Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 53(1) (2015), 153–164 **http://annagricmoshj.com**

Effect of plant density and some safety compounds on growth and productivity of green snap bean

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Abstract

Two field experiments were conducted during the two successive seasons of 2010/2011 and 2011/2012 at the Experimental Farm, Kaha station, Kalubia Governorate to study the effect of using four plant densities (5 cm,7.5 cm apart on one side of the irrigation line,10 and 15cm apart on two sides of the irrigation line) and five safety materials, i.e. amino more, yeast extract, oligo-x and salicylic acid in addition to the control as foliar spray on snap bean plants and the effect of that on vegetative growth, green pods yield and physical as well as chemical pod characters of cv. Poulista. The results indicated that, plant density 7.5 cm on one side of ridge (22plant/m^2) and sprayed with yeast extract, amino more or oligo-x, respectively, gave the highest values of all measured vegetative growth parameters (plant length, number of branches and leaves/plant, fresh and dry weight of plant), pod number/plant and pod yield/plant except plant length and stem diameter in both growing seasons. Moreover, planting at5 cm on one side of ridge (33plant/m^2) and sprayed with yeast extract in the first season and amino more in the second one were the best treatments for pod yield/fed. It is obvious that plant density15 cm on two sides of ridge and spraying plants with yeast extract, amino more or oligo-x, respectively increased the values of all chemical properties but didn't reach to 5% level of significance except N%, protein% in the second season.

Generally, it can be recommend by using plant density 5cm on one side (33plant/ m^2) or 7.5 cm on one side (22plant/m^2) and foliar spray by yeast extract, amino more followed by oligo-x to obtain the highest green pod yield with best quality.

Keywords: snap bean, plant density, yeast, amino acids, seaweed and salicylic acid

Introduction

Bean is considered as one of the most important and economic vegetable crops in Egypt. It does not require large amounts of fertilizers, plus it is considered as a short season crop, where it produce green pod yield through short period after two months from sowing. More over, it is one of the crops that cause soil fertility neither consumes nor depletes soil nutrients. It's also one of the few vegetable crops that can be grown for either local consumption or exportation. Moreover, the green pods as well as dry bean seeds contain cheap source from protein and carbohydrate. The total area devoted to green beans during winter season of 2011 was 57873 fed., this area produced 251279 ton as an average yield of 4.079 ton/fed. according to the Statistics of Ministry of Agriculture 2013.

Plant density is a prime factor in vertically increasing the yield **(Mohamed 2008** on faba bean; **Abd El-Latif 2009** on cowpea; **Kazemi *et al*., 2012** on snap bean) where, the highest plant density increased yield. There are many reports showing the importance of plant density on vegetative trails of other leguminous crops. Such reports indicated increasing plant height with increasing plant density. Where as, number of branches and leaves per plant as well as leaf area per plant were decreased with increasing plant density(**Abobaker, 2008** on snap bean ; **Abd El-Latif *et al*.,2009** on cowpea ;**Moniruzzaman *et al*.,2009** on French bean; **El Naim and Jabereldar, 2010** on cowpea ; **Darwesh, 2012** on cowpea) .

In recent years the world focused his attention to minimize environmental pollution and human health impacts, by reducing the use of synthetic fertilizer and chemicals in crops production, especially by fresh eaten vegetables **(IFAOM/SOEL, 2000 and FAO/TTC, 2001).** Several investigators using some nutritional safety compounds as a foliar spray, soil application and foliar spray combined with soil application to enhance its growth and maximizing the yield be using some natural extracts which are non toxic, environmentally friendly, of organic sources and costless.

Concerning yeast which contents protective agents, i.e., sugars, proteins, amino acids and several vitamins **(Shady, 1978).** His treatments suggested participating a beneficial role regarding growth and yield due to its cytokinens content **(Barnett *et al*., 1990).** In this respect, it was found that yeast improves the formation of flower initiation due to its effect on

carbohydrates accumulation **(Winkler *et al*., 1962)**. Also, reports were mentioned about its stimulatory effects on cell division and enlargement, as well as protein nucleic acid and chlorophyll formation **(Fathy and Farid, 1996)**.Improving growth and fruiting yield and overall quality of horticultural plants by yeast application was reported by **(Tartoura (2001)**who mentioned that spraying pea plants with yeast extract three times induced significant increase in all growth characters, i.e. plant height, number of leaves as well as fresh and dry weight of shoots/plant compared with the untreated control plants. In addition, **Amer (2004)** found that spraying common bean (*Phasealus vulgaris L*.) with yeast at the highest rate (2g/l.) gave higher values of all growth parameters, i.e. plant height, number of leaves/plant, leaf area and dry weigh/plant comparing with the control, In this regard, it is known that increment of leaf characteristics (number and area) could be a basic for increasing photosynthetic efficiency. These results are in agreement with those mentioned by **El-Tohamy and El-Greadly, (2007), El-Desouky *et al*. (2011), Abou El -Yazied and Mady,(2012) and Gaafar(2014)** for yeast.

Regarding to seaweed extract, several investigators showed that the great importance of this compounds due to it contain high levels of organic matter, micro elements (Fe, Cu, Zn, Co, Mo, Mn , and Ni),vitamins and amino acids and also, rich in growth regulators such as auxins , cytokinens and gibberellins (**Blunden,1991,Crouch and Van Staden, 1994 and Khan *et al*.,2009).**The beneficial effect of seaweed extract is a result of many components that work synergistically at different concentrations **(Fornes *et al*.,2002**).In this respect, all the crude extracts of seaweed increased protein content in shoot systems, total soluble sugars and chlorophyll content in faba bean leaves. **(El-Sheekh and Saied, 1999).** Exogenous application of seaweed extract has already been shown to enhance plant growth, yield and its quality as reported by **Nour and Eisa (2009)** on snap bean, **Abdel-Aziz and Gaafer (2012)** on tomato, who found that spraying tomato plants with Elgeferet (as a rich source of seaweed extract) at dose of 4cm/l four times induced superior improvement on growth, fruit yield and its quality comparing with the control or the other used compounds. **Abou El-Yazied *et al.* (2012)** on snap bean**, Kumar *et al*. (2012)** on green gram **and Gaafar (2014)** on snap bean came to similar results**.**

Regarding to amino more which contains mixture of amino acids, it is known that, amino acids as organic nitrogenous compounds stimulated cell growth acting as buffers maintaining favorable pH value within the plant cell as well as synthesizing other organic compounds such as protein, amines, purines, pyrimidines, alkaloids, vitamins, enzymes, terpenoids and others **(Goss, 1973).** So the importance of amino acids on enhancing plant growth and its productivity it had a positive effects on plant growth, yield and overall quality of crops, i.e. amino acids are fundamental ingredients in the process of protein synthesis, formation of vegetable tissue and chlorophyll synthesis. Similar effects and findings about amino acids were indicated by **Nour and Eisa (2009), Abd el- Mawgoud *et al*. (2011)**, **El-Awadi *et al*. (2011) and Gaafar (2014)** on snap bean. Moreover, amino acids are precursors or activators of phytohormones and growth substance (i.e. alternative routes of IAA synthesis exist in plants) all starting from tryptophan (amino acid) (**Marschner 1995**). The biosynthesis of cinamic acids (which are the starting materials for the synthesis of phenols) are derived from phenylalanine and tyrosine (tyrosinea is hydroxy phenyl amino acid that used to build neurotransmitters and hormones). Function of amino acid were found also in the synthesis of other organic compounds, amines, Purines and pyrimidines , alkaloids, vitamins enzymes, terpeniods and others as reported by (**Pratelli and Pilot, 2007**).Amino acids are important for pollination and fruit formation (**Stitt *et al*. 2002**).

Regarding to salicylic acid, it has been identified as one of the important phenolic compound in plants and is also reported as allelopathic chemical **(Einhelling 1986),** and is considered as a stress signaling compound in plant. Several studies indicated that foliar spray with salicylic acid increased the fresh and dry weights of plant, pod setting and total proteins of leaves and fruits (**Liu Xenia *et al*.2000** and **Sanaa *et al*.2001** on broad bean). **Kamal *et al* .2008,** on pea found that yield and its components were increased, especially at the higher concentrations of salicylic acid (200 ppm).

Materials and methods

The present work was carried out during two successive seasons of 2011/2012 and 2012/2013 at the Experimental Farm, Kaha Station, Qalubia Governorate. Soil was clay in texture with 7.2 Ph, 3.5 EC 1.15% organic matters, 110 ppm N, 49 ppm P and 103 ppm K. Seeds of snap bean cv. Poulista were obtained from Horticultural Research Institute, Agriculture Research Center, Egypt and sown on September 22th in 2011 and 2012,. A split plot design system with three replicates was adopted where plant density was distributed in the main plots and growth compounds in the sub - plots. The area of each experimental plot was 30m^2 and consisted of one row (5 dripper lines with 10 m length each at 60 cm distance between dripper lines). The experiment included 20 treatments as follows:

a- Plant densities

1- 33 plants/m^2, one plant / hill at 5 cm apart on one side of the irrigation line.
2- 33 plants/m^2, one plant / hill at 10 cm apart on the two sides of the irrigation line.
3- 22 plants/m^2, one plant / hill at 7.5 cm apart on one side of the irrigation line.
4- 22 plants/m^2, one plant / hill at 15 cm apart on the two sides of the irrigation line.

b- Foliar spraying treatments

1- Yeast extract at 200 ml/l.
2-Oligo-x (sea weed extract) at 0.5 ml /l.
3-Amino more at 0.75 ml /l.
4-Salicylic acid at 50 ppm.
5- Distilled water (control).

The compounds used were applied three times within 15 days intervals, starting 21 days after sowing. Other agricultural practices required for snap bean production were carried out as commonly followed in the district. The compounds used in this study, i.e., composition and concentration are shown in following **Table (1).**

Table 1. Names and components of the materials used in this study

Compounds name	Composition	Concentration
1-Control	Distilled water	-
2- Oligo-x	Oligo skrdase 0.3%, Manito 0.001%, Cytokinins0.001 %, IAA 0.002 % , macro and micro elements	0.5 cm/l
3- Amino more	15.13% amino acids ,macro and micro elements	0.75 cm/l.
4- Salicylic acid	A monohydroxy benzoic acid $C_7H_6O_3$	50 ppm.
5- Yeast	protein (5.3 %),total carbohydrates (4.7 %), N (1.2 %), P(0.13 %), K (0.3 %), Mg (0.013 %), Ca (0.02 %), Na (0.01 %); micro-elements (ppm), Fe (0.13) Mn (0.07), Zn (0.04), Cu (0.04), 3 (0.016), Mo (0.0003), IAA (0.5 mg/ml) and GA (0.3 mg/ml).	200 ml/l.

Table 2. Monthly air temperature and relative humidity in Kalubia region during two seasons of the experiment.

Month	2010/2011				2011/2012			
	Tmperature ^{0}C			Relative Humidity%	Tmperature ^{0}C			Relative Humidity%
	Max.	Min.	Average		Max.	Min.	Average	
September	31.69	16.27	24.13	72	36.21	14.74	25.15	74
October	38.07	10.83	21.30	71	33.94	13.05	23.20	73
November	24.98	5.78	15.48	80	29.88	6.86	18.75	75
December	21.79	2.50	12.45	84	27.27	3.77	13.83	83
January	21.93	1.48	11.37	75	24.81	0.74	12.00	74
February	20.74	3.37	11.25	69	26.26	1.74	13.33	77

Data recorded:

Five plants from each plot were randomly taken after 50 days from seed sowing and the following data were recorded.

1) Vegetative growth parameters :

-Plant height (cm) -Stem diameter (cm) - Number of branches/plant
- Number of leaves/plant -Total fresh and dry weight of plant -Leaf area

The leaf area was calculated according to the following formula of **Wallace and Munger (1965):**

$$\text{Leaf area } (cm^2) = \frac{\text{Leaves dry weight (gm)} \times \text{disk area } (cm^2)}{\text{Disk dry weight (gm)}}$$

2) Green pods yield and its components:-

At harvest, green pods were continuously harvested at suitable maturity stage and in second pickings a random sample of 10 fresh green pods from each plot were taken randomly to determine the following data:

- Pod length -Pod diameter - Number and weight of pods/plant.
- Fresh and dry green pod weight - Total yield of green pods as ton/fed.

3) Chemical components:

Pods of snap bean were dried in an electric forced-air oven at 70c^{o}to constant weight then fractionated and sifting. The fine powder (at 0.2g) of dry sample was digested in a mixture of sulphuric and perchloric acids according to **Piper (1947)**. Total protein in pods was calculated by multiplying nitrogen in 6.25 as described by **Stewart (1989**). N (%) using microkjeldahl, P (%) using calorimetrically and K (%) by flame photometer according to the methods described by **Bremner and Mulvaney (1982)**, **Olsen and Sommers (1982)** and **Jackson (1970)** for N, P and K, respectively.

Statistical analysis:

All data were subjected to statistical analysis according to the procedures reported by **Snedecor and Cochran (1982)** using M. stat program and means were compared by L.S.D multiple range tests at the 5 % level of probability in the two seasons of experimentation.

Results and Discussion

I- Vegetative growth:

I.1 Effect of plant density

The data reveal that plant density at 5cm on one side of ridge (33plant/ m^2) increased plant length compared with 10cm on two sides of ridge (33plant/m^2)in **Table(3)**. On the other hand, plant density at 7.5 cm on one side of ridge (22 plant/m^2) showed obvious increment in all other vegetative growth parameters in both growing seasons. There are many reports showing the importance of plant density on vegetative trails of other leguminous crops. Such reports indicated an increase in plant height with increasing plant density. Whereas, number of branches per plant, leaf area and number of leaves per plant were decreased with increasing plant density**(Abubaker 2008** on snap bean **, Abd El-Latif *et al*.2009** on cowpea **,Moniruzzaman *et al*.2009** on french bean**, El Naim and Jabereldar 2010** on cowpea and **Darwesh 2012)**on cowpea**.**

I.2 Effect of safety materials:

As shown in **Table 3**, snap bean plants sprayed with yeast extract, amino more or oligo-x, respectively gave the highest values of vegetative growth parameters, i.e., plant length, number of leaves/plant, leaf area number of branches, stem diameter as well as the fresh and dry weight/plant as compared with either salicylic acid or water .In this regard, salicylic acid showed superiority in case of stem diameter comparing with all other used compounds. This was true in both growing season .These results may be due to a beneficial role during growth due to its cytokinens content **(Barnett *et al*.1990),** also, it was reported about its stimulatory effects on cell division and enlargement **(Fathy and Farid, 1996).** These results are also in agreement with those mentioned by **El-Tohamy and El-Greadly (2007), El-Desouky *et al*. (2011), Abou El-Yazied and Mady (2012) and Gaafar (2014)** for yeast. Regarding to amino more which contain amino acids, it is known that, amino acids as organic nitrogenous compounds stimulated cell growth acting as buffers maintaining favorable pH value within the plant cell as well as synthesizing other organic compounds, such as protein, amines, purines, pyrimidines, alkaloids, vitamins, enzymes, terpenoids and others **(Goss,1973).** These results are in agreement with those mentioned by **Fawzy *et al*. (2010) on** snap bean**, Mawgoud *et al*. (2011)** on green bean**, El-Awadi *et al*. (2011) and Gaafar (2014)** on snap bean**.** Further more olego-x contains high levels of organic matter, micro elements (Fe, Cu, Zn, Co, Mo, Mn , and Ni),vitamins and amino acids and also, rich in growth regulators such as auxins , cytokinens and gibberellins **(Blunden1991,Crouch and Van Staden, 1994 and Khan *et al*.,2009).**The beneficial effect of seaweed extract is a result of many components that work synergistically at different concentrations **(Fornes *et al*.2002),** which can be found by **Hanafy *et al*.(2010)** on snap bean , **Kavipriya *et al*.(2011)** on green gram , **Abou El –Yazied *et al*.(2012)** and **Gaafar (2014)** on snap bean**.**

I.3 Effect of the interaction:

The results of the interaction effect between plant density and safety materials on vegetative growth, i.e., plant length, number of leaves, leaf area, number of branches/plan, stem diameter as well as fresh and dry weight of snap bean plant are shown in **Table 3.** It is obvious that plant density 7.5 cm on one side of ridge (22plant/m^2) and sprayed with yeast extract gave the highest values of all vegetative growth parameters except plant length and stem diameter.

2- Yield and yield components:

2.1 Effect of plant density:

Yield and yield attributes of snap bean show some significant results by using different plant density as shown in **Table 4.** The data show that the plants grown at plant density 5cm on one side of ridge (33plant/ m^2) increased pod yield ton/fed. On the other hand, plant density 7.5 cm on one side of ridge (22plant/m^2) gave the highest values of pod yield/plant, number of pod in both growing season and pod fresh weight in the first season. Moreover, pod length and pod diameter were significantly increased in the first season at plant

density 10 cm on two sides of ridge (33plant/m^2) but the increase failed to reach the significant in the second season. Data also show that, there is no significant effect from using all plant density on pod dry weight in both growing seasons. This may be due to the higher number of plants per unit area, which can be found by **Mohamed (2008)** on faba bean**, Abd El-Latif *et al.* (2009), El Naim and Jabereldar (2010)** on cow pea and **Kazemi *et al.* (2012)** on snap bean.

2.2 Effect of safety materials:

Yield and yield attributes of snap bean show significant results by using different safety materials as shown in **Table 4**. The data show that the plants sprayed with yeast extract, amino more or oligo-x exerted the highest values of pod yield /plant, pod yield t/fed. number of pod and pod diameter in both growing seasons but the differences did not reach the 5% level of significance in the second season for pod length. There is no significant effect from using all safety materials on pod dry weight in both growing seasons**.** These results may be due to also that, yeast extract contain growth promoters and a relatively larger proportion of free amino acids and short peptides of two or three amino acids long than protein hydrolisates (**Bevilcqua *et al.* 2008)**. Yeast is considered as a natural source of cytokines that stimulates cell division and enlargement **(Kraig and Habe, 1980).**These results also agree with those reported by **Nour and Eisa (2009)** on snap bean cv. Paulista, **Abdel- Aziz and Zakhar (2010)** on pea plant cv. Master B, **Abou El-Yazied and Mady (2012)** on broad bean cv. Super Aquadulse and **Gaafar (2014)** on snap bean cv. Pulista for yeast**.** Regarding to amino more which contain amino acids, it is known that, amino acids as organic nitrogenous compounds stimulated cell growth acting as buffers maintaining favorable pH value within the plant cell as well as synthesizing other organic compounds such as protein, amines, purines, pyrimidines, alkaloids, vitamins, enzymes, terpenoids and others **(Goss, 1973).** These results are in agreement with those mentioned by **Nour and Eisa (2009)** on snap bean cv. Paulista, **Abdel- Aziz and Zakhar (2010)** on pea, **Fawzy *et al.* (2010)**, **El-Awadi *et al.* (2011)** on snap bean, **Abd el-Mawgoud et al. (2011)** on green bean and **Gaafar (2014)** on snap bean cv. Pulista . Concerning to olego-x contains which high levels of organic matter, micro elements (Fe, Cu, Zn, Co, Mo, Mn , and Ni),vitamins and amino acids and also, rich in growth regulators such as auxins , cytokine and gibberellins was mentioned by **(Blunden1991,Crouch and Van Staden 1994 and Khan *et al.*2009), Nour and Eisa (2009)** on snap bean cv. Paulista, **Abdel- Aziz and Zakhar (2010)** on pea cv. Master B., **Zodape *et al.* (2010)** on green gram and **Gaafar (2014)** on snap bean cv. Pulista .

2.3 Effect of the interaction:

The results in **Table 4** revealed that the highest values of pod number/plant, pod yield/plant were obtained from plants sprayed with yeast extract followed by amino more at plant density 7.5 cm on one side of ridge (22plant/m^2). Moreover, plants sprayed with yeast extract at plant density 5cm on one side of ridge (33plant/ m^2) in the first and amino more in the second season were the best treatments for pod yield/fed. Meanwhile, the data show that there is no significant effect from using all plant density and safety compounds on pod length, pod diameter as well as fresh and dry pod weight in both seasons.

3- Chemical properties:

3.1 Effect of plant density:

Data in **Table 5** show the effect of plant density on chemical properties of snap bean pods, i.e., N%, P% and K% and protein percentage. It was found that the plant density 15 cm on two sides of ridge gave the highest value of all chemical properties except K% in both seasons which was increased by the plant density7.5 cm on one side of ridge. Obtained results are in agreement with those found by **Arisha and Bardisi (1999)** on common bean and **Abubaker (2008)** on snap bean.

3.2 Effect of safety compounds:

As shown in **Table 5** spraying snap bean plants with safety compounds increased all chemical properties of snap bean pods, i.e., N%, P% and K% and protein percentage compared with the control. Yeast extract and amino acids increased mostly all chemical properties of snap bean pods. Regarding to yeast the results are in agreement with those mentioned by **Nour and Eisa (2009)**, **Ali (2010)** , **Abou El Yazied and Mady (2012)** and **Gaafar(2014)**on bean .

Concerning to the effect of amino more, it was found that, the plants sprayed with amino-more compound gave pods contain high concentration of K, these result may be due to chemical structure of amino more, which contain mixture of amino acids, it is known that, Amino acids as organic nitrogenous compounds stimulated cell growth. **(Goss, 1973).**

The increases of chemical constituents by spraying yeast, amino more , olego- x and salicylic acid might be attributed to that macro and micronutrients increases the capacity of plant to absorb nutrients by the increase of root surface per unit of soil volume , as well as the high capacity

Of the plants supplied with macro and micronutrients in building up plant metabolites, which in turn contributes much to the increase of nutrients uptake (**Mandour *et al.* 1986**).

Table 3. Effect of plant density and safety compounds foliar spray and their interaction on vegetative growth parameters of snap bean plants during 2011 and 2012 seasons.

Season		2010/2011							2011/2012						
Treatments		**Plant height (cm)**	**No. of leaves/ plant**	**No. of branches/ plant**	**Stem diameter (cm)**	**Leaf area/ plant (cm^2)**	**Total fresh weight (g)**	**Total dry weight (g)**	**Plant height (cm**	**No. of leaves/ plant**	**No. of branches/ plant**	**Stem diameter (cm)**	**Leaf area/ plant (cm^2)**	**Total fresh weight (g)**	**Total dry weight (g)**
Plant density	**5cm- one side**	52.09	12.99	8.27	0.694	785.13	75.84	7.99	52.43	12.57	7.83	0.676	879.03	77.14	9.59
	10cm- two sides	51.18	12.68	7.73	0.723	725.14	76.22	8.08	52.33	12.43	7.86	0.702	827.28	74.77	9.39
	7.5cm-one side	47.00	13.55	9.06	0.788	774.96	84.62	8.45	45.59	13.82	9.15	0.739	978.61	83.10	10.27
	15cm–two sides	44.63	13.07	9.31	0.830	803.07	86.07	8.97	45.70	13.31	9.34	0.800	972.54	83.10	10.18
L .S. D at 5 % level of plant density		**0.186**	**0.330**	**0.379**	**0.205**	**N.S**	**2.431**	**0.284**	**0.048**	**0.019**	**0.296**	**0.047**	**66.30**	**2.228**	**0.242**
Foliar spray	**Amino more**	50.62	13.45	9.04	0.776	827.87	85.51	9.03	51.24	13.52	9.39	0.736	1018.80	85.87	10.74
	Salicylic acid	48.58	13.36	8.31	0.849	745.97	80.18	8.05	49.87	13.08	7.89	0.835	892.70	75.80	9.52
	Yeast	50.91	13.78	9.57	0.773	860.26	86.39	9.14	52.28	13.74	9.68	0.732	1029.60	88.02	10.97
	Olego-X	50.02	12.85	8.39	0.764	780.10	84.20	8.49	50.13	13.06	8.58	0.517	946.50	81..29	10.12
	Water	43.52	11.92	7.65	0.632	646.17	67.17	7.17	41.55	11.75	7.25	0.593	684.30	66.65	7.90
L .S. D at 5 % level of foliar spray		**0.206**	**0.238**	**0.275**	**0.029**	**49.71**	**2.459**	**0.479**	**0.087**	**0.027**	**0.608**	**0.047**	**54.51**	**1.582**	**0.493**
5cm- one side	**Amino more**	53.67	13.49	8.00	0.743	836.02	81.89	6.26	54.00	13.08	9.00	0.667	951.83	83.39	10.24
	Salicylic acid	51.25	13.39	7.33	0.778	770.66	78.36	7.76	53.11	12.50	7.00	0.783	853.39	78.36	9.43
	Yeast	54.09	13.89	9.33	0.711	864.76	82.60	8.58	55.34	13.06	9.22	0.700	974.95	82.60	10.70
	Olego-X	53.72	12.20	7.33	0.697	814.95	80.06	8.28	53.50	12.60	8.06	0.683	961.49	80.06	9.98
	Water	47.75	11.93	6.67	0.539	639.28	56.27	6.38	46.22	10.89	6.11	0.550	653.48	56.27	7.61
10cm- two sides	**Amino more**	49.25	12.86	9.00	0.721	805.40	82.06	8.59	56.22	14.33	8.78	0.711	919.53	82.06	10.30
	Salicylic acid	50.92	13.49	7.78	0.783	694.19	72.85	7.72	52.78	13.81	7.11	0.783	763.52	72.85	8.56
	Yeast	52.72	13.28	9.56	0.740	818.18	82.97	8.89	57.42	14.39	9.22	0.650	926.84	82.97	10.44
	Olego-X	52.68	12.25	8.22	0.798	701.50	82.18	7.99	52.89	14.00	8.06	0.789	890.94	82.18	9.92
	Water	42.25	11.49	6.78	0.572	606.33	61.03	7.20	42.33	12.56	6.11	0.578	635.54	61.03	7.74
7.5cm-one side	**Amino more**	46.90	13.92	9.50	0.792	809.33	88.65	9.21	47.14	13.72	9.78	0.756	1109.23	88.65	11.24
	Salicylic acid	46.73	13.52	9.00	0.920	746.23	84.51	7.95	46.49	13.17	8.45	0.822	975.13	84.51	10.11
	Yeast	49.09	14.40	9.72	0.772	877.72	90.37	9.06	48.17	14.00	10.34	0.760	1101.82	90.37	11.35
	Olego-X	47.91	13.75	8.67	0.759	772.94	86.41	8.61	47.08	13.42	8.89	0.759	981.62	86.41	10.42
	Water	37.33	12.17	9.50	0.699	809.33	73.18	7.44	39.09	12.22	8.28	0.600	1109.23	73.18	8.21
15cm–two sides	**Amino more**	46.90	13.53	8.39	0.847	860.74	89.43	9.61	47.50	13.52	9.99	0.811	1094.70	89.43	11.18
	Salicylic acid	45.43	13.04	9.67	0.917	772.81	84.92	8.77	47.11	13.08	9.00	0.952	978.57	84.92	9.99
	Yeast	47.75	13.56	9.11	0.869	881.04	89.61	9.75	48.19	13.74	9.66	0.819	1114.84	89.61	11.38
	Olego-X	45.76	13.19	9.67	0.802	830.93	88.15	9.07	47.05	13.06	9.56	0.776	951.79	88.15	10.33
	Water	37.33	12.04	9.33	0.718	669.84	78.19	7.655	38.56	11.75	8.51	0.644	722.83	78.19	8.03
L .S. D at 5 % level of interaction		**0.143**	**0.165**	**8.78**	**0.019**	**N.S**	**1.707**	**N.S**	**0.060**	**0.019**	**N.S**	**N.S**	**N.S**	**1.098**	**N.S**

Table 4. Effect of plant density and safety compounds foliar spray and their interaction on yield and its components of snap bean plants during 2011 and 2012 seasons.

Seasons		2010/2011							2011/2012						
Treatments		Pod yield (ton/fed)	Pod yield/ plant (g)	No.of pods/ plant	Pod fresh weight (g)	Pod dry weight (g)	Pod length (cm)	Pod diameter (cm)	Pod yield (ton/fed)	Pod yield/ plant (g)	No.of pods/ plant	Pod fresh weight (g)	Pod dry weight (g)	Pod length (cm)	Pod diameter (cm)
Plant density	5cm- one side	7.29	100.37	18.18	5.20	0.482	14.33	0.577	7.88`	95.75`	17.95	5.20	0.479	14.72	0.517
	10cm- two sides	7.04	93.95	18.08	5.15	0.493	13.95	0.594	7.58	87.78	16.82	5.26	0.503	14.11	0.569
	7.5cm-one side	6.12	111.36	19.17	5.71	0.539	14.79	0.669	5.92	109.11	19.29	5.72	0.534	14.79	0.633
	15cm–two sides	5.39	106.97	18.78	5.69	0.556	15.04	0.683	4.94	102.68	18.71	5.79	0.533	15.04	0.646
L .S. D at 5 % level	**of plant density**	**0.164**	**0.335**	**0.040**	**0.286**	**N.S**	**0.263**	**0.025**	**0.552**	**0.156**	**0.153**	**N.S**	**N.S**	**N.S**	**N.S**
Foliar spray	Amino more	7.21	111.97	19.45	5.67	0.526	15.04	0.662	7.50	111.40	19.96	5.73	0.517	14.75	0.632
	Salicylic acid	6.22	98.31	17.79	5.30	0.511	14.25	0.605	6.09	87.81	16.43	5.26	0.506	14.36	0.583
	Yeast	7.51	118.33	20.00	5.81	0.553	15.18	0.650	8.06	116.30	20.90	5.98	0.532	15.16	0.608
	Olego-X	6.41	102.47	18.10	5.56	0.522	14.63	0.664	6.32	102.70	18.34	5.65	0.532	14.66	0.647
	Water	4.95	84.72	17.42	4.86	0.477	13.54	0.573	4.93	75.80	15.32	4.83	0.477	14.11	0.553
L .S. D at 5 % level	**of foliar spray**	**0.280**	**0.349**	**0.095**	**0.362**	**N.S**	**0.242**	**0.024**	**0.529**	**0.150**	**0.184**	**0.377**	**N.S**	**0.541**	**0.036**
5cm- one side	Amino more	8.18	107.48	18.79	5.34	0.468	14.99	0.597	9.45	110.30	19.79	5.44	0.477	15.15	0.593
	Salicylic acid	7.48	98.44	17.57	5.03	0.496	14.10	0.580	8.04	86.30	16.36	4.92	0.485	14.41	0.580
	Yeast	8.46	113.33	19.63	5.67	0.499	15.01	0.593	9.40	109.70	20.89	5.64	0.490	15.28	0.560
	Olego-X	7.39	104.48	17.45	5.25	0.470	14.56	0.590	7.27	96.10	17.35	5.53	0.497	14.28	0.600
	Water	4.96	83.13	17.56	4.73	0.476	12.96	0.527	5.25	76.24	15.34	4.45	0.447	14.11	0.517
10cm- two sides	Amino more	7.91	98.55	18.76	5.47	0.516	14.49	0.613	8.89	97.44	18.15	5.37	0.507	14.17	0.573
	Salicylic acid	6.77	94.39	17.62	4.99	0.474	13.87	0.587	6.72	82.41	15.71	5.24	0.497	14.04	0.570
	Yeast	8.04	102.73	18.89	5.48	0.541	14.41	0.607	9.48	103.80	19.45	5.62	0.523	14.13	0.580
	Olego-X	6.99	94.24	18.02	5.35	0.510	13.96	0.613	7.19	88.53	16.57	5.35	0.533	14.12	0.580
	Water	5.47	77.08	17.09	4.51	0.424	13.04	0.550	5.62	66.73	14.32	4.71	0.453	14.02	0.540
7.5cm-one side	Amino more	6.88	124.98	20.42	6.12	0.545	15.30	0.717	6.30	124.98	21.32	6.09	0.543	15.52	0.680
	Salicylic acid	5.54	95.75	17.94	3.34	0.513	14.30	0.617	4.88	95.75	16.67	5.34	0.513	14.08	0.597
	Yeast	7.28	138.05	21.41	5.13	0.588	15.75	0.687	7.63	138.05	22.62	6.33	0.577	15.74	0.670
	Olego-X	5.99	108.51	18.23	5.95	0.541	14.71	0.717	6.09	108.51	19.88	5.96	0.537	15.09	0.713
	Water	4.88	89.50	17.82	5.03	0.512	13.92	0.607	4.69	89.50	15.95	4.87	0.500	14.02	0.570
15cm–two sides	Amino more	5.88	116.90	19.85	5.90	0.575	15.40	0.720	5.36	116.90	20.59	6.03	0.543	15.34	0.720
	Salicylic acid	5.05	101.89	18.00	5.85	0.561	14.72	0.637	4.70	101.89	16.97	5.52	0.530	14.90	0.637
	Yeast	6.27	119.22	20.08	5.98	0.582	15.54	0.713	5.74	119.22	20.65	6.33	0.537	15.50	0.713
	Olego-X	5.29	107.98	18.23	5.61	0.567	15.30	0.737	4.74	107.98	19.56	5.78	0.547	15.17	0.737
	Water	4.48	88.84	17.19	5.17	0.497	14.25	0.607	4.15	88.84	15.78	5.29	0.507	14.28	0.607
L .S. D at 5 % level	**of interaction**	**0.195**	**0.242**	**0.066**	**N.S**	**N.S**	**N.S**	**N.S**	**0.367**	**0.104**	**0.127**	**N.S**	**N.S**	**N.S**	**N.S**

Table 5. Effect of plant density and safety compounds foliar spray and their interaction on the percentages of some chemical composition of snap bean pods during 2011 and 2012 seasons.

Seasons		2010/2011				2011/2012			
Treatments		**N**	**P**	**K**	**Protein**	**N**	**P**	**K**	**Protein**
Plant density	**5cm- one side**	2.57	0.638	2.22	16.07	7.26	2.58	0.646	2.10
	10cm- two sides	2.60	0.581	2.28	16.26	7.42	2.69	0.642	2.25
	7.5cm-one side	2.85	0.685	2.76	17.82	7.40	3.03	0.734	2.21
	15cm–two sides	2.94	0.695	2.70	18.38	7.53	3.24	0.745	2.19
L .S. D at 5 % level of plant density		**0.056**	**0.045**	**0.086**	**0.347**	**N.S**	**0.037**	**0.611**	**0.085**
Foliar spray	**Amino more**	2.82	0.749	2.76	17.64	7.83	2.93	0.804	2.30
	Salicylic acid	2.71	0.612	2.32	16.92	7.18	2.86	0.664	2.16
	Yeast	2.84	0.672	2.68	17.74	7.66	3.01	0.724	2.26
	Olego-X	2.78	0.657	2.54	17.38	7.51	2.94	0.683	2.22
	Water	2.56	0.558	2.15	15.98	6.84	2.69	0.584	1.98
L .S. D at 5 % level of foliar spray		**0.076**	**0.046**	**0.077**	**0.472**	**0.487**	**0.075**	**0.038**	**0.076**
5cm- one side	**Amino more**	2.62	0.718	2.31	16.40	7.77	2.61	0.749	2.20
	Salicylic acid	2.57	0.616	2.20	16.06	7.00	2.60	0.622	2.12
	Yeast	2.65	0.656	2.24	16.53	7.60	2.61	0.669	2.20
	Olego-X	2.61	0.643	2.30	13.36	7.33	2.61	0.652	2.19
	Water	2.40	0.559	2.05	14.98	6.60	2.45	0.535	1.77
10cm- two sides	**Amino more**	2.65	0.602	2.37	16.57	7.87	2.74	0.759	2.37
	Salicylic acid	2.61	0.582	2.27	16.30	7.10	2.67	0.611	2.24
	Yeast	2.67	0.595	2.35	16.66	7.73	2.76	0.694	2.35
	Olego-X	2.64	0.587	2.32	16.50	7.43	2.71	0.616	2.31
	Water	2.44	0.538	2.10	15.25	6.67	2.59	0.531	2.01
7.5cm-one side	**Amino more**	2.98	0.881	3.16	18.62	8.00	3.09	0.867	2.36
	Salicylic acid	2.79	0.594	2.41	17.42	7.27	2.99	0.693	2.16
	Yeast	2.99	0.710	3.01	18.68	7.80	3.17	0.742	2.25
	Olego-X	2.89	0.672	2.97	18.05	7.47	3.07	0.707	2.23
	Water	2.62	0.567	2.23	16.35	7.00	2.84	0.663	2.05
15cm–two sides	**Amino more**	3.04	0.797	3.20	18.97	7.80	3.28	0.839	2.30
	Salicylic acid	2.86	0.656	2.40	17.89	7.33	3.19	0.731	2.16
	Yeast	3.05	0.726	3.11	19.09	8.20	3.51	0.791	2.24
	Olego-X	2.97	0.726	2.57	18.59	7.73	3.35	0.750	2.15
	Water	2.78	0.568	2.23	17.35	7.10	2.88	0.607	2.08
L .S. D at 5 % level of interaction		**N.S**	**N.S**	**0.027**	**N.S**	**N.S**	**0.052**	**N.S**	**N.S**

3.3 Effect of the interaction:

Effect of the interaction between plant density and safety materials on chemical properties, total protein, N, P and K% in snap bean pod are shown in **Table 5**. It is obvious that plant density at 15 cm on two sides of ridge and spraying plants with yeast, amino more or oligo-x, respectively increased the values of all chemical properties but didn't reach to 5% level of significance except N%, protein% in the second season

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تأثير الكثافة النباتية وبعض المركبات الآمنة على نمو وإنتاجية الفاصوليا الخضراء

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أجريت تجربتان حقليتان خلال الموسم الخريفى لعامى 2012/2011 فى محطة التجارب بقها محافظة القليوبية لدراسة تأثير استخدام أربع كثافات زراعية (5سم-7.5سم على على ريشة واحدة و 10سم -15سم على ريشتى الزراعة) و خمس مواد أمنة وهى امينومور(احماض امينية) -أوليجو اكس(طحالب بحرية)-مستخلص الخميرة -حمض السليسلك بالاضافة الى الماء (كنترول) كرش ورقى على نباتات الفاصوليا وتأثير ذلك على النمو ومحصول الفاصوليا الخضراء صنف بوليستا ومواصفاته الكيماوية والطبيعية. وقد أظهرت النتائج أن الكثافة الزراعية 7.5سم على ريشة واحدة مع الرش بالخميرة-الامينومور -الاوليجو اكس اعطى أعلى قيم لصفات النمو الخضرى وعدد القرون /نبات ومحصول النبات بينما لم تعطى نتائج ايجابية مع طول النبات -قطر الساق – المحصول الكلى للنبات . أعطت الكثافة النباتية 5سم على ريشة واحدة اعلى محصول مع الرش بالامينو مور فى الموسم الاول والرش بالخميرة فى الموسم الثانى . علاوة على ذلك اظهرت الكثافة 15 سم على ريشتين زيادة فى محتوى القرون الكيماوى لكن هذة الزيادة لم تصل الى مستوى المعنويةعند5% فيما عدا محتوى القرون من النيتروجين والبروتين فى الموسم الثاني .علاوة على ذلك زاد محصول القرون زيادة معنوية باستخدام جميع المواد الامنة المستخدمة فى الدراسة وكانت أفضل المعاملات فى ذلك استخدام الخميرة والامينومور ويليهم الاوليجواكس وحمض السلسيلك وعليه يمكن التوصية بزراعة نباتات الفاصوليا على مسافة 5سم على ريشة واحدة والرش بالخميرة او الامينومور للحصول على أفضل محصول من قرون الفاصوليا الخضراء.