calcium and plant density (Table 5) had a significant effect on number of branches, number of pods/plant, seed index and harvest index in season 2013/14 only. The highest number of branches/plant, number of pods/plant and seed index was obtained from 2g Ca/L with plant density of 26 plants/m^2. Number of seeds/plant was not affected by the interaction between Ca and plant density. Seed yield/fed was not significantly affected by the interaction between Ca and plant density.

Table 4. Yield and yield components of three faba bean varieties as affected by the interaction between calcium nutrition (Ca*) and variety (V*) during 2013/14 and 2014/15 seasons.

Interactions	No. of branches/ plant		No. of pods/plant		No. of seeds/plant	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Ca0 - V1	2.04	2.22	11.23	9.24	29.83	23.99
Ca0 - V2	2.17	2.29	9.90	8.73	22.08	21.06
Ca0 - V3	2.50	2.29	8.55	8.38	23.03	21.09
Ca1 - V1	2.59	2.33	11.48	9.49	28.68	25.87
Ca1 - V2	2.96	2.61	10.10	9.19	25.85	24.21
Ca1 - V3	3.17	2.74	8.58	8.40	22.75	21.24
Ca2 - V1	2.50	2.60	13.20	10.86	37.85	34.23
Ca2 - V2	3.17	2.76	9.63	8.85	28.38	26.46
Ca2 - V3	3.12	2.79	9.98	9.59	23.38	22.70
LSD 0.05	ns	ns	0.60	0.63	0.85	0.74
Interactions	**Seed index (g)**		**Seed yield (ardab/fed.)**		**Harvest index%**	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Ca0 - V1	95.50	78.56	8.67	7.56	36.10	35.03
Ca0 - V2	67.46	90.46	7.53	6.73	32.06	31.78
Ca0 - V3	100.46	99.68	7.19	6.47	29.53	29.50
Ca1 - V1	77.33	92.57	8.39	7.62	38.26	34.27
Ca1 - V2	92.06	83.31	7.78	6.86	28.31	31.27
Ca1 - V3	99.56	98.84	7.53	6.74	32.43	32.28
Ca2 - V1	85.48	93.37	10.07	8.88	44.60	38.47
Ca2 - V2	95.15	84.02	7.51	7.28	27.13	30.85
Ca2 - V3	99.36	97.82	7.89	7.30	30.98	32.73
LSD 0.05	4.38	3.87	0.75	ns	1.84	ns

***Ca0 = Ca 0g/L Ca1 = Ca 1g/L Ca2 = Ca 2g/L V1 =Sakha-1 V2 = Sakha-2 V3 = Nubaria-2 Ns = not significant**

Table 5. Yield and yield components of three faba bean varieties as affected by the interaction between calcium nutrition(Ca*) and plant density (D*) in 2013/14 and 2014/15 seasons.

Interactions	No. of branches/ plant		No. of pods/plant		No. of seeds/plant	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Ca0 - D1	2.50	2.36	11.15	9.80	29.02	24.63
Ca0 - D2	1.97	2.18	8.63	7.76	20.93	19.47
Ca1 - D1	3.25	2.66	11.00	9.65	28.13	25.56
Ca1 - D2	2.56	2.46	9.10	8.40	23.38	21.98
Ca2 - D1	3.58	2.97	11.78	10.22	31.90	29.03
Ca2 - D2	2.28	2.47	10.08	8.98	27.83	26.23
LSD 0.05	0.40	ns	0.48	ns	0.69	0.60
Interactions	**Seed index (g)**		**Seed yield (ardab/fed)**		**Harvest index%**	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Ca0 - D1	85.57	89.70	6.84	6.07	29.43	30.44
Ca0 - D2	87.48	89.42	8.76	7.77	35.69	33.76
Ca1 - D1	91.82	91.53	7.14	6.43	31.67	32.54
Ca1 - D2	90.05	90.64	8.66	7.72	34.33	32.68
Ca2 - D1	93.56	92.84	7.64	7.16	32.35	33.31
Ca2 - D2	93.09	91.62	9.34	8.48	36.12	34.72
LSD 0.05	3.58	ns	ns	ns	1.50	ns

***Ca0 = Ca 0g/L Ca1 = Ca 1g/L Ca2 = Ca 2g/L D1 = 26 plants/m2 D2 = 54 plants/m2**

Ns = not significant

The interaction between cultivar and plant density (Table 6) showed that Sakha-1 under the lowest plant density possessed the greatest number of pods/plant and seeds/plant in both seasons. While, Nubaria-2 with the lowest plant density recorded the highest seed index in season 2013/14 only. Number of branches/plant, yield/fed and harvest index were not significantly affected by the interaction between cultivars and plant density in both seasons.

Data in Table (7) indicated that the interaction between Ca × cultivar × plant density had insignificant effect on number of branches/plant and seed index in both seasons. Number of pods/plant was significantly affected by this interaction only in the first season which was highly significant. While, number of seeds/plant in the second season only. Seed yield/fed and harvest index were significantly affected by this interaction. Treatment Sakha-1 variety by 2g Ca/L with 54 plants/m^2 gave the highest seed yield / feddan and harvest index in both seasons.

Table 6. Yield and yield components of three faba bean varieties as affected by the interaction between variety (V*) and plant density (D*)in 2012/2013 and 2013/2014 seasons.

Interactions	No. of branches/ plant		No. of pods/plant		No. of seeds/plant		Seed index (g)		Seed yield (ardab/fed)		Harvest index%	
	seasons		seasons		seasons		seasons		seasons		seasons	
	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15
V1-D1	2.70	2.46	13.33	10.88	37.38	31.42	82.83	88.71	8.15	7.27	37.37	34.87
V1-D2	2.06	2.30	10.60	8.85	26.85	24.63	86.95	87.63	9.94	8.77	41.94	36.98
V2-D1	3.53	2.82	10.17	17.65	27.05	24.87	87.24	86.58	6.90	6.35	27.34	30.69
V2-D2	2.33	2.29	7.90	7.93	23.82	38.95	84.97	85.28	8.31	7.56	30.99	31.90
V3-D1	3.11	2.70	10.43	9.48	24.62	22.92	100.9	98.79	6.57	6.04	28.74	30.72
V3-D2	2.42	2.51	9.32	8.36	21.48	20.43	98.70	98.77	8.50	7.63	33.21	32.28
LSD 0.05	ns	ns	0.49	0.52	0.69	0.60	3.58	ns	ns	ns	ns	ns

***D1= 26 plants/m2 D2= 54 plants/m2 V1=Sakha-1 V2= Sakha-2 V3= Nubaria-2**

Table 7. Yield and yield components of three faba bean varieties as affected by the interaction between calcium nutrition(Ca*) and plant density (D*) during 2013/14 and 2014/15 seasons.

Interaction	No. of branches/ plant		No. of pods/plant		No. of seeds/plant		Seed index (g)		Seed yield (ard/fed)		Harvest index%	
	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15	13/14	14/15
Ca0 - V1 - D1	2.17	2.32	12.65	10.50	36.60	28.65	64.02	79.21	7.71	6.72	33.86	34.28
Ca0 - V1 - D2	1.92	2.12	9.80	7.98	23.05	19.33	70.91	77.91	9.64	8.40	38.35	35.79
Ca0 - V2 - D1	3.00	2.47	10.10	9.35	24.75	22.38	93.14	90.53	6.65	5.91	28.42	29.72
Ca0- V2 - D2	2.00	2.12	7.00	7.40	19.40	19.75	97.87	90.39	8.40	7.55	35.69	33.84
Ca0 – V3 - D1	2.33	2.28	10.70	9.55	25.70	22.85	99.56	99.38	6.15	5.58	26.02	27.32
Ca0 – V3 - D2	2.00	2.30	9.10	7.90	20.35	19.33	101.36	99.98	8.23	7.36	33.03	31.67
Ca1 - V1 - D1	3.00	2.38	13.25	10.60	33.65	29.01	93.10	92.84	7.51	6.94	35.10	32.61
Ca1 - V1 - D2	2.17	2.28	9.70	8.38	23.70	22.73	97.20	92.30	9.26	8.31	41.43	35.94
Ca1 - V2 - D1	3.58	2.84	9.20	8.90	27.10	25.96	86.47	82.80	7.00	6.20	26.30	30.78
Ca1 - V2 - D2	2.75	2.39	7.95	7.90	24.60	22.45	84.48	83.83	8.56	7.52	30.31	31.77
Ca1 - V3 - D1	3.17	2.75	10.55	9.45	23.65	21.70	101.11	98.94	6.91	6.15	33.61	34.23
Ca1 - V3 - D2	2.75	2.72	9.65	8.93	21.85	20.78	97.61	98.74	8.15	7.33	31.24	30.34
Ca2 - V1 - D1	2.92	2.69	14.10	11.53	41.90	36.60	91.36	94.07	9.22	8.14	43.17	37.71
Ca2 - V1 - D2	2.09	2.52	12.30	10.20	33.80	31.85	92.76	92.68	10.93	9.62	46.03	39.23
Ca2 - V2 - D1	4.00	3.16	11.20	34.70	29.30	26.28	82.10	86.40	7.06	6.94	27.29	31.59
Ca2 - V2 - D2	2.25	2.37	8.75	8.48	27.45	74.65	72.57	81.64	7.97	7.63	26.96	30.10
Ca2 - V3 - D1	3.83	3.06	10.05	9.45	24.50	24.20	102.00	98.04	6.64	6.41	26.60	30.62
Ca2 - V3 - D2	2.50	2.52	9.20	8.25	22.25	21.20	97.12	97.60	9.14	8.20	35.36	34.84
LSD 0.05	ns	ns	0.84	ns	ns	1.05	ns	ns	0.96	0.80	2.61	2.55

***Ca0 = Ca 0g/L Ca1 = Ca 1g/L Ca2 = Ca 2g/L V1 =Sakha-1 V2 = Sakha-2 V3 = Nubaria-2 D1 = 26 plants/m^2 D2 = 52plants/m^2 Ns = not significant**

REFERENCES

Abd Alla, A. A. and M. M. Omran (2002). Response of some faba bean varieties to irrigation intervals and plant spacing in the new sandy reclaimed lands. Munufiya J. Agric. Res. 27: 525-540

Abdalla, M.M.F., D.S. Darwish, A.A. Ali and E.A.A. El-Emam (2000). Investigation on faba bean (*Vicia faba.* L).15. Variability and clustering of faba bean Land Races . Egypt. J. Plant Breeding. 4: 257-272.

Abdel Latif, Y. I. (2008) Effect of seed size and plant spacing on yield and yield components of faba bean (*Vicia faba* L.). Res. J. Agric. Biol. Sci. 4(2): 146-148.

Abdel-Aziz, E. A. and F. H. Shalaby (1999). Physiological studies on response of new released faba bean varieties to different plant populations. Zagazig J. Agric. Res. 26 (5):1229-1244.

Abo-Shetaia, A.M.A. (1990). Yield and yield component responses of faba bean (*Vicia faba* L.) to plant density and NP fertilization. Ain Shams Annals Agric. Sci., 35 (1): 187-204.

Abou-Taleb, S. M. (2002). Morphological variation and dry matter distribution in some faba bean (*Vicia faba* L.) cultivars under different sowing dates. Proc. Recent Tec. Fac. Agric, Cairo Univ., Bull. Fac. Agric. Cairo Univ., Egypt 4: 864-874.

Ahmad, R. and R. Jabeen, (2005). Foliar spray of mineral elements antagonistic to sodium: A technique to induce salt tolerance in plants growing under saline conditions. Pak J Bot. 37: 913-920.

Ahmed, G. (2003). Deteriorated Soils in Egypt: Management and Rehabilitation. Ministry of Agricultur and Land Reclamation. Executive Authority for Land Improvement Projects (EALIP): 36 p**.**

Amer, M. I. A., M. A. El-Boari and M. M Radi (1992). Response of three faba bean (*Vicia faba* L.) cultivars to three sowing dates under different plant densities in North Delta. J. Agric. Res., Tanta Univ. 18 (4): 591-599.

Ashmawy, F.; S.A.S. Mehasen and M.S.A. Mohamed (1998). The relative contribution of some characters to seed yield in some faba bean (*Vicia faba*, L.) varieties grown under three population densities. Bull. Fac. Agric., Cairo Univ., 49 (4): 517-532.

Attia, A.N.; A.A. Leilah and M.S. Sultan (1987). Productivity of faba bean (*Vicia faba* L.) as affected by planting patterns, phosphorus and nitrogen levels. J. Agric. Sci., Mansoura Univ., 12(4): 679-686.

Bakheit, B. R., A. Y. Allam and A. H. Galal (2001). Response of some faba bean (*Vicia faba* L.) cultivars to planting dates and population densities. Assiut J. Agric. Sci. 32 (2): 85-101.

Caballero, R. (1987). The effect of plant population and row width on seed yield and yield components in field beans. Res. Development in Agric., 4 (3): 147-150.

El-Fieshawy, A.M. and E.H. Fady (1990). Seed yield and seed yield components of faba bean (*Vicia faba*, L.) as influenced by plant spacing and phosphorus fertilizer. Zagazig J. Agric. Res. 17(2): 227-233.

El-Tuhami, M.M.K., and T.A. Hussien (1986). Evaluating an British elite of faba bean (*Vicia faba* L.) varieties at different plant densities and distributions. 2. Seed yield per plant and some related characters. Ann. Agric. Sci., Moshtohor. 24 (4): 1881–1896.

Freed, R., S. P. S. Einensmith, S. Gutez, D. Reicosky, V. W. Smail and P. Wolberg (1989). User's guide to MSTAT-C analysis of agronomic research experiments program. Michigan Univ., East Lansing, USA. 420 p.

Hayward, H.E., and W.B. Spurr, (1944). The tolerance of flax to saline conditions: Effect of sodium chloride, calcium chloride, and sodium sulfate. J. Amer. Society Agron. 36: 287-300.

Hellal, F.A., M.T. Abdelhamid, M. Doaa Abo-Basha and R.M. Zewainy (2012). Alleviation of the Adverse Effects of Soil Salinity Stress by Foliar Application of Silicon on Faba bean (*Vica faba* L.) Journal of Applied Sci. Res. 8 (8): 4428-4433

Hellal, F.A., S.A.A. El-Sayed, R.M. Zewainy and M. Abdelhamid (2015). Interactive Effects of Calcium and Boron Application on Nutrient Content, Growth and Yield of Faba Bean Irrigated by Saline Water. International Journal of Plant & Soil Science. 4 (3): 288-296, 2015; Article no.IJPSS.2015.030 ISSN: 2320-7035

Hu, Y. and U. Schmidhalter (2005). Drought and salinity: A comparison of their effects on mineral nutrition of plants. J. Plant Nutr. Soil Sci. 168: 541-549.

Hussein, A. H. A. M. A. El-Deeb and El-Yamani. (2002). Response of new faba bean genotypes to different sowing dates and plant densities in the newly reclaimed lands in Upper Egypt. National Ann. Coordination meeting, ICARDA/EC. Cairo, 70-74.

Hussein, A. H. A., K. A. AL-Assily, M. A. El-Deeb, S. R. Saleib and H. A. Saber (1999). Response of three new faba bean (*Vicia faba* L.) varieties to different plant densities on both old and new reclaimed lands in Upper Egypt. Egypt J. Appl. Sci. 14 (2): 110-116.

Hussein, A.H.A., S.A. Saleh, K.A. EL-Assily and M.M. EL-Morsy (1995). Response of some released faba bean (*Vicia faba*, L.) varieties and promising lines to plant densities at newly reclaimed soil in middle Egypt. Annals Agric. Sci., Ain Shams Univ., 40(2): 539-545.

Ibrahem, N. T. (2000). Spectral reflectance of faba bean plants in relation to growth and yield. M.Sc. Thesis, Fac. Agric. Ain Shams Univ., Egypt.

Karadavut, U., C. Palta, Z. Kavurmaci and Y. Bolek (2010). Some grain yield parameters of multi-environmental trials in faba bean (*Vicia faba*) genotypes. Int. J. Agric. Biol. 12: 217–220

Matthews, P. W., E. L. Armstrong, C. J. Lisle, I. D. Menz, P. L. Shephard and B. C. Armstrong (2008). The effect of faba bean plant population on yield, seed quality and plant architecture under irrigation in southern NSW. Proc. of the 14th Australian Agronomy Conference. September :120-124.

Metwally, I.O.E. (1997). Performance of faba bean as affected by preceding summer crops,nitrogen levels and plant density. J. Agric. Sci., Mansoura Univ. 22 (99): 2779-2788.

Mohamed, W. K. H. (2000). Response of two faba bean varieties to different plant densities and distributions. Proc. 10th conf. Agron. –Suze Canal. Univ. Fac Environ. Agric. Sci. (El Arish) Egypt: 759-773

Mokhtar, S. A. (2001). Response of yield and yield components of faba bean (*Vicia faba*.) to increasing levels of nitrogen phosphorus under two level of plant density. Egypt. Annals Agric. Sci., Ain Shams Univ. 46 (1): 143-154.

Munns, R. (2002). Comparative physiology of salt and water stress. Plant Cell & Environment. 25: 239-250.

Munns, R. (2003). Physiological processes limting plant growth in saline soils. Some dogmas and hypotheses. Plant Cell and Environment, 16: 15-24.

Munns, R., and M. Tester (2008). Mechanism of salinity tolerance. Annl Rev Plant Biol. 59: 651- 681.

Nassib, A.M. and A.H.A. Hussein (1988). Effect of plant density, variety and time of glyphosate application on Orobanche infection and faba bean yield. 13th Int. Cong. Stat. Comp. Sci., Demo. Res., pp. 31- 42.

Nassif, A. A. M. (2002). Evaluation of some varieties and lines of chickpea, faba bean and lentils. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Saxena, N.P., M.C. Saxena, P. Ruckenber, R.S. Rara, M.N. El-Fouly and R. Shabana (1994). Screening techniques and sources of tolerance to salinity and mineral nutrient imbalances in cool season food legumes. Euphytica, 73: 85-93.

Singh, S.P., N.P. Singh and R.K. Padney (1992). Performance of faba bean varieties at different plant densities. FABIS Newsl., 30: 29-31.

Steel, R. G. D., J. H. Torrie and D. A. Dickey, (1997). Principles and Procedures of Statistics: A Biometrical Approach, 3rd ed., McGraw-Hill, New York.

Weil, R.R. and N.A. Khalil, (1986). Salinity tolerance of winged bean as compared to that of soybean. Agronomy J. 78: 67-70.

أداء ثلاثة أصناف من الفول البلدى تحت الظروف الملحية

نبيل على خليل، وجيه عبد العظيم المرشدي، إيمان عبد اللطيف

و رمضان عبد الواحد بدوي

قسم المحاصيل – كلية الزراعة – جامعة القاهرة – الجيزة– مصر

أجريت تجربتان حقليتان في محطة البحوث والتجارب الصحراوية لكلية الزراعة، جامعة القاهرة في وادي النطرون، محافظة البحيرة، مصر، خلال موسمى ٢٠١٣/١٤ ٢٠١٤/١٥ لدراسة أداء ثلاثة أصناف من الفول البلدي (سخا-١، سخا-٢ ونوبارية-٢) تحت تأثير ثلاثة مستويات من التغذية بالكالسيوم (٠، ١ و٢ جرام كالسيوم /لتر) وكثافتان نباتيتان (٢٦ و٥٤ نبات /م٢) وكذلك تأثير التفاعل بينهم. تم استخدام تصميم القطع المنشقة مرتين في أربعة مكررات. حيث وضعت مستويات الكالسيوم في القطع الرئيسية، والأصناف في القطع المنشقة، بينما وضعت الكثافات النباتية في القطع المنشقة الثانية ويمكن تلخيص النتائج المتحصل عليها كما يلي: تم الحصول على أفضل أداء للأصناف الثلاثة من المعاملة ٢ جم كالسيوم/لتر والتي حققت أعلي عدد من الفروع والقرون والبذور للنبات الواحد ، دليل البذور، محصول البذور/فدان ودليل الحصاد. وأظهرت النتائج أيضاً زيادة معنوية لمحصول البذور بزيادة الكثافة النباتية من ٢٦إلى ٥٤ نبات/م٢. وبصفة عامة حقق الصنف سخا-١ أعلى محصول بذور / فدان. كان للتفاعل بين التغذية بالكالسيوم والاصناف تأثير معنوي على عدد القرون على النبات، عدد البذور للنبات ودليل البذور في كلا الموسمين. وتم الحصول على أعلى محصول بذور للفدان من معاملة الكالسيوم ٢ جرام/لتر للصنف سخا-١ تحت الكثافة النباتية ٥٤ نبات /م٢.

المجلة المصرية لتربية النبات ٢٠ (٣) : ٥٢٩ - ٥٤٠ (٢٠١٦)