EFFECT OF ORGANIC FARMING ON YIELD, MACRO-, MICRO-NUTRIENTS AND HEAVY METALS CONTENTS IN GREEN BEAN AND PEA CROPS

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ABSTRACT

Two field experiments were carried out in the Experimental Farm of Agriculture Faculty, Kafrelsheikh University, Kafr El Sheikh Governorate during the successive summer and winter seasons of 2004/2005. Green bean (*Phaseolus vulgaris* L. cvs. Brònco) as a summer crop and pea (*Pisum sativum* cvs. Master B) as a winter crop, were grown to evaluate the potential effects of application of rice straw compost (RSC) and municipal solid waste compost (MSWC) at different rates (10, 15 and 20 tones fed^{-1}) as well as recommended dose of NPK on production of above vegetable crops . The seeds of the two crops were inoculated before sowing with each selective rhizobia and mycorrhizal spores. The experimental plots, those received compost, were enriched with some beneficial microorganisms. Four replicates were done for each treatment in complete randomized block design.

The data revealed that all the treatments of organic manure induced in significant increase in fresh and dry weight of bean green pods and pea seeds whereas there were insignificant differences in total seed yield per feddan between the three consequence rates of MSWC as well as between these treatments and both RSC10 and NPK. The values recorded within the RSC treatments were always higher than those obtained for the corresponding rate of MSWC application. Actually, the increases in bean pods and peas seed yield were in parallel to the increase in dose of organic matter amendments.

Application of ascending rates of organic materials exhibited significant increases in nitrogen, phosphorus and micronutrient contents (Cu, Fe, Mn and Zn) for bean pods and peas seeds. Also, plant concentration of trace elements and heavy metals was at the optimum level and significantly influenced by the organic amendments.

Key words: Organic farming, Solid waste composting, rice straw compost, municipal solid waste compost, vegetable crops, Green bean , pea.

INTRODUCTION

Intensive vegetable farming has the potential to damage soil health, leading to poor productivity and large environmental impacts. Many farmers on the large organic farms are consider the possibility of devoting part of the rotation to field-scale organic vegetables production and even making vegetables the main enterprise on the farm. The integration between field crops and vegetables in the rotation has many advantages, not least being the opportunity to cash in and also building soil fertility, vegetable crops can be grown successfully at most points in the rotation (**Wells *et al.* 2000**).

In fact, as a number of studies attest, organic farming methods can produce higher yields than conventional methods. Moreover, a worldwide conversion to organic has the potential to increase food production levels not to mention reversing the degradation of agricultural soils and increase soil fertility and public health (**Vasilikiotis, 2000**).In this respect **Lampkin (1990)** stated that green legumes are becoming an increasingly popular crop on organic farming as the demand for organically produced stock food develops. **Drinkwater *et al.*, (1998)** studied the effect of organic manuring on common bean plants,their results showed a significant increase in plant dry mass by increasing the rate of compost.

Abd-Alla *et al.* (2001) found that application of organic fertilizers to cowpea crop overcame the control and improved vegetative growth characters, dry matter content and yield parameters. **Smith *et al.* (2001)** reported that bean grown on soil-compost mixture significantly produced more pods and seeds than bean grown in soil only, irrespective to the amount of fertilizers added. They also added that increasing the amount of compost in the potting media from 25 to 50 % increased number of pods and seeds. **El-Araby *et al.* (2003)** demonstrated that application of 25 m^3 fed^{-1} organic manure to peas crop significantly improved all parameters of pea pods and also increased NPK content of seeds. **Abdelhamid *et al.* (2004)** demonstrated that application of composted rice straw significantly increased growth, yield, yield component and total crude protein of faba bean plants. They added that the benefit of compost without chemical fertilizers demonstrated the validity and possibility of sustainable agronomic performance of faba bean using locally available recycled organic material.

CSANR (1997) reported that composted solid waste was applied at rates ranging from 36-72 tons per acre. Bean yields in the composted plots were nearly double that of the untreated. A crop of black-eyed peas followed the beans, and again yields doubled with compost. The number of branches, pods per plant and seed yield of peas increased significantly with the graded levels of compost up to 10 t/ha (**Singh *et al.*, 2004**).

In regards to the interaction between organic and biofertilizers **El-Fadaly *et al.*(2003)** and **Wu *et al.*(2005)** indicated that microbial inoculation of soil with some beneficial microorganisms may increase the efficiency of fertilizer use at both high and low fertilization levels. For instance, the inoculation with rhizobacteria can increase the root mycorrhizal colonization, increased vegetative and yield parameters of different crops. **Shafeek *et al.* (2004)** reported that the effects of organic manure and biofertilizers on the growth and yield of pigeon pea were determined in a field experiment conducted in Egypt during 2003-04. Plant growth, total pod and seed yield, and N, protein and carbohydrate content of seeds were highest with the application of organic manures. Inoculation of pigeon peas with the biofertilizers improved the must characters of the crop. On the light of the above mentioned information the present study aimed to assess application of organic farming principals for production of some vegetable crops.

Material and Methods

Two field experiments were carried out in the Experimental Farm of Faculty of Agriculture, KafrelSheikh University, Kafr El-Sheikh governorate during the successive summer and winter seasons of 2004/2005. Green bean (*Phaseolus vulgaris* L. cvs. Bronco) as a summer crop and pea (*Pisum sativum* cvs. Master B) as a winter crop, were sown on September 18^{th} and December 2^{nd} 2004, respectively in hills containing 3- 4 seeds with 10 cm spacing. All the agricultural practices were followed as recommended instructions.

Soil plot area was 7 m^2, manured with 3 different rates of rice straw compost (RSC)or municipal solid waste compost (MSWC) at the rates of 10, 15 and 20 ton fed^{-1}. The control plots received the recommended dose of NPK(200 kg ammonium sulphate, 200 kg superphosphate and 100 kg potassium sulphate / feddan). The commercial bio-pesticide (Bio-Fly) was used for pest control with the compost treatments while the "Malathion" was used with NPK treatment. Table (1) shows the phisco-chemical characteristics of the tested experimental soils. Table (2) shows chemical analysis and some of total macro-, micro-nutrients and heavy metals of RSC and MSWC according to **Chapman and Pratt(1961) Page *et al.*(1982) and Cottenie *et al* (1982).**

Microorganisms Inocula**

a. Seed* inocula: Green bean and pea seeds were inoculated before sowing with each selective rhizobia, *Rhizobium leguminosarum* cv *phasoli* and *Rhizobium leguminosarum* cv *vicia* respectively. Strains were grown for 5 days on yeast extract mannitol agar, (**Allen, 1953**). Media intensity was 10^8 cell ml^{-1} and applied at the rate of 50 ml $plot^{-1}$ for soaking green bean and pea seeds. At the same time both of seeds were also treated with mycorrhizal inoculum. The inoculum consisted of root pieces of maize (200g).

b. Soil inocula: Tested soils were enriched with some benefit

* Seeds were obtained from Horticulture Institute, Agricultural Research Center, Giza.

**All the microbial culture strains were obtained from the collection culture of Agriculture Microbiology Dept., NRC, Cairo.

microorganisms(Azotobacter chroococcum (108 CFU ml-1) Ashby's manitol medium (**Abd-El-Malek and Ishac (1968)**.,Azospirillum lipoferum (107 CFU ml-1) and Bacillus megatherium (108 CFU ml-1) (**Difco, 1976**) as a biofertilizers, which are capable to play a distinct role in a symbiotic N_2 fixation process as well as in nutrients transformation and availability .

Table (1): Some Phisco-chemical characteristics of the tested surface (0- 30 cm) composite soil samples

Soil parameter	Value	Soil parameter	Value
pH (1:2.5 soil water susp.)	8.32	**Soluble anions, meq L^{-1}**	
EC, dSm^{-1} (soil paste extract) at 25°C	4.83	CO^{--}_3	0.00
TSS (Total soluble salts) , %	0.26	HCO^-_3	4.81
SP % (saturation percent)	85.05	Cl^-	24.60
Total nitrogen , %	0.08	SO^{--}_4	16.92
Total organic carbon, %	0.68	**Micronutrient , mg kg^{-1}***	
Organic matter ,%	1.17	Available Cu	0.98
Total carbonate ,%	2.97	Available Fe	3.26
CEC (**Cmol kg^{-1}**)	32.86	Available Mn	4.37
Available N, mg kg^{-1}	38.00	Available Zn	1.23
Available P, mg kg^{-1}	10.30	**Heavy metal, mg kg^{-1}***	
Available K, mg kg^{-1}	417.20	Available Cd	0.012
Soluble cations, meq L^{-1}		Available Ni	0.019
Ca^{++}	17.30	Available Pb	0.49
Mg^{++}	4.25	**Texture**	**Clayey**
Na^+	23.92	Sand %	22.86
K^+	0.86	Silt %	28.65
		Clay %	48.49

*Ammonium acetate-EDTA extraction method.

Table (2): Chemical analysis and total macro-, micro-nutrients and heavy metals of tested composts samples.

parameter	RSC	MSWC	Parameter	RSC	MSWC
Moisture,%	20	24	**Macronutrients %**		
E.C (dSm^{-1})•	5.60	5.98	N	1.91	1.30
			P	0.35	0.32
pH•	8.42	8.19	K	0.25	0.21
CEC, Cmol kg^{-1}	70.92	59.73	**Micronutrients, mg kg^{-1}▫**		
			Cu	33.0	309
T.N,%	1.91	1.30	Fe	715	3625
			Mn	440	323
O.C,%	35.74	24.75	Zn	183	737
			Heavy metal, mg kg^{-1}▫		
O.M,%	61.47	42.19	Cd	1.90	15.8
			Ni	8.8	50.2
C/N	18.70	19.04	Pb	4.12	111

• E.C&pH in water extract(1:10) , ▫ Ammonium acetate-EDTA extraction method

Cultures were grown for 5 days before inoculation, a volume of 100 ml of each microorganism's cultures were used for inoculation of the experimental plots, except those of NPK treatments. Inoculation with the chosen microorganisms was done after compost amendment using hand sprayer. its volume was 3 liters.

Treatments and Experimental design:

Seven treatments were done for both crops bean and pea as following: NPK (control), both rice straw compost (RSC) and municipal solid waste compost (MSWC) at rates of 10, 15 and 20 ton fed^{-1}. Completely randomized block design with four replicates was used in the experiments. One-way ANOVA was used to detect significant differences among mean effects of amendments observed. The means of yield and yield components were tested for significance using Duncan's multiple range test **(SPSS, 2005)**.

A random sample of plants was taken from each experimental plot at 50 days after sowing to assess the vegetative growth parameters (plant height and plant fresh and dry weight) and for the plant chemical analysis. Samples of pods from bean and pea were taken at 52 and 86 days after sowing to estimate their growth parameters (pod length, pod diameter, pod fresh and dry weight) and chemical analyses (macro-, micro-nutrients and heavy metals). The yield of bean green pods were harvested after 52, 66 and 70 days from sowing date.The pea's green pods were harvested at 86 and 106 days after sowing date. Representative samples of vegetative parts, pods (bean) and seeds (pea) were taken for yield determination. Chemical analysis of tested elements were done analyses according to **Chapman and Pratt(1961) and Cottenie *et al* (1982).**

RESULTS AND DISCUSSION

Yield and yield components of bean crop

Plant characteristics

Response of bean plants to fertilization with NPK and different rates of organic fertilizers (RSC and MSWC) was presented in Table (3). As a result of organic fertilized addition, plant height tended to increase significantly with the increasing of application rates. Data also showed that there were no significant differences between NPK treatment and both RSC15 and MSWC20 treatments. The same trend was observed by many authors, **Abd-Alla *et al.* (2001), El-Fadaly *et al.* (2003) & El Bassiony (2003),** they reported that the faba bean plants height, fresh and dry weight are increase affected by increase of organic wastes rates.

Pod characteristics

The differences in length and diameter of bean green pods detected to much extent their quality. It is preferable to consume the long and thick pods. As regards to pods fresh and dry weight, the data in Table (3) revealed that all the treatments of organic manure resulted in significant increase in fresh and dry weight of bean green pods, except the treatment of MSWC 10 which was almost at the same values detected by NPK fertilization. The values which recorded within the RSC treatments were always higher than those obtained for the corresponding rates of MSWC application. Also, there were significant differences in pods fresh weight between the different rates of organic materials application. These differences were found between the different rates of RSC, whereas these differences almost diminished between MSWC15 and MSWC20. Though, it could be concluded that organic matter amendment irrespective to its type could be improve pod characteristics. In this respect, **El Bassiony (2003)** stated that the pod weight of three varieties of bean was affected by application of organic manure.

Pod yield

The present data in Table (3) showed that the lower rate of organic matter amendment (10 ton fed^{-1}) for both RSC and MSWC was not significant enough to compensate the absence of NPK fertilization and to fulfill the plant requirement of nutrients and this consequently reflected on the yield of bean pods which was less than that obtained by NPK treatment. On the other hand, there were significant increases obtained due to the medium dose(15 ton fed^{-1}) of both types of compost. However, the application of 20 ton fed^{-1} had more positive effect on bean pod yield, since highly significant increases were obtained compared to NPK fertilization.

Table 3. Yield and yield components of bean plants

Treatment	Plant characteristics			Pod characteristics				Total pod yield	
	Height (cm)	F W (g $plant^{-1}$)	D W	Length (cm)	Diameter	F W (g)	D W	Kg $plot^{-1}$	Ton fed^{-1}
NPK	43.88^{b}	66.71^{b}	7.86^{e}	13.10^{b}	0.57^{f}	4.57^{f}	1.12^{d}	5.57^{de}	3.34^{d}
RSC 10	40.00^{d}	58.92^{e}	8.10^{d}	12.66^{b}	0.59^{e}	4.82^{e}	1.23^{c}	5.52^{ef}	3.31^{d}
RSC 15	43.75^{b}	65.04^{c}	8.66^{b}	13.08^{b}	0.66^{c}	5.68^{c}	1.41^{b}	5.70^{bc}	3.42^{bc}
RSC 20	46.00^{a}	70.38^{a}	9.03^{a}	14.28^{a}	0.69^{a}	6.04^{a}	1.62^{a}	5.55^{a}	3.33^{a}
MSWC 10	38.20^{e}	56.71^{f}	7.95^{de}	12.13^{c}	0.57^{f}	4.66^{f}	1.12^{d}	5.43^{f}	3.26^{e}
MSWC 15	42.22^{c}	63.87^{d}	8.42^{c}	13.13^{b}	0.62^{d}	5.44^{d}	1.34^{b}	5.63^{cd}	3.38^{c}
MSWC 20	43.90^{b}	69.88^{a}	8.90^{a}	13.90^{a}	0.67^{b}	5.81^{b}	1.40^{b}	5.72^{b}	3.43^{b}

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

Actually, the increases in bean pods yield were in parallel to the increase in dose of organic matter amendments.

It is worthy to mentioned that these increases in yield of organic fertilized plants generally deduced to the large nutrient content of organic manure, in case of supplying the soil with enough quantities, which act as slow-release fertilizers. Organic fertilizers also provide the growing plants with their nutritional requirements in sufficient amounts throughout the stages of plant growth.

In this respect, **Santos *et al.* (1999)** found that the inoculation with beneficial microorganisms may play an important role in increasing bean yield by different means such fixing atmospheric N and increasing nutrient availability through its role in decaying OM and release of its nutrient content and/or through excretion of some growth-promoting substances. This may also one of the reasons that the improvement in plant vegetative parameters and yield could be obtained with compost received treatments those also inoculated with useful microorganisms as soil inoculants.

Macro-, micro-nutrient and heavy metals content in bean plants

NPK contents: The data in Table (4) illustrated that there were significant increases in pods N-content due to the application of organic manure with the medium and high application rates (15 and 20 ton fed^{-1}) compared to NPK treatment whereas the variation between lower rate of organic amendments and unamended treatments was not significant. However, the treatment of RSC20 was the only one surpassed the NPK treatment in the plant N-content, except this treatment, the others exhibited less values of plant N-content compared to the NPK treatment (Table 4). Due to phosphorus, there was no observed increase in pods P-content as a result of organic matter amendments with their different rates and types relative to the NPK treatment. However, all rates of organic matter application induced significant increase in P-content of the vegetative parts. Concerning the K content, the amendment of 15 and 20 ton fed^{-1} of both types of compost resulted in significant increases in pods K-content compared to the unamended control treatment (NPK), whereas the 10 ton fed^{-1} exhibited significant decreases (Table 4). However, all treatments received organic manures, except that one of RSC20, were significantly less than the chemical treatment in the plant K-content.

Table (4): Macronutrient contents (%) in bean pods and plants

Treatments	N		P		K	
	pods	plant	pods	plant	pods	Plant
NPK	1.79^{de}	2.45^{b}	1.09^{ab}	1.08^{e}	2.39^{d}	2.50^{b}
RSC10	1.85^{d}	2.11^{d}	1.04^{c}	1.18^{c}	2.29^{e}	2.06^{d}
RSC15	2.14^{b}	2.36^{c}	1.07^{b}	1.23^{ab}	2.62^{c}	2.19^{c}
RSC20	2.22^{a}	2.57^{a}	1.11^{a}	1.26^{a}	2.76^{a}	2.53^{a}
MSWC10	1.77^{e}	2.00^{d}	0.97^{d}	1.13^{d}	2.22^{f}	1.97^{e}
MSWC15	2.01^{c}	2.27^{c}	1.03^{c}	1.20^{bc}	2.41 [illegible]	2.13^{g}
MSWC20	2.13^{b}	2.43^{b}	1.09^{ab}	1.22^{abc}	2.68^{b}	2.35^{f}

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

In general, it could be concluded that, these fluctuated values in N, P and K content of bean green pods and the vegetative parts of plants indicating that the application of organic matter with low and medium rates (10 and 15 ton fed^{-1}) was not considered a good source for providing bean plant with N, P and K. Therefore, it could be recommended that an adequate quantity of compost should be amended to soil for achieving the greatest plant biomass and good quality production. In accordance to the current data of **Zheljazkov *et al.*, (2006)** they stated that, high rates of compost can provide sufficient N, S and perhaps other nutrients .Generally, the rates of N and P in the vegetative parts of bean plant were always higher than those of pods in all organic treatments, indicating that the plant in this active stage of growth tended to vigorously absorb and accumulate the essential minerals. On the other hand, the accumulation of potassium was more pronounced in pods due the critical need to K for active carbohydrate metabolism to fill bean pods. Similar trend were recorded by **El Bassiony (2003)**.

Micronutrients content: Application of ascending rates of RSC and MSWC exhibited significant increases in the micronutrient content (Cu, Fe, Mn and Zn) for bean pods and aerial parts of plant. Whilst fluctuated differences in micronutrient content between mineral and organic fertilization were obtained in particular in pods content, whereas the incorporation of organic matter with their successive rates achieved to highly significant increases in micronutrient content of the plant aerial parts compared to NPK treatment (Table 5).

Table (5): Micronutrients content(mg kg^{-1}) in bean pods and plants

Treatments	Zn		Fe		Mn		Cu	
	pods	plant	pods	plant	pods	plant	pods	plant
NPK	18.50^{b}	38.20^{f}	8.63^{e}	43.10^{g}	11.21^{d}	37.29^{g}	11.23^{c}	18.32^{g}
RSC10	16.88^{d}	37.56^{g}	8.73^{e}	46.71^{f}	10.13^{f}	55.23^{e}	10.75^{e}	24.52^{f}
RSC15	18.53^{b}	40.82^{d}	8.21^{f}	53.54^{e}	11.00^{d}	60.72^{c}	11.25^{c}	25.06^{e}
RSC20	19.32^{a}	43.78^{b}	10.13^{b}	61.32^{b}	12.31^{b}	69.11^{a}	11.36^{b}	35.92^{a}
MSWC10	17.32^{c}	39.21^{e}	8.93^{d}	50.38^{e}	10.73^{e}	53.62^{f}	9.82^{f}	25.22^{d}
MSWC15	18.64^{b}	42.36^{c}	9.36^{c}	58.46^{c}	11.52^{c}	60.13^{d}	11.12^{d}	26.32^{c}
MSWC20	19.55^{a}	44.71^{a}	10.28^{a}	66.81^{a}	12.84^{a}	68.08^{b}	12.21^{a}	27.10^{b}
*	200-300		20-100		300		100-400	

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

*Toxicity limits according to Gray, 1992. Concentration in contaminant pants (mg kg^{-1}); the higher levels are toxic.

It is also worthy to mentioned that with each type of compost, the increase in the rate of application exhibited corresponding significant increase in micronutrient contents in both green pods and plants (Table 5), except in case of Fe in the medium rate of RSC. It should be concluded that the micronutrient content of aerial parts of bean plants could be arranged in ascending order as following: Mn < Fe < Zn < Cu. However, the mineral content of the elements in green pods were less variable.

It is clearly seen from the first view that although the high micronutrient content of the aerial parts, it was found that its contents were much lower in bean green pods. That means the plant can accumulate these minerals in their shoots and leaves which make as musk could capture these elements and prevent their accumulation in the pods and these elements were within their normal range in pods and below the values of their critical concentration in tissue **(Demirbas, 2005)**.

Heavy metals content: Heavy metal concentrations are shown in Table(6). The current data exhibited that the level of heavy metals Cd, Ni and Pb were generally very low in bean green pod than in the aerial parts of plants under all treatments, where the plants fortunately accumulate these toxic elements in the vegetative parts. The amount of heavy metals in pods and plants were fluctuated as affected by the levels of added organic matter, whereas the medium and high organic rates generally increase significantly the level of heavy metals in both pods and plants. It was also observed that mean level of heavy metals in pods and plants could be descendible arranged Ni > Pb > Cd. Probably one of the reasons for the lake of Cd accumulation in the plant was the relatively high Zn content of compost, since Zn in compost might reduce the availability of Cd in soil **(Zheljazkov** and **Warman, 2004)**.

It could be concluded that increasing the addition rates of organic matter amendments resulted in significant increase in heavy metals contentlevel in both pods and plants irrespective to its type.

Ultimately, heavy metals are potential environmental contaminants with the capability of causing hazardous human health problems if present in excess in foodstuff. They are given special attention throughout the world due to their toxic effects even at very low concentrations.

Table (6): Heavy metal contents (mg kg^{-1}) in bean pods and plants

Treatments	Cd		Pb		Ni	
	pods	plant	pods	Plant	pods	Plant
NPK	0.01^{e}	2.95^{g}	0.87^{g}	4.69^{f}	1.38^{de}	6.30^{e}
RSC10	0.02^{d}	3.13^{f}	0.97^{f}	4.61^{f}	1.10^{f}	5.83^{f}
RSC15	0.03^{c}	3.90^{e}	1.13^{d}	4.92^{d}	1.36^{e}	6.71^{d}
RSC20	0.06^{b}	4.35^{d}	1.21^{c}	5.10^{b}	1.55^{c}	7.62^{b}
MSWC10	0.04^{b}	4.16^{c}	1.03^{e}	4.83^{e}	1.43^{d}	6.28^{e}
MSWC15	0.06^{b}	5.83^{b}	1.27^{b}	5.01^{c}	1.61^{b}	7.36^{c}
MSWC20	0.08^{a}	6.52^{a}	1.44^{a}	5.32^{a}	1.69^{a}	8.82^{a}
*	10-100		30-300		5-30	

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

*Toxicity limits according to Gray, 1992 Concentration in contaminant pants (mg kg^{-1}); the higher levels are toxic

Yield and its components of pea crop

Plant characteristics

It is likely that the plants fertilized with NPK have a distinguished vegetative growth as that occurred in case of organic fertilization with the two types of compost, except those plants received the lowest manure rate. Overall, the treatment of RSC15 is characterized with the highest plant length. Along with these findings, the plant fresh and dry weights were at their maximum values due to the mineral fertilization without any significant differences with treatments received the large doses of organic matter. It was also observed that increasing the rate of organic manures increased the plant fresh and dry weight.

Pod characteristics

Fertilization of pea plants with NPK (Table 7) induced pod length since this treatment was preceded the organic manures fertilized treatments, particularly those received MSW compost. However, the differences in pod length among all treatments of organic manures were insignificant. As obviously seen that no significant differences in number of seeds per pod were obtained due to the type of fertilization, mineral or organic and also to the differences in OM application rates, although the fluctuation in their values.

The same trend was observed in fresh and DW of 100 seeds, although the fluctuation occurred between the different treatments in FW of 100 seeds but no significant differences were obtained between them. Whilst the maximum seed DW was obtained by fertilization with 15 ton fed^{-1} of RSC, on the other hand the lowest values resulted from the manuring with MSWC. In accordance with the present data **El-Araby *et al.* (2003)** found that application of 25 ton fed^{-1} cattle manure increased the length of pea pods from 7.4 to 7.9 cm. Also **Talha (2003)** indicated that the increase of organic manure application rate are insignificantly increase weight of 100 peas seed .

Seed yield

Regards to seed yield of peas crop, it is no doubt that mineral NPK was sufficient to supply plant with its mineral requirements to give appreciable seed yield. Since this treatment produced reliable seed yield 4.77 kg per plot (1/600 fed) which returned on the total yield of feddan (2.86 ton fed^{-1}). The obtained values were less than the mean obtained values by the organic fertilization with rice straw compost (2.98 kg plot^{-1}) but it was larger than the seed values mean (2.69 kg plot^{-1}) which resulted from MSWC fertilization.

It was observed that there were insignificant differences in total seed yield per feddan between the three consequence rates of MSWC as well as between these treatments and both RSC10 and NPK. However, RSC in the medium rate and the highest one (15 and 20 ton fed^{-1}) were significantly surpassed all treatments. Also, the rate of 20 ton fed^{-1} RSC induced the best seed yield (3.15 ton fed^{-1}), whereas the lowest seed yield

(2.63 ton fed^{-1}) was found by using the lowest rate of MSWC (10 ton fed^{-1}). In general, the medium rates of RSC and MSWC were recommended for manuring of peas crop and they were more or little less the produced seed values of mineral fertilization treatment "NPK", respectively.

Table 7. Yield and yield component of pea crop.

Treatment	Plant characteristics			Pod characteristics				Total pod yield	
	Height (cm)	F W (g plant^{-1})	D W (g plant^{-1})	Length (cm)	No. seeds/ pod	F W 100 seed (g)	D W 100 seed (g)	Kg plot^{-1}	Ton fed^{-1}
NPK	39.52a	65.35a	8.42b	9.84a	7.35a	31.00a	5.76bc	4.77bc	2.86bc
RSC 10	37.91ab	57.56d	7.74c	9.58ab	7.28a	30.72a	6.10ab	4.52c	2.71c
RSC 15	40.10a	63.55bc	8.59ab	9.63ab	7.62a	31.77a	6.31a	5.17ab	3.10ab
RSC 20	39.20a	64.70ab	8.91a	9.73ab	7.40a	30.82a	6.03ab	5.25a	3.15a
MSWC 10	36.58b	55.95e	7.58c	9.47b	7.17a	30.20a	5.55c	4.38c	2.63c
MSWC 15	39.50a	62.80c	8.44b	9.53ab	7.47a	30.85a	5.96abc	4.60c	2.76c
MSWC 20	38.58a	63.95ac	8.85a	9.49b	7.52a	30.89a	5.54c	4.47c	2.68c

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

El-Sedfy *et al.* (2002) indicated that addition of organic materials enhanced plant growth and consequently its productivity through application of 10 ton fed^{-1} of compost.

Overall, it is conspicuous that OM could play a definite role in improving plant growth and plant yield, soil fertility and increasing soil productivity and could compensate the comprehensive use of chemical fertilizers in the traditional agricultural system with another system pronounced organic farming which is safely productive system with no doubt that crop yield may decreased **(Baran *et al.*, 2001)**.

<u>Macro-, micro-nutrients and heavy metals content in pea plants</u>

NPK contents: The contents of nitrogen and phosphorus in peas green seeds (Table 8) were higher compared to their contents in vegetative parts under application of in both types of fertilization mineral or organic. In contrarily to that potassium took different trend, its content in plant was higher than in seeds. The N, P and K selective values of the NPK treatment were larger than those of lower rate of both two composts used, but they were less than those detected for its high rates (Table 8). It should be concluded that the application of RSC was more promising compared to MSWC. The data obtained from the first were significantly higher than the second at all rates of addition.

In agreement with these data, **El-Araby *et al.* (2003)** found that application of 25 m^3 fed^{-1} of organic manure increased NPK content of pea seeds compared to mineral fertilization.

Micronutrient contents :It is clearly seen that all micronutrients, except Zn, tended to accumulate in the vegetative parts more than in the edible seeds (Table 9). On the other hand, the value of Zn content in seeds was larger than the mean Zn value of the vegetative parts. In addition, Zn content of both plant and seeds due to RSC fertilization were surpassed these values obtained at the same rates of MSWC .

Table (8): Macronutrients content(%) in Pea seeds and plants

Treatments	N		P		K	
	Seeds	plant	seeds	plant	seeds	plant
NPK	3.02^{c}	2.31^{e}	0.33^{cd}	0.25^{cd}	1.83^{b}	2.23^{b}
RSC10	2.83^{d}	2.36^{e}	0.31^{de}	0.23^{de}	1.75^{d}	1.91^{d}
RSC15	3.11^{c}	2.74^{c}	0.35^{bc}	0.27^{bc}	1.82^{bc}	2.26^{b}
RSC20	3.54^{a}	3.15^{a}	0.38^{a}	0.34^{a}	1.86^{a}	2.33^{a}
MSWC10	2.69^{e}	2.16^{f}	0.29^{e}	0.21^{d}	1.71^{e}	1.87^{e}
MSWC15	3.04^{c}	2.53^{d}	0.34^{bc}	0.24^{d}	1.80^{c}	2.19^{c}
MSWC20	3.30^{b}	2.90^{b}	0.36^{ab}	0.29^{b}	1.84^{ab}	2.25^{b}

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

Table (9): Micronutrients content(mg kg^{-1}) in pea seeds and plants

Treatments	Fe		Cu		Mn		Zn	
	Seeds	plant	Seeds	plant	Seeds	plant	Seeds	plant
NPK	13.00^{e}	40.50^{g}	3.40^{g}	13.00^{f}	10.70^{g}	31.00^{e}	34.00^{g}	20.00^{e}
RSC10	11.83^{f}	54.90^{f}	5.63^{e}	22.00^{d}	11.62^{f}	59.00^{c}	42.10^{e}	22.00^{d}
RSC15	13.28^{d}	67.30^{d}	5.91^{c}	23.80^{b}	14.00^{d}	65.00^{d}	44.32^{c}	27.00^{b}
RSC20	15.60^{a}	75.10^{b}	6.32^{a}	25.30^{a}	16.80^{b}	72.00^{a}	48.90^{a}	32.00^{a}
MSWC10	11.60^{g}	55.60^{e}	5.54^{f}	21.00^{e}	12.10^{e}	58.00^{c}	41.00^{f}	21.00^{d}
MSWC15	13.35^{c}	68.00^{c}	5.87^{d}	23.00^{c}	14.13^{c}	63.00^{b}	43.65^{d}	25.00^{c}
MSWC20	15.03^{b}	74.80^{a}	6.10^{b}	25.00^{a}	17.12^{a}	70.00^{a}	48.30^{b}	31.00^{a}
*	300		100-400		20-100			200-300

Means with the same letter(s) are not significantly different at $p \geq 0.05$.
*Toxicity limits according to **Gray, 1992**. Concentration in contaminant pants (mg kg^{-1}); the higher levels are toxic.

Although Mn content of plants in case of RSC was higher than that of MSWC for the corresponding rates of both, its content in seeds was in different order. Whereas Cu contents of both plant and seeds were higher in RSC compared to MSWC. In addition, Fe content values were fluctuated and no obvious trend was observed. It is worthy to mention that micronutrients content in both plant and seeds as affected by NPK treatments were significantly less than the mean values which obtained under organic treatments.

Heavy metal contents: With regards to the heavy metals content of Cd, Ni and Pb, the mean values of them in plants were significantly varied then in the seeds. The plants contained much higher values compared to seeds (Table 10). In this respect, **Alloway** and **Jackson (1991)** indicated that Cd tends to accumulate in leaves and so it is more of a risk in leafy vegetables grown on contaminated soil than in seeds or root crops. The fertilization with MSWC exhibited significant increases in heavy metals content for both plant and seeds compared to RSC at the same rate of application. It could be concluded that the levels of Ni content in both plant and seeds were larger than that of Pb content which was larger than Cd (Ni > Pb > Cd).

It should be mentioned that, the fertilization with organic matter significantly increased the heavy metals content in both plants and seeds compared to mineral fertilization.

Table (10): Heavy metal contents (mg kg^{-1}) in pea seeds and plants

Treatments	Cd		Ni		Pb	
	Seeds	plant	Seeds	plant	Seeds	plant
NPK	0.02^{g}	2.10^{g}	0.31^{g}	5.93^{g}	0.17^{g}	5.31^{f}
RSC10	0.03^{f}	2.80^{f}	0.58^{f}	6.30^{f}	0.18^{f}	5.30^{g}
RSC15	0.04^{e}	3.70^{e}	0.62^{e}	7.10^{d}	0.20^{e}	5.90^{d}
RSC20	0.06^{d}	4.10^{d}	0.66^{b}	7.90^{b}	0.22^{c}	6.20^{b}
MSWC10	0.07^{c}	4.30^{c}	0.63^{d}	6.90^{e}	0.21^{d}	5.40^{e}
MSWC15	0.08^{b}	5.60^{b}	0.65^{c}	7.40^{c}	0.24^{b}	6.10^{c}
MSWC20	0.09^{a}	6.40^{a}	0.69^{a}	8.70^{a}	0.27^{a}	6.90^{a}
*	5-30		30-300		10-100	

Means with the same letter(s) are not significantly different at $p \geq 0.05$.

*Toxicity limits according to Gray, 1992. Concentration in contaminant pants (mg kg^{-1}); the higher levels are toxic

In comparison between the tow vegetable crops bean and peas it can be could concluded that their minerals content were different. The obtained values for N, K, Mn, Fe and Zn contents in peas green seeds were more pronounced than its values in bean green pods. Although Zn content was much higher in vegetative parts of bean than peas, whilst the contents of P, Cu, Ni and Pb were in opposite direction, since they were higher in bean pods compared to pea seeds, whereas the mean values of Cd content were almost equal in both bean pods and pea seeds.

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تأثير الزراعة العضوية علي الإنتاج والمحتوي من العناصر ألكبري والصغرى والثقيلة لمحصولي الفاصوليا و البسلة

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أجريت تجربتان حقليتان في مزرعة كلية الزراعة، جامعة كفر الشيخ خلال موسمي 2004 و2005 لزراعة محصولي خضار (فاصوليا في الموسم الصيفي لعام 2004 و البسلة في الموسم الشتوي لعام 2005). وذلك لتقيم أثر استخدام نوعى السماد العضوي هما كمبوست قش الأرزRSC وقمامة المدن MSWC بثلاث معدلات إضافة لكل منهما (10، 15 و20 طن / فدان) بالإضافة إلى معاملة التسميد المعدني بالمعدلات الموصى بها علي إنتاجية الفاصوليا والبسلة. و القطع التجريبية التي تم معاملتها بالأسمدة العضوية تم تلقيحها ببعض الميكروبات التي تلعب دورا هاما في عملية التسميد الحيوي (*Azotobacter chroococcum*، *Bacillus megatherium* و *Azospirillum lipoferum*) وكذلك تم تلقيح البذور قبل الزراعة بالريزوبيا الخاصة بكل محصول بالإضافة إلى التلقيح بلقاح من فطريات الميكوريزا.وكذا أتبع تصميم القطع التجريبية كاملة العشوائية فى توزيع المعاملات في أربعة مكررات لكل معاملة. وأجريت العمليات الزراعية حسب التوصيات الخاصة بكل محصول. وفيما يلي أهم نتائج الدراسة:

أوضحت كل المعاملات العضوية زيادة الوزن الطازج والجاف بدون فروق معنوية لكل من قرون الفاصوليا و بذور البسلة وكذلك لم يكن هناك فروق معنوية بين المحصول الكلي للبذور/ فدان و بين كل معدلات كمبوست قمامة المدنMSWC الثلاث مع معامله RSC10 أو الكنترول(NPK). كما أوضحت النتائج دائما أفضلية RSC عن MSWC عند معدلات الإضافة المختلفة. كما أوضحت النتائج الزيادة الحقيقة في محصول القرون للفاصوليا والبذور للبسلة بالتوازي مع زيادة معدل إضافة نوعى السماد العضوي(كمبوست قش الأرزRSC وقمامة المدن MSWC).

أدي إضافة كلا نوعي الكمبوست بمعدلاتها المختلفة إلي زيادة محتوي قرون الفاصوليا وبذور البسلة من النتروجين والفسفور والعناصر الصغرى(Cu,Fe,Mn,Zn). كما أوضحت النتائج أن التسميد العضوي وبخاصة مع المعدلات العالية قد ادي إلي زيادة معنوية في محتوى نباتات وقرون الفاصوليا ونباتات وبذور البسلة من العناصر الثقيلة(Cd,Pb,Ni) بالمقارنة بالتسميد المعدني(NPK).كما أظهرت النتائج أن محتوي النباتات تحت الدراسة من العناصر الصغرى والثقيلة كان عند الحدود المثلي وكانت تتأثر معنويا مع إضافة المحسنات العضوية.