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Effect of Different Sources of Organic Manure on Production of Snap Bean Cultivars

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ABSTRACT

An experimental trial was carried out in the two successive seasons of 2015 and 2016 at the Experimental Station of National Research Centre in Nubaria region, North Egypt to study the effect of different sources of organic manure (Compost, chicken and cattle) of two snap bean cultivars (Bronco or Paulista) to improve quantity and quality of pods production. Results of this work showed that the best values of snap bean plant criteria as well as the contents of N, P, K, protein and carbohydrates in pods of snap bean were obtained in plants supplied with compost manure. On the contrary, the lowest plant growth, total yield and pods criteria were obtained by fertilizer plant by cattle manure. The same trend found in bronco cultivar compared to paulista cultivar. It can be generally concluded that the compost manure fertilizer can be recommended for producing of snap bean plant by using bronco cultivar.

Key words: Organic manure, snap bean cultivars, yield

Introduction

Snap bean is one of the most important food crops in Egypt and consumed as a cooked vegetable either as dry seeds or green pods. It plays an important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals and is considered one of the most important vegetable crops cultivated in Egypt for exportation and for local market as well (Ahmed, 2015). Increasing yield of snap bean in Egypt is highly recommended to meet the increasing demand **(**Abdel Hakim *et al.* 2012).

In view of the widely diverse cropping systems under which snap bean is grown, commercial yields are very variable and often fall for below the genetic potential of the species (Graham and Ranalli, 1997). Hundreds of varieties of snap bean are now available for the greenhouses and open field. They range widely in size, shape, color, flavor, disease resistance and season of maturity. However, many previous workers indicated that varieties of snap bean plants play a great role for improving the growth and productivity (Rembiałkowska *et al.,* 2005 and Zaki *et al.,* 2012). However, Dahmardeh *et al.* (2010) reported that Aljazaeri of bean cultivar surpassed all other cultivars in terms of biological and economical yields. As such, the cultivars had a significant effect on economical and biological yields. Thus, the development of tolerant cultivar becomes an efficient and economical production strategy.

Using organic manure fertilizers can serve as an alternative practice to use N mineral fertilizers (Naeem *et al.,*2006), Which play an important role in enhancing the physical properties of the soil (Ros *et al.,* 2006 ; Dauda *et al.,* 2008 and Bougnom *et al.,* 2010). It contributes to the increasing the organic soil carbon content and raising the productivity of the soil, by increasing the beneficial microorganisms in the soil Activity (Remesh, 2008 and Hepperly *et al.,* 2009). Converting forms of organic nutrient's to mineral forms, which become available to plants, such as slow-release fertilizers (Marschner, 1995; Shafeek *et al.,* 2001; Rizk *et al.,* 2003 and Murphy 2014). Another study demonstrated that organic fertilizer increased macro- elements and micro- elements compared to non-organic fertilizer treatment (Shaddad, 2009). Cattle and chicken manure application to agricultural land is an economic and environmentally sustainable mechanism in order to increase crop production

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(Ahmed, 2010). Furthermore, chicken manure contains high levels of nutrients is relatively available, especially N, which is essentially required for plant growth (Amanullah *et al.,* 2007). However, Evanylo *et al.* (2008) found that compost use affected bulk density, porosity and water-holding capacity of the soil such that losses of nitrogen and phosphorus. In the same trend, Bybordi and Malakouti (2007) found that the organic fertilizers such as animal manure, municipal solid waste composts and vermicomposts were lead to sustainable food production of red onion. Luna Zendejas *et al.* (2011) showed that (*Phaseolus vulgaris* L.) grown with the application of compost recorded the highest growth of control (without compost). Similar results found by Mahmoud *et al.* (2013) found that the vegetative growth parameters of pea plant were significantly increased by raising the level of compost application in sandy soil. In the same respect, Seran and Suthamathy (2013) showed that the increase of cattle manure (up to 15 t/ha) increased the number of pods, weight of pods and kernels per plant, 100-kernel weight, shelling % and total yield of groundnut plants. However, Aisha *et al.* (2014) reported that adding organic compost manure (produced from recycling the agriculture residues) at high rates (20 m^3/fed.) had a significant effect on growth characters, i.e. plant length, number of leaves/plant, fresh and dry weight/plant as well as root fresh and dry weight and its components (root length and diameter). Also, gave the highest percentage of protein, N, P, K and Fe ppm as well as total carbohydrate % of turnip plants. Furthermore, Shafeek *et al.* (2015) showed that the addition of organic manure at a higher level (3.2 ton/fed.) improved plant growth, fruit yield, physical and chemical characters of fruit quality of cantaloupe plants.

Therefore, this work was established to furnish knowledge and to have some understood about some basic factors and important tools such as the use of different sources of organic manure and cultivars to improve quantity and quality of snap bean production.

Materials and Methods

The present work was carried out under plastic house during two successive winter seasons of 2015 and 2016 at the Experimental Station of National Research Centre in Nubaria region, North Egypt to study the effect of three sources of organic manure(Compost, chicken and cattle) on the growth, yield and pods quality of two snap bean varieties (Bronco or Paulista).The physical and chemical properties of the soil are presented in Table 1.

Table 1: Physical and chemical properties of the experimental soil

Physical properties							
Sand		Clay	Silt	Texture	F.C. %	W.P. %	
90.08		9.26	0.66	Sandy	16.57	5.25	
Chemical analysis							
E.C. M/m	pH	Meq/ L					
		Ca	Mg	Na	K	Hco3	Cl
1.7	8.2	7.02	0.527	0.982	0.31	1.3	0.566

Treatments were as follows:

1- Compost (20 m^3/fed.).
2- Chicken manure (16 m^3/fed.)
3- Cattle manure (30 m^3/fed.).

NPK fertilizer i.e. ammonium sulphate (20.6%N), calcium super phosphate (16% P_2O_5) and potassium sulphate (48% K_2O) were added at rates of 150, 100 and 50 kg/fed. respectively. The phosphorus fertilizer was added during soil preparation and before seed sowing. The nitrogen and potassium fertilizers were divided into two equal parts and the first addition added during the soil preparation but the second added 35 days after seed sowing. Seeds were sown on the first week of October in both seasons. Seeds of snap bean cv. Bronco or Paulista were obtained from Horticultural Research Institute, Agriculture Research Center, Egypt. The design of the experiments were split plot with three replicates, sources of organic manures were arranged in the main plots but snap bean cultivars were distributed within the sub plots. The area of experimental plot was 10.5 m^2. Every plot consisted of 5 dripper lines 3m in length and 0.7m in width. Seeds were sown in hills 20 cm apart on

one side of dripper lines and two seeds per hill. The normal agriculture practices of snap bean under drip irrigation system were followed according to the recommendations of Agriculture Ministry.

The chemical analysis of organic manure used in this study is shown in Table 2.

Table 2: Chemical composition of the applied organic manures

Organic manure	ph	EC	Percentages				ppm			
			C	N	P	K	Fe	Mn	Zn	Cu
Cattle	7.5	14.1	7.9	0.32	0.41	0.85	650	135	105	11
Chicken	6.5	5.7	32	2.95	1.14	1.80	168	241	110	92
Compost	7.0	5.0	41	2.00	0.60	6.00	7900	1904	4.75	20

Data recorded:

Growth Characters:

A random sample of ten plants was taken from every plot at 45 days after sowing in both seasons of study for measuring the growth characters of snap bean plants expressed as follows: Plant height, number of leaves and branches, fresh weight g/ plant of leaves, branches and whole plant and dry weight g/ plant of leaves, branches and whole plant.

Total yield and its components:

At harvesting stage (60 days from seeds sowing for both seasons), the total green pods from each treatment were collected along the harvesting season (40 days) and 15 of snap bean plants from each treatment were randomly taken to study the yield and its components including: pods (length, diameter, no./plant and weight) and yield (tons/fed.).

Chemical analysis:

Fresh pods of snap bean were dried in oven at (70°C) to constant weight and dried sample was taken for chemical analysis. Nitrogen was determined on the basis of Kjeldal-N. Phosphorus was determined by spectrophotometer, while potassium was determined by flam and total protein content (N×6.25) according to the method described in the AOAC (2000). Total carbohydrates were determined calorimetrically by spectrophotometer according to Dubois *et al.* (1956).

Statistical analysis:

The obtained data of experiments were subjected to the statistically analysis of variance procedure and means were compared using the LSD method at 5% level of significance according to Gomez and Gomez (1984).

Results and Discussion

Vegetative growth characters of snap bean plant:

1 Effect of different sources of organic manure:

Data presented in Table (3) showed that all vegetative growth characters of snap bean plant (Plant height, number of leaves and branches, fresh weight g/ plant of leaves, branches and whole plant and dry weight g/ plant of leaves, branches and whole plant) increased with compost treatment as compared to other treatments during two successive seasons 2015 and 2016. This increment might be due to residue returned as compost supplies a better soil environment and an abundant carbohydrate and nitrogen source that benefits the growth of beneficial microorganisms (Zayed and Abdel-Motaal, 2005 and Bougnom *et al.* 2010). Therefore, residue returned as compost results in enhanced soil enzyme activity by increasing the amount of enzymes and their substrates in the soil

(Ros *et al.,* 2006). However, Evanylo *et al.* (2008) indicated that compost use affected bulk density, porosity and ability to keep the water of the soil. These results were in agreement in part with the findings of Luna Zendejas *et al.* (2011) showed that (*Phaseolus vulgaris* L.) grown with the application of compost recorded the highest growth of control. In the same trend, Mahmoud *et al.* (2013) on pea and Shafeek *et al.* (2015) on cantaloupe found that the vegetative growth parameters of pea plant were significantly increased by raising the level of compost application in sandy soil.

Table 3: Effect of different sources of organic manure, cultivars and their interaction on vegetative growth characters of snap bean plant during 2015 and 2016 seasons

Treatments		Plant height (cm)		No. of Leaves		No. of Branches	
		2015	2016	2015	2016	2015	2016
A- Different sources of organic manures :							
Compost		49.0	45.3	15.0	13.8	7.8	7.0
Chicken manure		43.8	42.0	12.7	11.7	7.3	6.0
Cattle manure		39.0	37.8	11.1	9.8	5.8	4.8
L.S.D at 5%		1.78	1.81	0.61	0.42	0.46	0.27
B- Cultivars:							
Bronco		46.8	46.2	15.5	14.0	7.7	6.4
Paulista		41.1	37.2	10.3	9.6	6.3	5.4
L.S.D at 5%		1.51	0.92	0.50	0.27	0.43	0.27
C- Different sources of organic manures × Cultivars :							
Compost	Bronco	51.7	50.0	17.7	16.7	8.3	7.3
	Paulista	46.3	40.7	12.3	11.0	7.3	6.7
Chicken manure	Bronco	46.7	47.0	15.3	14.0	8.0	6.7
	Paulista	41.0	37.0	10.0	9.3	6.7	5.3
Cattle manure	Bronco	42.0	41.7	13.5	11.3	6.7	5.3
	Paulista	36.0	34.0	8.7	8.3	5.0	4.3
L.S.D at 5%		N.S.	N.S.	N.S.	0.47	N.S.	N.S.

Table 3: *Cont.*

Treatments		Fresh weight g/ plant						Dry weight g/ plant					
		Leaves		Branches		Whole		Leaves		Branches		Whole	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
A- Different sources of organic manures:													
Compost		67.2	56.0	59.8	58.9	127.0	114.9	11.3	9.5	9.2	8.3	20.5	17.8
Chicken manure		59.0	51.3	51.3	43.3	110.2	94.6	9.6	7.7	7.8	6.6	17.4	14.3
Cattle manure		51.6	45.7	38.8	34.5	90.4	80.2	7.6	6.7	6.6	4.7	14.2	11.4
L.S.D at 5%		2.72	1.60	2.19	6.49	3.92	7.22	0.62	0.17	0.47	0.42	0.63	0.38
B- Cultivars:													
Bronco		76.1	61.3	61.5	60.5	137.6	121.7	10.8	8.6	9.0	7.6	19.8	16.2
Paulista		42.4	40.7	38.4	30.6	80.8	71.3	8.2	7.3	6.7	5.5	14.9	12.8
L.S.D at 5%		2.39	2.41	3.66	1.33	5.39	3.22	0.34	0.52	0.37	0.35	0.55	0.67
C- Different sources of organic manures × Cultivars :													
Compost	Bronco	86.6	66.8	72.6	71.4	159.2	138.2	12.4	10.4	10.6	9.7	22.9	20.0
	Paulista	47.8	45.1	46.9	46.5	94.7	91.5	10.3	8.6	7.8	6.9	18.1	15.5
Chicken manure	Bronco	75.6	61.3	62.8	59.9	138.4	121.2	10.7	8.3	8.8	7.8	19.5	16.1
	Paulista	42.3	41.3	39.7	26.7	82.1	68.0	8.5	7.1	6.7	5.5	15.2	12.5
Cattle manure	Bronco	66.1	55.7	49.1	50.2	115.2	105.8	9.3	7.2	7.7	5.2	17.0	12.4
	Paulista	37.1	35.7	28.6	18.8	65.7	54.5	5.9	6.2	5.5	4.1	11.3	10.3
L.S.D at 5%		N.S.	N.S.	N.S.	2.30	N.S.	N.S.	N.S.	N.S.	N.S.	0.61	N.S.	N.S.

Total yield and its components of snap bean plant:

1 Effect of different sources of organic manure:

The results of snap bean yield characters are summarized in (Table, 4).The snap bean plants produced in compost presented marked increase in yield characters as expressed as pods (length, diameter, no./plant and weight) and yield (tons/fed.) and followed in descending order by plants supplied with chicken manure and cattle manure. These results might be discussed by the results of Kambooh (1984) showed that the organic matter content of the planting medium has a profound effect on its biological, chemical and physical characteristics. Through the decomposition of organic matter

chemical elements become available to the plants**.** Bevacqua and Mellano (1993) found that adding compost to the soil had lower pH and increased levels of organic matter and primary nutrients. Shafeek *et al*.(2001) reported that the addition of organic material enhances the physical, chemical and biological properties of the soil and the natural organic material one broken down slowly by soil microorganisms. Similar results found by (Rizk *et al.,* 2003 and Murphy, 2014). In another study done by Mahmoud *et al.* (2013) indicated that the green pods yield and pod quality of pea plant enhanced to a great extent through increasing the level of compost application at rate of 120, 150 up to 180 kg N/fed in sandy soil.

2 Effect of snap bean cultivars:

It is obvious that bronco cultivar of snap bean caused significant increase in pods (length, diameter, no./plant and weight) and yield (tons/fed.) in comparison to *paulista* cultivar during seasons 2015 and 2016 (Table, 4). The trend of these results was supported by Kikas and Libek (2005) showed that high quality production of yield depends on the mineral adequate nutrition, weather terms and varieties. Choosing cultivar choice is of the most important single factors for organic strawberry production

3-Effect of the interaction of sources of organic manure and cultivars:

Generally, the interaction between different sources of organic manure and cultivars did not show any significant effect on pods (length and weight) of snap bean during seasons 2015 and 2016 (Table, 4). Pods number per plant recorded significant response during season 2015.While, pods (diameter and yield tons/fed.) increased significantly in both seasons 2015 and 2016.This increase showed with bronco cultivar grown in compost application. Luna Zendejas *et al.* (2011) showed that (*Phaseolus vulgaris* L.) grown with the application of compost recorded the highest growth of control.

Table 4: Effect of different sources of organic manure, cultivars and their interaction on total yield and its components of snap bean plant during 2015 and 2016 seasons.

Treatments		Pod								Yield	
		Length (cm)		Diameter (cm)		No./plant		Weight (g)		Tons/ fed.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
A- Different sources of organic manures :											
Compost		13.8	12.0	1.3	1.1	69.2	66	7.0	6.6	5.7	5.3
Chicken manure		12.9	10.4	1.1	0.9	63.6	54	5.7	5.9	4.7	4.6
Cattle manure		11.3	9.4	0.8	0.8	51.9	47	5.1	4.5	3.8	4.0
L.S.D at 5%		0.65	0.33	0.07	0.03	2.84	3.99	0.23	0.41	0.24	0.28
B- Cultivars:											
Bronco		13.5	10.9	1.3	1.0	71.2	63	6.5	6.3	5.8	6.2
Paulista		11.8	10.3	0.8	0.8	51.9	48	5.4	5.1	3.7	3.1
L.S.D at 5%		0.32	0.35	0.07	0.03	1.84	1.63	0.23	0.35	0.32	0.24
C- Different sources of organic manures × Cultivars :											
Compost	Bronco	14.7	12.5	1.6	1.2	76.0	73	7.7	7.3	7.4	7.2
	Paulista	13.0	11.5	1.0	1.0	62.3	60	6.4	5.8	4.1	3.3
Chicken manure	Bronco	13.7	10.9	1.3	1.0	71.2	63	6.1	6.5	5.6	6.2
	Paulista	12.2	10.0	0.9	0.8	56.0	44	5.3	5.3	3.8	3.0
Cattle manure	Bronco	12.2	9.3	0.9	0.8	66.5	54	5.7	5.0	4.6	5.1
	Paulista	10.3	9.5	0.7	0.7	37.3	40	4.5	4.1	3.0	3.0
L.S.D at 5%		N.S.	N.S.	0.13	0.05	3.19	N.S.	N.S.	N.S.	0.56	0.41

Chemical analysis of pods snap bean:

1 Effect of different sources of organic manure:

The significant effect observed on increasing percentage of N,P,K, protein and carbohydrates in pods of snap bean with different sources of organic manure application during 2015 and 2016 seasons

is shown in (Table, 5).Compost application showed the highest percentage of N,P,K, protein and carbohydrates and followed by chicken manure and cattle manure. Similar results were reported by Shafeek *et al.* (2003) reported that the increasing rate of compost (organic manure) up to (40 m^3/ fed.) resulting in higher values of crude protein, N, P and K in Japanese radish. El-Sherbeny *et al.* (2012) found that adding the organic compost tea increased carbohydrate content of turnip roots in clay loamy soil. Mahmoud and Ibrahim (2012) showed that organic matter and nutrients available (N, P and K) were increased as the rate of the organic materials increased in the soil. In pea pods, Mahmoud *et al.*(2013) found that the chemical constituents (N, P, K and total protein) significantly increased by increasing the level of compost application up to 180 kg N/fed in sandy soil. Also, Heba and Sherif (2014) showed that compost manure as a soil drench alone or with yeast increased the N % and % P uptake rates, the values were 126%, 174% for N and 255%, 322% for P, respectively. In turnip plant, Aisha *et al.* (2014) recorded that the adding organic compost (produced from recycling the agriculture residues) at high rates (20 m3/fed) gave the highest percentage of protein, N, P, K and Fe ppm as well as total carbohydrate percentage. These results may be due to the capacity of soil organic matter to influence a range of functional soil physical, chemical and biological properties and to play an important role in nutrient cycling (Murphy, 2014)**.**

Table 5: Effect of different sources of organic manure, cultivars and their interaction on chemical analysis of snap bean pods during 2015 and 2016 seasons

Treatments		N (%)		P (%)		K (%)		Protein (%)		Carbohydrates (%)	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
A- Different sources of organic manures :											
Compost		2.85	2.90	0.29	0.35	2.24	2.24	17.79	18.09	13.63	13.73
Chicken manure		2.49	2.48	0.21	0.21	2.01	2.02	15.53	15.48	12.86	12.71
Cattle manure		2.02	2.09	0.13	0.12	1.83	1.81	12.59	13.07	11.54	11.47
L.S.D at 5%		0.118	0.109	0.024	0.030	0.042	0.036	0.737	0.683	0.246	0.371
B- Cultivars:											
Bronco		2.63	2.71	0.25	0.28	2.11	2.11	16.46	16.95	15.20	15.26
Paulista		2.26	2.26	0.17	0.17	1.94	1.94	14.15	14.15	10.15	10.01
L.S.D at 5%		0.107	0.175	0.029	0.013	0.033	0.028	0.672	1.096	0.267	0.344
C- Different sources of organic manures × Cultivars :											
Compost	Bronco	3.09	3.21	0.34	0.45	2.34	2.29	19.29	20.04	16.34	16.60
	Paulista	2.61	2.58	0.23	0.24	2.13	2.19	16.29	16.15	10.92	10.85
Chicken manure	Bronco	2.70	2.75	0.25	0.27	2.05	2.10	16.88	17.19	15.50	15.50
	Paulista	2.27	2.20	0.17	0.16	1.96	1.94	14.19	13.77	10.23	9.91
Cattle manure	Bronco	2.11	2.18	0.15	0.13	1.94	1.93	13.21	13.63	13.77	13.69
	Paulista	1.92	2.00	0.10	0.11	1.72	1.68	11.98	12.52	9.30	9.26
L.S.D at 5%		N.S.	N.S.	N.S.	0.022	0.058	0.048	N.S.	N.S.	N.S.	N.S.

2 Effect of cultivars:

The resulted data of Table (5**)** revealed that cultivars of snap bean had significant effect on increasing the percentage of N, P, K, protein and carbohydrates in pods of snap bean in both seasons 2015 and 2016. Bronco cultivar recorded the best percentage of N, P, K, protein and carbohydrates in pods of snap bean *compared to Paulista* cultivar. This result might be due to chemical analysis is affected by genotypes. Dahmardeh *et al.* (2010) reported that Aljazaeri of bean cultivar surpassed all other cultivars in terms of biological and economical yields.

3 Effect of the interaction of sources of organic manure and cultivars:

The interaction of sources of organic manure and cultivars of snap bean showed no significant effect on the percentage of N, P, K, protein and carbohydrates in pods in both seasons 2015 and 2016 (Table, 5). On the contrary, the percentage of P recorded significant response (0.022) during season 2016.In the same trend showed with K (0.059) during season 2015 and (0.048) during season 2016.

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