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RESPONSE OF SNAP BEAN PLANTS TO DIFFERENT SOURCES OF ORGANIC AND BIO FERTILIZERS UNDER SANDY SOIL CONDITIONS

Nasser T.S. Mansour [1*] and A.M.G. Ewis[2]

1. Veg. Res. Dept., Hort. Res. Inst. Agric. Res. Cent., Egypt

2. Soil and Water Dept., Efficient Product. Inst., Zagazig Univ., Egypt

ABSTRACT

Two field experiments were conducted in sandy soil at the Experimental farm, El-Kassasein Research Station, Ismailia Governorate, during the two successive summer seasons of 2009 and 2010, to study the effect of different organic fertilizer sources; i.e., farmyard, compost and rabbit manure and bio. nitrogen fertilizers (Rhizobium, Nitrobein and their mixture) and their interactions on growth, green pod yield and it's components as well as pods physical and chemical quality of snap bean (*Phaseolus vulgaris* L) cv. Paulista. Obtained results indicated that using rabbit manure at a level of $20m^3$/fad., followed by compost at $30m^3$/fad., reflected high values of all studied measured morphological plant traits as well as fresh and dry weight of shoots and leaves per plant. Also, the same treatments exhibited high total green pods yield and it's components (number and weight of pods/plant and total yield/fad.), physical pods quality and pods chemical constituents. The combination of using rabbit manure at $20m^3$/fad. and pre- sowing seed inoculation with the mixture of tested bio-fertilizers was superior in enhancing all measured vegetative growth parameters, green pods yield and it's components as well as physical and chemical pods quality compared with using each of them solely and the control.

Keywords: Farmyard, compost, rabbit manure, Rhizobium, Nitrobein, snap bean.

INTRODCTION

Snap bean (*Phaseolus vulgaris* L.) is one of the most important legume vegetable crops grown in Egypt for local consumption and exportation. Also it is considered as a main source of protein, carbohydrates and other nutrients in human diets. It is well known that sandy soil had unfavorable physical, chemical and biological conditions which affect adversely on plant growth and productivity.

Thus, addition of organic manures to sandy soil is very important to increase soil fertility, provide energy for micro organisms activity, increasing water holding capacity (Hsieh and Hsu, 1993). Organic manure also, contains many species of living organisms which release many phytohormones such as GA, IAA and CYT which had an stimulation effect on plant growth (Reynders and Vlassak. 1982). In this respect, many investigators reported positive and increasing effect for the application of different organic manure sources on vegetative growth, pods yield and it's components as well as yield quality for different legume crops El-Gizy (1994) on pea, Hanna and El-Gizy (1999) on bean, Santos *et al.* (2004) on snap bean, Soubeih (2005) on pea, Abd El-Hady (2009) on cow pea as well as Nour and Anwar (2009) on pea.

Inoculation of legume seeds pre-sowing with associative nitrogen fixing bacteria led to improvement of plant growth and chemical composition of plant foliage as well as produced yield and it's quality (Rizk and Shafeek, 2000).

Moreover, many researchers reported that, using bio-nitrogen fertilizers in addition to organic fertilizer led to important activation of vegetative growth and productivity of vegetable

* **Corresponding author: Tel. :** +201141706015
E-mail address: dr_khaled-nour@yahoo.com

crops (Ali *et al.*, 2001; Ahmed *et al.*, 2002; El-Bassiony, 2002; Solaiman and Rabbani, 2006 ; Susheela *et al.*, 2007; Gharib *et al.*, 2009; El-Desuki *et al.*, 2010).

Therefore, this experiment was conducted to study the effect of organic manure sources and inoculation bean seeds pre sowing with nitrogen fixing bio-fertilizers on vegetative growth, chemical constituents of plant foliage, productivity and pod quality of snap bean grown under sandy soil condition.

MATERIALS AND METHODS

The present work was carried out during two successive summer seasons of 2009 and 2010 at the Experimental Farm, El Kassasein Research Station, Ismailia Governorate, to study the effect of two sources of biofertilizers; i.e., Rhizobium and Nitrobein as well as the combination between Rhizobium and Nitrobein in addition to the control, and three different sources of organic manure (farmyard manure, compost manure and rabbit manure) and the interactions between bio and organic fertilizers on growth, yield and chemical constituents of snap bean plants (*Phaseolus vulgaris* L.) cv. Paulista grown under sandy soil conditions. The physical and chemical properties of the experimental soil are given in Table1.

This experiment included 12 treatments, which were the combinations between four biofertilizer treatments and three different sources of organic manure. Treatments were arranged in a split plot design with three replicates, organic manure sources treatments were assigned at random in the main plots, while sub-plots were devoted to biofertilizer treatments.

The chemical analyses of used organic manures were shown in Table 2. Also, nitrogen amount in each of one m^3 of different organic manure was shown in Table 3.

Seeds of snap bean cv. Paulista were obtained from Horticulture Research Institute, Agricultural Research Center, Egypt and sown on March 14th and 15th in 2009 and 2010, seasons respectively. The area of experimental plot was $9m^2$ (5 rows x 0.6m width x 3m length). Seeds were sown in hills 15 cm apart on one side of the ridge and two seeds per hill. Organic manure treatments were applied at soil preparation in the middle of row and covered with 10cm soil. All treatments received 50% of recommended nitrogen fertilization level; i.e., 120 kg/ fad. Ammonium nitrate (33.5%N) was added in two equal applications at soil preparation and the second at 20 days after sowing. The normal cultural practices were followed according to Ministry of Agriculture recommendations for snap bean.

Biofertilizers were mixed with wet seeds by adding Arabic gum solution before sowing and the treated seeds were, directly, sown in the same day. The used biofertilizers were Rhizobium (*Rhizobium phaseoli*) as nitrogen fixing bacteria and Nitrobein (contains *Azotobacter* sp. and *Azospirillum lipoferum*) as nitrogen fixing bacteria. The source of Rhizobium and Nitrobein was the General Organization for Agriculture Equalization Foundation (GOAEF), Ministry of Agriculture, Egypt.

The treatments carried out in this study were as follows:

Main plots (organic manure sources)

1. Farmyard manure at 30 m^3/fad. (81.6 kg nitrogen),
2. Compost manure at 30 m^3/fad. (81.9 kg nitrogen), and
3. Rabbit manure at 20 m^3/fad. (80.2 kg nitrogen)

Sub-plots (soil application)

1. Control (untreated) ,
2. Rhizobium (*Rhizobium phaseoli*) at rate of 1kg/fad.,
3. Nitrobein (*Azotobacter* sp., *Azospirillum lipoferum*) at rate of 1kg/fad., and
4. Combination between Rhizobium and Nitrobein.

Data Recorded

Growth parameters

A random sample of three plants was taken from every plot at 60 days after sowing in both seasons of study for measuring the growth characters of snap bean plants expressed as: plant height (cm), number of both leaves and branches/ plant, total dry weight (leaves + branches) / plant (g), then samples were dried in an electric oven at 70°C till constant weight.

Table 1. The physical and chemical properties of the tested soil during 2009 and 2010 seasons

Physical properties	2009	2010	Chemical properties	2009	2010
Sand (%)	96.5	95.6	**Organic matter (%)**	0.03	0.08
Silt (%)	1.7	1.6	**Available K (ppm)**	52	64
Clay (%)	1.8	2.8	**Available P (ppm)**	5.5	6.2
FC (%)	6.5	6.8	**Available N (ppm)**	5.4	6.9
WP (%)	2.4	2.5	**Calcium carbonate (%)**	0.18	0.26
Available water	4.1	4.3	**pH**	8.1	8.1
Water holding capacity (%)	13.8	14.5			

FC: Field capacity WP: Wilting point

Table 2.Chemical analysis of used organic manures during 2009 and 2010 seasons

Type of analysis	Kind of manure					
	FYM		Compost		Rabbit	
Season	1^{ST}	2^{ND}	1^{ST}	2^{ND}	1^{ST}	2^{ND}
O.M.%	30.22	33.28	27.45	28.32	50.88	52.8
N%	0.56	0.63	0.93	1.03	1.59	1.65
P%	0.31	0.36	0.45	0.52	0.43	0.51
K%	0.93	0.96	1.08	1.21	1.26	1.29

Table 3. Nitrogen amount in different organic manures (Kg/m^3)

Kind of manure	2009	2010
$1m^3$ FYM = (486kg)	2.72	3.06
$1m^3$ Compost = (380kg)	2.73	2.91
$1m^3$ Rabbit = (243kg)	3.86	4.01

Yield and it's components

The total pod yield was determined from collecting all harvesting green pods during the harvesting season and the total pod yield was recorded as ton/fad., average number of pods/plant, average weight of green pods/plant was calculated by number of pods by number of plant per plot, average pod weight and dry matter of pods (%).

Pod chemical constituents

Dried pods were finely ground and digested with sulfuric acid and percholoric acid (3:1). Nitrogen, phosophorus and potassium (%) were determined according to the method described by Kock and Mc-Meekin (1924), Murphy and Riley (1962) and Brown and Lilliland (1946), respectively.

Total crude protein

The previously determined nitrogen of dry pods was used for calculating total crude protein by multiplying N values by 6.25 (A.O.A.C., 1980).

Statistical Analysis

The collected data were subjected to statistical analysis of variance using the normal (F) test and the means separation were compared by using Least Significant Difference (L.S.D.) at 5% level according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Vegetative Growth Characters

Effect of organic manures

Data recorded in Table 4 show clearly the effect of organic manure sources; i.e., farmyard, compost and rabbit manure on snap bean plant height, number of leaves and branches per plant as well as dry weight of branches, and leaves during both seasons of study.

Such data in Table 4 revealed that, application of rabbit manure at rate of $20m^3$/fad. increased significantly all the forementioned vegetative growth traits compared with the application of $30m^3$/fad., either from farmyard manure or compost. Obtained results are true during both seasons of study. In addition, using compost at $30m^3$/fad. ranked the second in all growth measurements followed by using farmyard manure .

Such increments in morphological growth aspects due to using rabbit manure may be attributed to the highest nitrogen and mineral elements content compared to farmyard manure and compost. Also, such increments may be due to the rapid decompose of rabbit manure and release of nutrient elements available for plant absorption and in true effects, positively a plant growth rate.

Obtained results are coincided with those reported by El-Gizy (1994) on pea, Hanna and El-Gizy (1999) on bean, Santos *et al.* (2004) on snap bean, Soubeih (2005) on pea, Abd El-Hady (2009) on cow pea and Nour and Anwar (2009) on pea.

Effect of bio-fertilizers

Concerning the effect of bio-fertilizers (Rhizobium, Nitrobein and their mixture), data in Table 4 indicated that pre-sowing inoculation of seeds with Rhizobium, Nitrobein or their mixture increased significantly all vegetative growth parameters except the number of branches per plant which was not significantly affected compared to the control treatment during both seasons of growth. Moreover, using the mixture of Rhizobium and Nitrobein, reflected the highest increment in all studied growth aspects compared with using each of them alone in seed inoculation.

Mean while, inoculation of seeds pre-sowing with Nitrobein was more effective on stimulating plant growth (plant height, number of leaves and branches/plant as well as dry weight of different plant parts) compared with Rhizobium inoculation treatment.

In this connection, the stimulating effect of bio-fertilizers may be due to it's ability for fixing nitrogen element from atmosphere which is the main nutrient element for vegetative plant growth.

Obtained results are similar to those reported by Ali *et al.* (2001); Ahmed *et al.* (2002); El-Bassiony (2002); Solaiman and Rabbani (2006); Susheela *et al.* (2007); Gharib *et al.* (2009) and El-Desuki *et al.* (2010).

Table 4. Effect of organic manure sources and bio fertilizers on growth characters of snap bean during 2009 and 2010 seasons

Treatments	Growth characters									
	Season 2009					Season 2010				
	Plant height (cm)	Branche No./ plant	Leaf No./ plant	Leav dry weight (g)	Branche dry weight (g)	Plant height (cm)	Branche No./ plant	Leav No./ plant	Leav dry weight (g)	Branche dry weight (g)
F.Y. manure	42.25	3.41	22.92	6.42	3.88	37.33	3.16	20.58	6.06	3.31
Compost	45.33	4.08	25.16	7.78	5.26	38.16	3.42	22.33	6.31	4.07
Rabbit manure	47.75	4.67	27.00	8.26	5.44	42.25	3.75	24.83	6.50	4.44
L.S.D at 5%	2.40	0.76	0.64	0.40	0.50	1.22	0.19	0.57	0.31	0.21
Control	42.89	4.11	21.89	5.94	3.68	35.00	3.00	20.78	4.38	2.96
Rhizobium	44.44	4.00	23.67	6.88	4.45	37.78	3.67	21.89	5.36	3.46
Nitrobein	45.33	4.11	26.33	8.03	4.94	40.78	3.45	23.22	7.17	3.98
Mix	47.78	4.00	28.22	9.09	6.39	43.45	3.66	24.45	8.26	5.38
L.S.D at 5%	1.97	N.S.	1.33	0.34	0.36	1.32	N.S.	1.47	0.46	0.31

Mix: (Rhizobium+ Nitrobein) N.S.: Not significant

Effect of the interactions

As for the effect of the interactions among the used organic manures and bio-fertilizers, data in Table 5 show that irrespective of the dry weight of branches and leaves per plant which were significantly affected due to the interaction treatment, all the studied growth aspects were not significantly affected during both seasons of study.

In this regard, application of rabbit manure at $20m^3$/fad. during soil preparation and pre-sowing seed inoculation with the mixture of tested bio-fertilizers exhibited high growth values compared with other interaction treatments during the two seasons.

Total Green Pod Yield and it's Components

Effect of organic manures

Data presented in Table 6 show the effect of organic manures and bio-fertilizers on total green pod yield and it's components expressed as number and weight of pods per plant, average pod length and weight as well as total produced yield per faddan. Such data revealed that there were significant differences in total green pod yield and it's components among the tested organic fertilizers during both seasons of study.

In this connection, application of $20m^3$/fad. rabbit manure as soil amendment before sowing during soil preparation increased positively and significantly the total produced yield and it's components compared with using compost or farmyard manure at $30m^3$/fad. from each of them.

Obtained results were connected with the increments in all vegetative growth parameters (Table 4) and also may be due to the more and fast decomposition of rabbit manure and realize of macro- and micro- nutrients which available to be uptake by growing plants which in turn affect it's growth compared to compost and farmyard manure. In this respect, similar findings were reported by El-Gizy (1994) on pea, Hanna and El-Gizy (1999) on bean, Santos *et al.* (2004) on snap bean, Soubeih (2005) on pea, Abd El-Hady (2009) on cow pea and Nour and Anwar (2009) on pea.

Effect of bio-fertilizers

With regard to the effect of bio-fertilizers. It is obvious from the data in Table 6 that the total yield and it's components; i.e., number and weight of green pods per plant, average pod weight and length as well as total produced yield per faddan were significantly increased as a result

Table 5. Effect of organic manure sources and bio fertilizers interactions on growth characters of snap bean during 2009 and 2010 seasons

Treatments		Growth characters									
		Season 2009					Season 2010				
		Plant height (cm)	Branche No./ plant	Leaf No./ plant	Leaf dry weight (g)	Branche dry weight (g)	Plant height (cm)	Branche No./ plant	Leaf No./ plant	Leaf dry weight (g)	Branche dry weight (g)
F.Y. manure	Control	40.00	3.33	19.67	4.64	3.16	33.33	3.00	18.33	4.04	2.70
	Rhizobium	42.33	3.33	21.33	5.76	3.71	35.33	3.33	19.67	4.96	2.97
	Nitrobein	42.33	3.67	24.00	7.13	3.79	39.67	3.00	21.33	6.81	3.34
	Mix	44.33	3.33	26.67	8.14	4.87	41.00	3.33	23.00	8.45	4.25
Compost	Control	43.67	4.33	22.33	6.51	3.71	34.33	3.00	20.33	4.53	2.66
	Rhizobium	44.67	4.00	24.00	7.38	4.82	36.33	3.67	21.67	5.31	3.56
	Nitrobein	46.00	4.00	26.33	8.04	5.45	39.33	3.67	23.67	7.38	4.27
	Mix	47.00	4.00	28.00	9.18	7.08	42.67	3.33	23.67	8.02	5.80
Rabbit manure	Control	45.00	4.67	23.67	6.66	4.16	37.33	3.00	23.67	4.57	3.51
	Rhizobium	46.33	4.67	25.67	7.51	4.81	41.67	4.00	24.33	5.80	3.84
	Nitrobein	47.67	4.67	28.67	8.91	5.58	43.33	3.67	24.67	7.31	4.34
	Mix	52.00	4.67	30.00	9.96	7.23	46.67	4.33	26.67	8.31	6.09
L.S.D at 5%		N.S.	N.S.	N.S.	0.60	0.62	N.S.	N.S.	N.S.	0.80	0.55

Mix: (Rhizobium+ Nitrobein) N.S.: Not significant

Table 6. Effect of organic manure sources and bio fertilizers on yield and it's components of snap bean during 2009 and 2010 seasons

Treatments	Yield and its components									
	Season 2009					Season 2010				
	Pod No./ plant	Pod length (cm)	Ave. pod weight (g)	Plant yield (g)	Total yield (ton/fad.)	Pods No./ plant	Pod length (cm)	Ave. pod weight (g)	Plant yield (g)	Total yield (ton/ fad.)
F.Y. manure	26.41	15.77	3.42	91.03	4.096	24.17	14.85	3.43	83.22	3.745
Compost	28.41	14.85	3.61	102.88	4.630	25.16	14.77	3.71	93.58	4.211
Rabbit manure	30.83	15.80	4.05	125.41	5.643	27.16	15.77	3.95	108.10	4.865
L.S.D at 5%	1.76	0.44	0.26	11.44	0.515	1.25	0.56	0.30	6.82	0.307
Control	24.66	15.33	3.51	87.09	3.919	21.89	14.57	3.47	75.75	3.409
Rhizobium	27.11	15.50	3.54	96.70	4.351	23.67	15.30	3.59	85.51	3.848
Nitrobein	30.56	15.10	3.64	111.52	5.018	27.33	15.20	3.77	102.94	4.632
Mix	31.89	15.97	4.08	130.45	5.871	29.11	15.47	3.97	115.68	5.206
L.S.D at 5%	1.91	0.42	0.32	12.12	0.545	1.81	0.46	0.30	8.25	0.371

Mix: (Rhizobium+ Nitrobein)

of pre-sowing seed treatments with tested bio-fertilizers (Rhizobium, Nitrobein and their mixture) compared with the control (without inoculation). Obtained results are true during both seasons of study.

In this respect, pre-sowing seed inoculation with the mixture of Rhizobium and Nitrobein reflected high values of total green pod yield and it's components compared with using of Rhizobium and Nitrobein each of them solely during both seasons of study. In addition, pre-sowing seed inoculation with Nitrobein exhibited higher total yield and satiated in the second order after the using of tested bio-fertilizers mixture compared with using Rhizobium and the control treatment.

Such increments in total yield and it's components as a result of using Nitrobein and it's mixture with Rhizobium may be due to it's enhancing effect on vegetative growth of plant (Table 4), and in turn increased the total produced yield and it's components. Such stimulating effect of bio-fertilizer on total green pod yield and it's components are similar to those reported by Ali *et al.* (2001); Ahmed *et al.* (2002); El-Bassiony (2002); Solaiman and Rabbani (2006); Susheela *et al.* (2007); Gharib *et al.* (2009) and El-Desuki *et al.* (2010).

Effect of the interactions

Data in Table 7 indicated that pre-sowing seed inoculation with mixture of Rhizobium and Nitrobein combined with the application of $20m^3$/fad. of rabbit manure during soil preparation increased insignificantly all measured yield parameters compared with other interaction treatments during the two seasons of growth. However, such increases reached the level of significance in case of average pod length only during the two seasons of study.

Chemical Composition of Pods

Effect of organic manures

As for the effect of organic manures, data in Table 8 show clearly that there were significant differences among the different sources of organic manure in all assayed macro-elements and crud protein percentage during the two seasons of growth. In this connection, the highest value of each of total nitrogen, potassium and total crud protein percentage was recorded as a result of using $20m^3$/fad., rabbit manure, while, the highest value of phosphorus percentage was obtained as a result of using $30m^3$ compost/fad. The increment in nitrogen, potassium and crud protein percentage in case of rabbit manure may be due to it's high content of nitrogen and other elements which become quickly available to plant uptake and consequently migrate to storage organs (pods).

Obtained results were similar to those reported by El-Gizy (1994) on pea, Hanna and El-Gizy (1999) on bean, Santos *et al.* (2004) on snap bean, Soubeih (2005) on pea, Abd El-Hady (2009) on cow pea and Nour and Anwar (2009) on pea.

Effect of bio-fertilizers

Data in Table 8 indicated that pre-sowing seed inoculation with Rhizobium, Nitrobein and their mixture increased significantly all the assayed macro-elements (NPK) and the crud protein percentage compared to the control treatment. Obtained results were true during both seasons of study.

In addition, high nitrogen and phosphorus percentages were recorded as a result of pre-sowing seed inoculation with Nitrobein either solely or mixed with Rhizobium without significant differences. While, high potassium percentage during both seasons and crud protein during the second season were noticed due to using the mixture of bio-fertilizers. However, using Nitrobein alone in inoculation, reflected high protein percentage during the first season. Similar results were reported by Ali *et al.* (2001); Ahmed *et al.* (2002); El-Bassiony (2002); Solaiman and Rabbani (2006); Susheela *et al.* (2007); Gharib *et al.* (2009) and El-Desuki *et al.* (2010).

Effect of the interactions

As for the effect of the interactions, data in Table 9 indicated that, total nitrogen, phosphorus, potassium and crud protein percentage were significantly affected due to the interaction treatments among the organic manure sources and bio-fertilizers. In this regard, high value for each of all determined chemical attributes were recorded in case of the combination between using

Table 7. Effect of organic manure sources and bio fertilizers interactions on yield and it's components of snap bean during 2009 and 2010 seasons

Treatments		Yield and it's components									
		Season 2009					Season 2010				
		Pod No./ plant	Pod length (cm)	Ave. pod weight (g)	Plant yield (g)	Total yield (ton/ fad.)	Pod No./ plant	Pod length (cm)	Ave. pod weight (g)	Plant yield (g)	Total yield (ton/fad.)
F.Y. manure	Control	22.33	15.3	3.12	69.73	3.138	20.33	13.6	3.22	64.66	2.910
	Rhizobium	25.33	16.0	3.03	76.66	3.450	23.00	15.5	3.30	76.01	3.420
	Nitrobein	28.67	15.6	3.65	104.36	4.696	25.67	15.3	3.50	89.08	4.009
	Mix	29.33	16.2	3.87	113.37	5.102	27.67	15.0	3.72	103.15	4.642
Compost	Control	24.33	15.4	3.57	87.08	3.919	22.33	14.9	3.57	79.47	3.576
	Rhizobium	26.67	14.7	3.68	98.02	4.412	22.67	14.7	3.58	81.12	3.650
	Nitrobein	30.33	14.3	3.27	99.36	4.471	27.33	14.4	3.76	102.66	4.620
	Mix	32.33	15.0	3.92	127.06	5.718	28.33	15.1	3.94	111.09	4.999
Rabbit manure	Control	27.33	15.3	3.84	104.45	4.700	23.00	15.2	3.61	83.13	3.741
	Rhizobium	29.33	15.8	3.92	115.41	5.193	25.33	15.7	3.90	99.39	4.473
	Nitrobein	32.67	15.4	4.00	130.84	5.888	29.00	15.9	4.04	117.07	5.268
	Mix	34.00	16.7	4.44	150.93	6.792	31.00	16.3	4.24	132.81	5.977
L.S.D at 5%		N.S.	0.72	N.S.	N.S.	N.S.	N.S.	0.80	N.S.	N.S.	N.S.

Mix : (Rhizobium+ Nitrobein) N.S.: Not significant

Table 8. Effect of organic manure sources and bio fertilizers on chemical constituents of snap bean during 2009 and 2010 seasons

Treatments	Chemical constituents (%)							
	Seasons 2009				Seasons 2010			
	N	P	K	Protein	N	P	K	Protein
F.Y. manure	2.75	0.45	3.69	17.20	2.69	0.44	3.65	16.87
Compost	2.82	0.48	3.71	17.67	2.75	0.47	3.70	17.23
Rabbit manure	2.92	0.47	4.03	18.25	2.83	0.46	3.80	17.72
L.S.D at 5%	0.05	0.02	0.07	0.04	0.08	0.04	0.03	0.03
Control	2.56	0.45	3.56	15.94	2.49	0.43	3.52	15.60
Rhizobium	2.83	0.47	3.75	17.69	2.72	0.46	3.75	16.98
Nitrobein	2.98	0.48	3.74	18.67	2.89	0.47	3.66	18.09
Mix	2.96	0.48	4.19	18.53	2.95	0.47	3.95	18.43
L.S.D at 5%	0.08	0.01	0.07	0.06	0.07	0.03	0.07	0.07

Mix : (Rhizobium+ Nitrobein)

Table 9. Effect of organic manure sources and bio fertilizers interactions on chemical constituents of snap bean during 2009 and 2010 seasons

Treatments		Chemical constituents (%)							
		Season 2009				Season 2010			
		N	P	K	Protein	N	P	K	Protein
F.Y. manure	Control	2.53	0.44	3.45	15.66	2.46	0.42	3.45	15.51
	Rhizobium	2.71	0.47	3.52	16.94	2.61	0.46	3.58	16.29
	Nitrobein	2.93	0.44	3.64	18.37	2.84	0.43	3.70	17.75
	Mix	2.85	0.47	4.14	17.84	2.87	0.45	3.89	17.94
Compost	Control	2.54	0.47	3.52	15.89	2.49	0.44	3.52	15.60
	Rhizobium	2.82	0.50	3.71	17.65	2.71	0.48	3.77	16.89
	Nitrobein	2.99	0.50	3.64	18.71	2.89	0.50	3.58	18.06
	Mix	2.95	0.47	3.98	18.42	2.93	0.46	3.95	18.37
Rabbit manure	Control	2.61	0.43	3.70	16.27	2.51	0.44	3.58	15.70
	Rhizobium	2.95	0.45	4.02	18.47	2.84	0.45	3.89	17.75
	Nitrobein	3.03	0.49	3.95	18.94	2.95	0.48	3.70	18.46
	Mix	3.09	0.50	4.45	19.33	3.04	0.49	4.02	18.99
L.S.D at 5%		0.15	0.02	0.12	0.10	0.12	0.06	0.12	0.12

Mix: Rhizobium+ Nitrobein

$20m^3$/fad. rabbit manure added during soil preparation combined with pre-sowing seed inoculation with the mixture of Rhizobium and Nitrobein. Such results were true during both seasons of study.

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استجابة نباتات الفاصوليا لمصادر مختلفة من الأسمدة العضوية والحيوية تحت ظروف الأراضى الرملية

ناصر توفيق سليمان منصور[1] - أشرف محمد جودة عويس[2]

١ - قسم بحوث الخضر - معهد بحوث البساتين- مركز البحوث الزراعية - مصر

٢ - قسم الأراضى والمياة - معهد الكفاية الإنتاجية - جامعة الزقازيق - مصر

أجريت تجربتان حقليتان فى المزرعة البحثية بمحطة بحوث البساتين بالقصاصين بمحافظة الإسماعيلية خلال الموسم الصيفى لعامى ٢٠٠٩ و ٢٠١٠ وذلك لدراسة تأثير مصادر مختلفة من التسميد العضوى (سماد المزرعة - الكومبوست- سماد الأرانب) والتلقيح بالأسمدة الحيوية المثبتة للنتروجين (ريزوبيوم- نيتروبين) والخلط مابين الإثنين والتفاعل بينهم على النمو، والمحصول الأخضر للقرون، والمحصول الأخضر الكلى ومكوناته، وكذلك مواصفات القرون، والتركيب الكيماوى لمحصول الفاصوليا صنف بوليستا، أوضحت النتائج أن استخدام سماد الأرانب بمعدل ٢٠م^3/فدان يليه سماد الكومبوست بمعدل ٣٠م^3/فدان سجلت أعلى القيم بالنسبة للصفات المورفولوجية للنبات متمثلة فى ارتفاع النبات ، وعدد الأفرع ، وعدد الأوراق للنبات ، وكذلك الوزن الغض والجاف للأفرع والأوراق ، وأيضا سجلت نفس المعاملات أعلى القيم بالنسبة للمحصول الأخضر الكلى ومكوناتة (عدد ووزن القرون/النبات ، والمحصول الكلى/نبات ، والقياسات الفيزيائية للقرون ، والمحتوى الكيماوى لقرون الفاصوليا) كما سجلت معاملة التفاعل بين سماد الأرانب بمعدل ٢٠م^3/فدان وتلقيح البذور بمخلوط الأسمدة الحيوية (ريزوبيوم+ نيتروبين) أفضل النتائج بالنسبة لقياسات النمو الخضرى ، ومحصول القرون الأخضر ومكوناته، وكذلك الصفات الفيزيائية والمحتوى الكيماوى للقرون بالمقارنة باستخدام أى منهما منفردا أو الكنترول.