

EFFECT OF CULTIVARS, PLANT SPACING AND AL-GAMIX ON GROWTH AND GREEN YIELD OF BROAD BEAN (*Vicia faba* L.)

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ABSTRACT

The experiment was aimed to test the effects of three cultivars (Reina, Giza & Local), two plant spacing (15&20cm) and Al-gamix at concentration (0& 2 ml.L⁻¹) on growth, green yield and green seed yield of Broad bean (*Vicia faba*). Results showed that the cultivars had affected on vegetative, green yield and seed yield characters; The Reina cultivar had significant increase in (No. of branches, Pod Yield g. plant⁻¹, Total Yield ton. donum⁻¹, No. of seed per pod, no. of seed. Plant⁻¹, seed weight g, seed yield.plant⁻¹, Total seed yield ton. Donum⁻¹ and weight of 100 seed g). While Giza cultivar had a significant increase in (plant high, pod length cm, pod weight g). The local cultivar had a significant increase in (No. of pods per plant and No. of seed per plant). There were significant effect of plant spacing on vegetative and yield characters, 15 cm spacing increased (plant high cm, No. of branches, pod weight g, plant yield g. plant⁻¹, total yield ton.donum⁻¹). But 20cm spacing significantly increased (No. of pods per plant, pod length cm, No. of seed per pod, seed weight g, weight of 100 seed g), While treating of broad bean plant with Al-gamix especially (2ml.L⁻¹) led to significant increases in all parameters like vegetative, green yield and green seed yield characters.

KEY WORD:- Faba bean, cultivars, plant spacing and Al-gamix

1.INTRODUCTION

Faba bean (*Vicia faba* L.) is the fourth most important pulse crop in the world with 4.316.371 tons produced (Anon., 2010). It contains a large amount of proteins, carbohydrates, B-group vitamins and minerals. The protein content (29.57- 31.83%), carbohydrate (52.96-54.60%), ash (3.37-3.47%), fat (0.81-1.24%) and fiber (10.88-11.96%) of faba beans depends on the variety (Sarah *et al.*, 2009). Faba beans play a key role in crop rotation due to their ability to fix nitrogen, and the beans are able to provide a significant level of nitrogen from the soil air using a symbiotic relationship with Rhizobium bacteria.

The main aim objective when growing the crop is to obtain the highest yield. However, there are several factors that affect the production such as sowing time, soil fertility, and varieties or genotypes. According to many studies carried out in faba bean, there are significant differences among varieties concerning yield and yield components (El-Masry, 2010; Osman *et al.*, 2010; Darya, 2013 and Kubure *et al.*, 2016). Another factor is seeding rate or planting density,

which affect the growth, development and grain productivity per unit area in almost all agricultural crops, including faba bean, and is not stable for one variety due to different climate conditions. Low plant density may result in low yield; however, high plant density can cause lodging, less light penetration in the crop canopy, reduced photosynthetic efficiency and can reduce the yield drastically (Vassilev, 1998; Jettner *et al.*, 1998a 1998b; Lemerle *et al.*, 2004; Lemerle *et al.*, 2006). Earlier studies have shown that yield and its components are affected by planting densities (Turk & Tawaha, 2002; Bakry *et al.*, 2011; Thalji, 2006 & 2010; Khalil *et al.*, 2011). Seaweed extracts are natural extracts of herb plants and sea algae, nowadays they are used widely in many areas as a source of growth regulators and that produce commercially. Seaweed extract (*Ascophyllum nodosum*) is also known by other names such as olive trees or sea grapes, and the company Golway alone collects about 34.000 tons per year of seaweeds. In England, these extracts were used in agriculture as fertilizers in restricted terms to improve soil conditions, nowadays, they are used world widely in various field of life's and are prepared as a

powder or liquid (Potter, 2005). Zadape *et al.*, (2008) recorded that spraying okra plants with liquid seaweed fertilizers with 0, 2.5, 5, 7.5 and 10% concentration, that concentration 2.5% significantly increased the fresh and dry weight of plant. Sabh & Shallan (2008) resulted in a study carried out on Faba bean plants that uses seaweed extract had significantly increased the number of leaves, plant length, leave area, dry weight of shoot and root growth and total chlorophyll content in leaves.

Allelah (2011) showed that spraying Melon plants with seaweed extract (Algamix and Alagren) that Algamix treated plant lead to significant increase in fruit weight, number of fruit per plant, total yield. Ismael (2012) revealed that spraying cucumber plants with seaweeds extract significantly enhanced fruit setting, increased number of fruit per plant, fruit weight, yield per plant, early yield, TSS and ascorbic acid percentage compared to control treatments.

Therefore, the present research was conducted to evaluate response of different local faba bean cultivars, planting densities and seaweed extract on the yield and yield components under the conditions of Duhok - kurdistan reign- Iraq.

2.MATERIALS AND METHODS

The experiment was conducted in the Vegetable Research Farm, Horticultural Department, College of Agriculture, University of Duhok, Kurdistan region/Iraq, during the growing season of 2014-2015. To study the effect of cultivars, plant spacing and Al-gamix on growth and green yield of broad bean cultivars. The cultivars were planted on 14th November 2015 in the farm. Seed planting was achieved on both sides of ridges at 25 cm between hills and 75cm between ridges. urea fertilizer was added (46% N) at a rate of 30 kg. Dunm⁻¹ in a ditch way after a month of cultivation. All agricultural operations were carried out in the production of this crop from irrigation, weeding. Irrigation was carried out according to plant needs.

The experiment was conducted in split split plot design, the three cultivars (Reina, Giza and

locale) in main plot and the two spacing (15 and 25cm) in sub plots and Al-gamix (0,2m.L⁻¹) in sub sub plot and was arranged in a randomized complete block design (RCBD). Each treatment included eight plants with three replication. Spraying plants with Al-gamix was done three times, the first one added 45days after planting and the other one at ten day between them. Data were analyzed by using the (SAS program, 2007). Means values were compared using Duncan's multiple range tests at 0.05% level (AL-Rawi and Khalaf Alah, 2000). Data were recorded for plant high, No. of branches/plant, No. of pods per plant, pod length cm, pods weight g, pod yield g. plant⁻¹, total yield ton. donum⁻¹, No. of seeds pod, No. of green seeds plant⁻¹, fresh seed weight (mg), weight of 100 seed (g), green seed yield plant (g), total green seed yield ton. donum⁻¹.

3.RESULTS

1-Vegetative Growth Characters:-

Plant High.

Data in table (1) shows that significant differences occurred between cultivars, Giza cultivar superior to other cultivars which gave 85.13cm high. Also significant differences had been obtained between two spacing on plant hight, the15cm gave the longer (83.97cm) as compared to 20cm (81.82cm). Significant differences was obtained on plant high when sprayed with Al-gamix the highest plant high (85.53cm) in 2 g. L⁻¹.

The interaction between cultivars and spacing was significant in its effect, Giza planted in 15cm spacing gave the higher value (87.13cm) compared to other interaction. Significant differences found between cultivars and Al-gamix the highest value obtained between Reina and Al-gamix reached (90.98cm), while the interaction between spacing and Al-gamix also significant differences occurred the interaction between spacing and Al-gamix(2 m.L⁻¹)reached(87.86cm). The triple interaction among three factors revealed that significant differences occurred and the highest value was (92.57cm) between Reina, 20 cm and 2 m. L⁻¹, while the lowest value (72.10cm) between Reina, 20cm spacing and control treatment.

Table (1): Effect of cultivars, plant spacing, Al-gamix and their interaction on length (cm) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2m.L ⁻¹	*	
		spacing			
Reina	15	76.87d	89.40a	83.13b	82.73b
	20	72.10e	92.57a	82.33b	
Giza	15	83.47bc	90.80a	87.13a	85.13a
	20	87.77ab	78.47cd	83.12b	
Local	15	79.90cd	83.37bc	81.63b	80.82b
	20	81.40cd	78.60cd	80.00b	
Al-gamix		80.25b	85.53a		
var.	Reina	74.48d	90.98a	spacing	
*	Giza	85.62b	84.63b		
conc.	Local	80.65c	80.98c		
spacing.	control	80.08c	87.86a	83.97a	
*Al-gamix	2m.L⁻¹	80.42c	83.21b	81.82b	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Number of Branch's per plants.

Table (2) revealed that significant differences occurred between cultivars, Reina cultivar gave the higher number of branch (5.12 branch/plant) compared to other cultivars. Significant differences had been in spacing the highest value (5.27 branch/plant) in 15cm spacing. Also 2ml.L⁻¹ superior to control treatment which gave (4.95 branch/plant). The interaction between cultivars and spacing had significantly effected the Giza cultivars planted in 15cm spacing gave the highest value (6.03 branch/plant), also the interaction

between cultivars and Al-gamix had significant effect on the highest value (5.53 branch/plant) when spray Reina cultivars with 2ml.L⁻¹. The highest no. of branches (5.68 branch/plant) was observed between spacing 15cm and 2ml.L⁻¹ Al-gamix. The triple interaction between three factors had significant effect, the highest branches per plant (6.57 branch/plant) was observed among Reina, 15cm spacing and 2ml. L⁻¹ Al-gamix as compared to other interaction and the lowest value (3.30 branch/plant) among Giza cultivar, 20cm and control treatment.

Table (2): Effect of Cultivars, plant spacing, Al-gamix and their interaction on number of branch's per plant of Broad bean.

var.	space	Al-gamix		var	Var.
		control	2ml.L ⁻¹	*	
		spacing			
Reina	15	4.60de	6.57a	5.58b	5.12a
	20	4.80d	4.50ef	4.65d	

Giza	15	5.67b	6.40a	6.03a	4.75b
	20	3.30i	3.63h	3.47f	
Local	15	4.30f	4.07g	4.18e	4.57c
	20	5.37c	4.53ef	4.95c	
Al-gamix		4.67b	4.95a		
var.	Reina	4.70c	5.53a	spacing	
*	Giza	4.48d	5.02b		
Al-gamix	local	4.83c	4.30e		
spacing	15	4.86b	5.68a	5.27a	
*Al-gamix	20	4.49c	4.22d	4.36b	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

2-Green Yield Characters:- Number of pods per plant.

Table (3) illustrated that significant effect of cultivars on No. of pods per plant the highest value (22.97 pod. plant⁻¹) occurred from Local cultivar, there were significant effect of spacing and Al-gamix, 20cm spacing and 2ml.L⁻¹ gave the highest value (22.12 and 22.72 pod. plant⁻¹) respectively. The dual interaction had significant effect and gave the highest No. of pods (24.73 pod.plant⁻¹) in interaction between Reina cultivar and 15cm spacing compared to other interaction.

Also the highest No. (24.58pod.plant⁻¹) between Reina and 2ml.L⁻¹ compared to other interaction treatments. There were significant difference between spacing and Al-gamix and the highest value was (23.74 pod.plant⁻¹) between 20cm spacing and 2ml.L⁻¹ as compared to other interaction.

The interaction among three treatments had significant effect the highest value (27.73 pod.plant⁻¹) between Reina, 15cm and 2ml.L⁻¹, while the lowest value (16.67pod.plant⁻¹) between Giza cultivar,15cm and 2ml.L⁻¹ Al-gamix.

Table (3): Effect of, cultivars, plant spacing, Al-gamix and their interaction on No. of pods per plant (pod.plant⁻¹) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2ml.l ⁻¹	*	
				spacing	
Reina	15	21.73d	27.73a	24.73a	22.45b
	20	18.90f	21.43de	20.17c	
Giza	15	18.97f	16.67h	17.82d	19.78c
	20	17.80g	25.67b	21.73b	
Local	15	22.23d	20.70e	21.47b	22.97a
	20	24.80bc	24.13c	24.47a	
Al-gamix		20.74b	22.72a		
var.	Reina	20.32e	24.58a	spacing	

*	Giza	18.38f	21.17d	
Al-gamix	Local	23.52b	22.42c	
spacing	B1	20.98c	21.70b	21.34b
*Al-gamix	B2	20.50c	23.74a	22.12a

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Pod Length (cm).

Data in table (4) shows that significant effect between cultivars on pod length and the Giza and Local cultivars superiority over the Reina cultivars reached (14.28 & 14.23cm) respectively. There were significant differences of plant spacing on pod length the highest value (14.14cm) in 20cm spacing. The treated plants with Al-gamix had significant effects on the highest pods length (14.55cm) in 2ml.L⁻¹ concentration.

The interaction between cultivars and spacing significantly affected on pod length, the highest

value (14.78cm) in the interaction between Giza and 15cm spacing, and the highest pod length (15.10cm) obtained between Giza and 2ml.L⁻¹. The interaction between spacing and Algamix had significant effect, the highest value (14.86cm) between 20cm spacing and 2ml.L⁻¹ Al-gamix was obtained. The interaction among three factors had significant effect and the interaction among Giza, 15cm and 2ml.L⁻¹ gave highest value (15.70cm) compared to other interactions.

Table (4): Effect of cultivars, plant spacing, Algamix and their interaction on pod length (cm) of Broad bean.

var.	space	Al-gamix		var	Var.
		control	2ml.L ⁻¹	*	
				spacing	
Reina	15	10.67g	12.43f	11.55d	12.94b
	20	13.53d	15.13b	14.33b	
Giza	15	13.87d	15.70a	14.78a	14.28a
	20	13.07e	14.50c	13.78c	
Local	15	13.70d	14.60c	14.15b	14.23a
	20	13.70d	14.93bc	14.32b	
Conc.		13.09b	14.55a		
var.	Reina	12.10e	13.78c	Spacing	
*	Giza	13.47d	15.10a		
Al-gamix	Local	13.70cd	14.77b		
spacing	15	12.74d	14.24b	13.49b	
*Al-gamix	20	13.43c	14.86a	14.14a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Pods Weight (g).

Table (5) illustrate that there were significant differences between cultivars on pod weigh of

broad bean, Giza cultivar superior to other two cultivars which gave (11.97g). The plant spacing significantly increased pod weight the 15cm

superior over the 20cm (11.31 and 10,82g) respectively. The treatment with Al-gamix also had significant effect and the highest one (11.14g) in 2ml.L⁻¹ concentration compared to control. As the effect of dual interaction significantly affected on pod weight, the interaction between Giza cultivars and 15cm space superior over other interaction which gave highest value (12.90g) while the lowest value (9.65g) obtained from the interaction between local cultivar and 20cm space. The other interactions between cultivars and Al-gamix had a significant effect on pod weight the

highest value (12.27g) was observed between Giza cultivar and control treatment. In the interaction between spacing and Al-gamix also significant effect and the highest weight (11.64g) it was between spacing and 2ml.L⁻¹, but the lowest value (10.65g) between 20cm space and 2ml.L⁻¹ treatment. The interaction among three factors significantly affected on pod weight the highest pod weight (14.22g) was observed among Giza cultivar, 15cm space and 2ml.L⁻¹ treatment, while the lowest one (9.38g) was noticed among Local cultivar, 20cm space and control treatment.

Table (5): Effect of cultivars, plant spacing, Al-gamix and their interaction on pod weight (g) of Broad bean.

var.	space	Al-gamix		var	Var.
		control	2ml.L ⁻¹		
				*	
				spacing	
Reina	15	10.67d	9.59ef	10.13d	10.95b
	20	10.61d	12.92b	11.76b	
Giza	15	11.58c	14.22a	12.90a	11.97a
	20	12.96b	9.10f	11.03c	
Local	15	10.69d	11.11cd	10.90c	10.28c
	20	9.38f	9.92e	9.65e	
Al-gamix		10.98a	11.14a		
var.	Reina	10.64d	11.25c	spacing	
*	Giza	12.27a	11.66b		
Al-gamix	Local	10.04e	10.51d		
Spacing	15	10.98b	11.64a	11.31a	
*Al-gamix	20	10.99b	10.65c	10.82b	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Pod Yield (g. plant⁻¹).

Data in table (6) shows that the Reina cultivar superior over the two other cultivar on pod yield per plant (243.43g.plant⁻¹). As the effect of spacing had a significant effect on plant yield 15cm gave the higher yield (236.83g.plant⁻¹). There were significant effect of Al-gamix on the pod yield per plant and the highest value (247.06 g.plant⁻¹) compared to control treatment. The interaction between cultivars and spacing had a significant effect pod yield, the Reina cultivar planted in 15cm spacing gave the higher yield

(248.42g.plant⁻¹) as compared to other interaction. The interaction between cultivars and Al-gamix had significant effect and the highest value (271.30 g.plant⁻¹) was noticed in the interaction between Reina and 2 ml.L⁻¹. The interaction between spacing and Al-gamix had significant effect the highest value

The interaction among three factors significantly increased pod yield of broad bean plants, the highest pod yield (276.77 g. plant⁻¹) among Reina cultivar, 20cm spacing and 2 ml.L⁻¹ Al-gamix compared to the other interaction and the lowest value had (200.50 g. plant⁻¹) between Reina, 20cm spacing and control treatments.

Table (6): Effect of cultivars, plant spacing, Al-gamix and their interaction on Pod Yield (g. plant⁻¹) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	
				spacing	
Reina	15	231.00fg	265.83b	248.42a	243.53a
	20	200.50i	276.77a	238.63b	
Giza	15	219.67h	236.93d	228.30f	230.24c
	20	230.70g	233.67e	232.18e	
Local	15	237.70cd	229.83g	233.77d	234.89b
	20	232.73ef	239.30c	236.02c	
Algamix		225.38b	247.06a		
var.	Reina	215.75d	271.30a	spacing	
*	Giza	225.18c	235.30b		
Al-gamix	Local	235.22b	234.57b		
Spacing	15	229.46c	244.20b	236.83a	
*Al-gamix	20	221.31d	249.91a	235.61b	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Total Yield (ton. donum⁻¹).

Table (7) shows that the Reina cultivar was superior over the other cultivar on total yield per plant (1.53 ton.donum⁻¹). As the effect of two spacing had a significant effect on total yield, 15cm spacing gave the higher total yield (1.49 ton.donum⁻¹). There were significant effect of Al-gamix on the total yield per donum and the highest value (1.55 ton.donum⁻¹) in the 2ml.L⁻¹ concentration compared to others. The interaction between cultivars and spacing was a significant effect on total yield, the interaction between Reina cultivars and 15cm gave the highest value (1.56 ton.donum⁻¹) as compared to other interaction. Also the interaction between Reina cultivar and

2ml.L⁻¹ gave the higher total yield (1.71ton.donum⁻¹) compared to other interaction. The interaction between spacing and Al-gamix was significant effect the highest value (1.57 ton.donum⁻¹) between 20cm spacing and 2ml.L⁻¹Al-gamix.

The interaction among three factors significantly increased total yield of broad bean plants, the highest total yield (1.74 ton.donum⁻¹) was observed among Reina cultivar, 20cm spacing and 2ml.L⁻¹Al-gamix compared to the other interaction and the lowest value had (1.26 ton.donum⁻¹) between Reina cultivar, 20cm spacing and control treatments.

Table (7): Effect of cultivars, plant spacing, Al-gamix and their interaction on Total Yield (kg.m^{-2}) of Broad bean plant.

var.	space	Al-gamix		var	Var.
		control	2ml.L ⁻¹	*	
		spacing			
Reina	15	1.45fg	1.67b	1.56a	1.53a
	20	1.26i	1.74a	1.50b	
Giza	15	1.38h	1.49d	1.44f	1.45c
	20	1.45g	1.47e	1.46e	
Local	15	1.49cd	1.45g	1.47d	1.48b
	20	1.46ef	1.50c	1.48c	
Algamix		1.42b	1.55a		
var.	Reina	1.36d	1.71a	Spacing	
*	Giza	1.42c	1.48b		
Al-gamix	Local	1.48b	1.47b		
spacing	15	1.44c	1.54b	1.49a	
*Al-gamix	20	1.39d	1.57a	1.48b	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

3-Green Seed Yield Characters: Number of Seeds per Pod.

The data in table (8) illustrated that significant effect of cultivars on No. of seeds per pod and the Reina cultivar overcome to other cultivar ($5.01 \text{ seed. pod}^{-1}$), no significant effect of spacing occurred. But significant differences occurred when sprayed with Al-gamix resulting the highest value ($5.13 \text{ seed.pod}^{-1}$) compared to control ($4.27 \text{ seed.pod}^{-1}$). The interaction between cultivars and spacing had significant effect and the highest No. of seeds ($5.82 \text{ seed.pod}^{-1}$) in interaction between Reina and 20cm spacing. The interaction between cultivars and Algamix also significantly affected

on the No. of seeds and highest value (5.53 and $5.57 \text{ seed.pod}^{-1}$) was occurred between Reina and Giza cultivars and 2 ml.L^{-1} respectively. There were significant effect between spacing and Al-gamix and the highest value (5.21 and $5.04 \text{ seed.pod}^{-1}$) between 2 ml.L^{-1} Al-gamix and the two spacing respectively.

The three interaction among treatments had significant effect the highest value (6.27 and $6.50 \text{ seed.pod}^{-1}$) among Reina and Giza cultivars, 20 and 15cm spacing and 2 ml.L^{-1} respectively compared to other interaction and the lowest value ($3.60 \text{ seed.pod}^{-1}$) between Reina, 15cm spacing and control treatment.

Table (8): Effect of cultivars, plant spacing, Al-gamix and their interaction on No. of seed per pod of Broad bean.

var.	space	Algamix		var	Var.
		Control	2ml.L ⁻¹	*	
		spacing			
Reina	15	3.60f	4.80c	4.20cd	5.01a
	20	5.37b	6.27a	5.82a	
Giza	15	4.50cd	6.50a	5.50b	4.98a
	20	4.27de	4.63cd	4.45c	
Local	15	3.93ef	4.33cde	4.13cd	4.12b
	20	3.97ef	4.23de	4.10d	
Al-gamix		4.27b	5.13a		
var.	Reina	4.48b	5.53a	spacing	
*	Giza	4.38b	5.57a		
Al-gamix	Local	3.95c	4.28b		
Spacing	15	4.01c	5.21a	4.61a	
*Al-gamix	20	4.53b	5.04a	4.79a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Number of Seeds per Plant.

The table (9) shows that significant effect of cultivars on No. of seeds per plant, the Reina cultivar overcome to other two cultivars which gave (111.67 seed.plant⁻¹), Also significant effect of spacing occurred and 20cm gave highest value (105.18 seed.plant⁻¹) compared to 15cm spacing (96.98 seed.plant⁻¹). The effect of Al-gamix significantly increased the No. of seeds and 2ml.L⁻¹ gave the highest value (114.42 seed.plant⁻¹) compared to control treatment (87.74 seed.plant⁻¹). The interaction between cultivars and spacing had significant effect and the highest No. of seeds (117.85 seed.plant⁻¹) in interaction between Reina and 20cm spacing. The interaction between

cultivars and Al-gamix also significantly affected on the No. of seeds and highest value (133.69seed.plant⁻¹) was occurred between Reina and 2ml.L⁻¹ treatments, and there were briefly significant between spacing and Al-gamix and the highest value (118.44 seed. plant⁻¹) occurred between 20cm spacing and 2ml.L⁻¹ conc. Al-gamix as compared to other interaction. The three interaction among treatments had a significant effect, the highest value (133.12 and 134.26 seed.plant⁻¹) among Reina cultivar, two spacing and 2ml.L⁻¹ respectively compared to other interaction and the lowest value (75.97seed.plant⁻¹) among Giza cultivar, 20cm spacing and control treatment.

Table (9): Effect of cultivars, plant spacing, Al-gamix and their interaction on No. of seeds per plant (seed.plant⁻¹) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	
		spacing			
Reina	15	77.87fg	133.12a	105.50b	111.67a
	20	101.43cd	134.26a	117.85a	
Giza	15	85.34ef	108.42c	96.88c	97.16b
	20	75.95g	118.91b	97.43c	
Local	15	87.47e	89.65e	88.56d	94.41b
	20	98.37d	102.14cd	100.26bc	
Al-gamix		87.74b	114.42a		
var.	Reina	89.65d	133.69a	spacing	
*	Giza	80.65e	113.67b		
Al-gamix	Local	92.92cd	95.90c		
Spacing	15	83.56d	110.40b	96.98b	
*Al-gamix	20	91.92c	118.44a	105.18a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Seed Weight (g).

The Data in Table (10), shows that the Reina cultivar significantly overcomes to the other cultivars in weight of seed, which reached (2.38g). The two spacing revealed significant differences in weight of seed, the 20cm spacing produced higher weight of seed (2.34mg) compared to 15cm (2.30g). The foliar Al-gamix concentration significantly affected weight of seed and the highest value (2.36g) in 2ml.L⁻¹ as compared to control treatment (2.27g). Significant differences were observed between the cultivars and the spacing in weight of seed, the interaction treatment between Reina cultivar and 20cm spacing gave the highest weight of seed which was (2.48g) compared to other interaction. The interaction between cultivars and Al-gamix had

significantly affect on weight of seed, the interaction treatment between Reina cultivar and 2ml.L⁻¹ had the highest weight of seed which was (2.48g) and significantly overcame all interaction treatments. Significant differences occurred from the interaction treatments between spacing and Al-gamix in weight of 100 seed character, the interaction treatment between 20cm space and spraying with 2ml.L⁻¹ gave the highest weight, which was (2.40g) compared to other interaction.

The interaction treatments among the three factors indicated to significant differences, spray Reina cultivar with 2ml.L⁻¹ of Algamix planted in 20cm space gave the highest weight (2.65g), while the local cultivar planted in 15 cm spacing and control treatment gave the lowest value (2.21g).

Table (10): Effect of cultivars, plant spacing, Al-gamix and their interaction on seed weight (g) of Broad been.

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	
		spacing			
Reina	15	2.26e	2.30c	2.28c	2.38a
	20	2.31c	2.65a	2.48a	
Giza	15	2.30c	2.45b	2.38b	2.33b
	20	2.28d	2.28d	2.28c	
Local	15	2.21g	2.26e	2.23e	2.24c
	20	2.24f	2.25e	2.25d	
Al-gamix		2.27b	2.36a		
var.	Reina	2.28d	2.48a	spacing	
*	Giza	2.29c	2.36b		
Al-gamix	Local	2.23f	2.25e		
Spacing	15	2.26d	2.33b	2.30b	
*Al-gamix	20	2.28c	2.40a	2.34a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Weight of 100 Seed (g).

The results in Table (11), display that the Reina cultivar significantly overcomes on the other cultivar in weight of 100 seed, which reached (237.83) compared to others. The two spacing revealed significant differences in weight of 100 seed, the 20cm produced higher weight of 100 seed (233.48g) compared to 15cm (229.52g). The foliar Algamix concentration significantly affected weight of 100 seed and the highest value (236.43) in 2ml.L⁻¹ as compared to control treatment (226.57g). Significant differences were observed between the cultivars and the spacing in weight of 100 seed, the interaction treatment between Reina cultivar and 20cm gave the highest weight of 100 seed which was (247.90g) compared to other interaction. The interaction between cultivars and Al-gamix had significantly

affected weight of 100 seed, the interaction treatment between Reina cultivar and 2ml.L⁻¹ gave the highest weight of 100 seed which was (247.47g) and significantly overcame all interaction treatments. Significant differences occurred from the interaction treatments between spacing and Al-gamix in weight of 100 seed character, the interaction treatment between 20cm and spraying with 2ml.L⁻¹ gave the highest weight, which was (239.47g) compared to other interaction.

The interaction treatments among the three factors indicated to significant differences among some treatments, spray Reina cultivar with 2ml.L⁻¹ of Al-gamix planted in 20cm spacing gave the highest weight (265.13g), while the control treatment in the 15cm spacing of local cultivar had the lowest value (221.20g).

Table (11): Effect of cultivars, plant spacing, Al-gamix and their interaction on weight of 100 seeds (g) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	
		spacing			
Reina	15	225.70e	229.80c	227.75c	237.83a
	20	230.67c	265.13a	247.90a	
Giza	15	230.03c	244.90b	237.47b	232.60b
	20	227.57d	227.90d	227.73c	
Local	15	221.20g	225.50e	223.35e	224.08c
	20	224.27f	225.37e	224.82d	
Al-gamix		226.57b	236.43a		
var.	Reina	228.18d	247.47a	Spacing	
*	Giza	228.80c	236.40b		
Al-gamix	Local	222.73f	225.43e		
Spacing	15	225.64d	233.40b	229.52b	
*Al-gamix	20	227.50c	239.47a	233.48a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Green Seed yield (g.plant⁻¹).

It is obvious from Table (12) that there were a significant effect of cultivars on seed yield per plant, Reina cultivar overcome on other cultivars which were (1229.52g.plant⁻¹) On the other hand, the effect of spacing had no significantly affected on plant yield. While, Al-gamix concentration significantly affected plant seed yield. The plants which received 2ml.L⁻¹ had the highest seed yield (1273.63g plant⁻¹), the lowest yield was (956.43g.plant⁻¹) in control treatments. Significant differences were observed in yield due to cultivars + spacing interaction treatments, the highest yield was recorded for plants from the Reina cultivar with 20cm spacing (1405.20g.plant⁻¹). The effect of interaction treatments between the cultivars and

Al-gamix also significantly affected yield, Reina cultivar sprayed with 2ml.L⁻¹ improved yield and reached (1505.22 g. plant⁻¹) compared to other treatments. Similarly, spacing+ Al-gamix interaction treatments significantly increased seed yield per plant, 20cm with 2ml.L⁻¹ had a highest seed yield (1276.67g. plant⁻¹) as compared to other interaction treatments.

The influence of the interaction consisting of cultivar + acids + concentration had a significant effect on the seed yield per plant and the maximum yield was for plants from Reina cultivar that were sprayed with 2ml.L⁻¹ of Al-gamix planted in 20cm (1734.44.plant⁻¹), while the minimum yield was in the Rina cultivar + 15cm + control treatment (831.70g.plant⁻¹).

Table (12): Effect of cultivars, plant spacing, Al-gamix and their interaction on Seed yield (g.plant⁻¹) of Broad bean.

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	

		disance			
Reina	15	831.70f	1276.00c	1053.85c	1229.52a
	20	1075.95d	1734.44a	1405.20a	
Giza	15	988.47de	1539.78b	1264.13b	1148.82b
	20	984.35de	1082.66d	1033.51cd	
Local	15	934.96ef	995.94de	965.45d	966.74c
	20	923.13ef	1012.92de	968.03d	
Al-gamix		956.43b	1273.63a		
var.	Reina	953.83c	1505.22a	Distance	
*	Giza	986.41c	1311.22b		
Al-gamix	Local	929.05c	1004.43c		
spacing	15	918.38c	1270.58a	1094.48a	
*Al-gamix	20	994.48b	1276.67a	1135.58a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

Total Seed Yield (ton. donum⁻¹).

Table (13) displays that there were a significant differences between cultivars in the total seed yield, the Reina cultivar overcome to other cultivars which valued (7.73 ton.donum⁻¹). The two spacing in total yield were accessed to no significant level, Spraying the plants with Al-gamix significantly increased the total seed yield; 2ml.L⁻¹ resulted in a higher total yield (8.01 ton.donum⁻¹) as compared to a lower value from control treatment which was (6.01 ton.donum⁻¹). The interaction treatment between cultivars and spacing significantly affected total seed yield, the interaction between Reina cultivars and 20cm gave higher total yield reached (8.83ton.donum⁻¹) as compared to other interaction. The interaction

effect between cultivars and Al-gamix also had significant effect the highest value (9.46ton.donum⁻¹) recorded between Reina cultivars and 2ml.L⁻¹. compared to other interaction. The interaction between spacing and Al-gamix revealed significant effect on total green seed yield, the higher interaction (8.03ton.donum⁻¹) between 20cm spacing and 2ml.L⁻¹ compared to other interaction.

The interaction effect among three factors had also significant effect on total seed yield, the higher value (10.90 ton.donum⁻¹) was observed in interaction among Reina cultivar sprayed with 2.ml.L⁻¹ Algamix planted in 20 cm spacing, while the lowest value (5.23 ton.donum⁻¹) among Reina cultivars, 15cm spacing and control treatment.

Table (13): Effect of cultivars, plant spacing, Al-gamix and their interaction on total green seeds yield(ton.donum⁻¹).

var.	space	Al-gamix		var	Var.
		Control	2ml.L ⁻¹	*	
				spacing	
Reina	15	5.23f	8.02c	6.624c	7.73a
	20	6.76d	10.90a	8.833a	
Giza	15	6.21ef	9.68b	7.946b	7.22b
	20	6.19de	6.81d	6.496cd	

Local	15	5.88ef	6.26de	6.069d	6.08c
	20	5.80ef	6.37de	6.085d	
Al-gamix		6.01b	8.01a		
var.	Reina	6.10c	9.46a	Spacing	
*	Giza	6.20c	8.24b		
Al-gamix	Local	5.84c	6.31c		
spacing	15	5.77c	7.99a	6.88a	
*Algamix	20	6.25b	8.03a	7.14a	

Means within a column, row and there interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% leve.

4. DISSCUTION

It is evident from the previously mentioned results in table (2, 6, 7, 8,9, 10, 11, 12 and 13) the Reina cultivar superior to the Giza and Local cultivar in (No. of branch per plant, Pod Yield g. plant⁻¹, Total Yield ton. donum⁻¹, No. of seed per pod, No. of seed. Plant⁻¹, seed weight g, weight of 100 seed g, seed yield.plant⁻¹ and Total seed yield ton. Donum⁻¹), while Giza cultivar superior to other cultivars in (plant length cm, pod length cm, pod weight g) which is due to the genotype differences among the three cultivars and the increase in absorption of the nutrient in the soil, may be due to the differences in root system and RCEC (Root Cation Exchange Capacity) which is differing among cultivars. These results are in harmony with those of the (Bakry *et al.*, 2011; Osman *et al.*, 2010), and also the differences between studied cultivars in growth habit and response of each one to environmental conditions during the growing season which are controlled by genetically factors. That may be reflected on the nodulation and N-fixation consequently growth characteristics. Similar results were obtained by (El-Masry, 2010; Derya, 2013 and Kuber *et al.*, 2016).

These results provide clear evidence that the 15 plants spacing will increase plant growth, which may be lead that the plants taking sufficient nutrients and water in addition to the light with less competition between plants for nutrients, water and light. The reduction of leaf chlorophyll content could be explained partially by the effects of shading of the lower canopy, causing poor canopy interception of the photo synthetically active radiation (Brahim *et al.*, 1998).

Significantly differences occurred between plant spacing in green and seed yield characters. 15 cm spacing increased (plant high cm, No. of branches, pod weight g, plant yield g. plant⁻¹, total yield ton.donum⁻¹). But 20cm spacing significant increased (No. of pods per plant, pod length cm, No. of seed per pod, seed weight g, weight of 100 seed g). This may be attributed to the over shadowing of the plant due to the highest number of plants per unit area. That yield per donum increased with higher planting densities was probably due to an increase in the number of plants per unit area, which might have contributed to the production of extra yield per unit area leading to high yield high plant density can cause lodging, less light penetration in the crop canopy, reduced photosynthetic efficiency and can reduce the yield drastically (Vassilev, 1998; Jettner *et al.*, 1998a 1998b; Lemerle *et al.*, 2004; Lemerle *et al.*, 2006). Earlier studies have shown that yield and its components are affected by planting densities (Turk & Tawaha, 2002; Bakry *et al.*, 2011; Thalji, 2006 & 2010; Khalil *et al.*, 2011). The closer spacing (high planting density) might have enabled maximized the use of the applied nutrients better than the wider spacing (low planting density).

Spraying broad bean plants with Al-gamix significant affected on the growth and green yield of pods and seed characteristics, In general, seaweed extracts contain important growth hormones like Auxin, gibberellins and Cytokinin which induce cell division, increase cell enlargement, lead to balance of the physiological and biological processes, increase photosynthesis processes and improve growth characters (Jensen, 2004). The positive effect of seaweed extracts on

the vegetative growth characters table (1&2) may be due to the mineral content Zn, Cu and B in the seaweed extracts which promote cell division and enlargement and induce the photosynthesis leading to better vegetative growth. It might also be due to the macronutrient that the seaweed extracts contain like N, P, K, which (macronutrients) play a great role in plant nutrition which are essential for the growth of plant (**Lopes et al., 2008 and Attamimy, 2009**). The beneficial effect of seaweed extracts on crop yield table (3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13) could be due to the stimulatory influence of seaweed concentration on triggering early flowering and fruit set (Arthur *et al.*, 2003). The micronutrients status of the soil is limited. Low rates of nutrients will not be sufficient to close the gap between crop need and supply. The continuous use of low rates of fertilizer nutrients can deplete the soil nutrient reserves, so the uses of seaweed provide the plants with mineral elements and stimulating the action of soil bacteria. The present investigation demonstrated that faba bean root criteria increased with foliar spray with seaweed extract, whereas shoot parameters were enhanced with foliar spray. Pigment content of faba bean was also increased on foliar spray, these results were in favor with the findings of **Blunden et al. (1996) and Crouch and van Staden (2005)** also found that the seaweed concentrate stimulated root growth at the expense of shoot growth and increase of the overall photosynthetic accumulation efficiency of the plant. A better root system might be attributed to endogenous auxin and related compounds in the extracts. Yield enhancement in plants treated with seaweed extracts is thought to be associated with the hormonal substances existing in the extracts, particularly cytokinins. This was evident in fruits treated with seaweed extracts which had higher cytokinin levels as compared with untreated fruits (**Featonby and Van Stadena, 1983**). In addition to growth hormones, the increase in yield characters could be due to the fact that seaweed extracts contain macro and micronutrients and organic matters like amino acids that improve nutritional status, vegetative growth and yield quality (**O'Dell, 2003**). These results are in harmony with the findings by **Gajewski et al. (2008) on Chinese Cabbage, Allelah (2011) on melon.**

5. CONCLUSION

The obtained results revealed that the Reina cultivar superior over the Giza and Local cultivars in more character. Plant spacing 15cm enhance vegetative and some yield characters, while 20cm spacing increase other yield characters. Foliar spraying faba bean plants with Al-gamix was beneficial to the crop growth and yield along with vegetative, green pods and seeds. Hence, it could be suggested that the Reina cultivar is suitable with area condition and faba bean grown under the experiment and similar growing conditions and foliar sprayed with Al-gamix to produce high quantity and good quality of some characters green pods, green yield and green seed yield suitable for marketing.

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