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SUSTAINABLE PEANUT PRODUCTION THROUGH INTEGRATION BETWEEN BIO, ORGANIC AND CHEMICAL FERTILIZERS

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ABSTRACT

Modern agriculture is depended on the integration between biofertilizers and both of organic and/or inorganic fertilizers to enhance the utility of nutrients in farming system and to be safe and friend of environment. The common bio-inoculums are Effective Microorganisms (EM) and N-fixers. EM is based on four principal types of organisms commonly found in all ecosystems (Lactic acid bacteria, yeast *Actinomyces*, photosynthetic bacteria and Ray fungi). Meanwhile N-fixers contains dual inoculation of *Rhizobium* and *Azospirillum*.

A field experiment was carried out at Experimental Farm of Ismailia during summer season 2002 on peanut crop. In this experiment two sources of organic fertilizer; fermented compost (Comp) and town waste (T.W) with two levels of nitrogen fertilizer; full recommended (RRn) and half recommended rate (1/2RRn).

The results showed significant effects with using bio and compost fertilizers, where seed yield recorded 1086.7, 1080.5, 1022.6, 1018.3, 978.5 and 913.3 kg/fed for treatments Comp., EM, N-fixers, RRn, T.W and 1/2RRn respectively. Also, nitrogen uptake of peanut seeds was 43.76, 40, 36, 40.15, 39.95, 33.23 and 30.65 kg/fed with the treatments Comp., N-fixers, EM, RRn, Wt and 1/2RRn respectively.

Concerning the dual effect of (Bio-chemical), (bio-organic) and (chemical-organic) fertilizers, the results of the integration between EM or N-fixers inoculums and compost or full recommended nitrogen (RRn) gave higher seed yield and NPK content of seeds.

The best peanut seed yield obtained from the interaction treatment of EM+Comp.+1/2RRn followed by the treatment of N-fixers + Comp. +1/2RRn (1450 and 1235kg/fed). Nitrogen uptake in both treatments were 67.51 and 58.68 kg/fed respectively.

The treatments of town waste fertilizer revealed lower values of seeds yield and NPK uptake. The yield decreased to 1214 and 1000 kg/fed for the treatments (EM + T.W + 1/2 RRn) and (N-fixers + T.W + 1/2 RRn) respectively.

EM and N-fixers inoculums decreased the recommended rate of mineral nitrogen in the experiment to about 50%.

INTRODUCTION

Traditional agriculture systems are based on the use of chemical fertilizers to promote growth, and pesticides to control diseases and insects attacking the crops, addition to herbicides to fight herbage. Although the importance of these chemical nutrients as intensive energy for production, there is a beneficial role of organic ones in improving the physical, chemical and microbiological properties of soil. Also, organic matter provides considerable part of macro and micronutrients for plant growth.

Recently, modern agriculture is depended on the use of biofertilizers in integration with organic and chemical fertilizer to enhance the utility of nutrients to improve and sustain the crop yields. Also, it is importance to widen the use of biofertilizer to avoid the problems resulted from the intensive use of chemical materials, such as environmental pollution, loss of biodiversity, increase of pests and diseases, and incidence of soil degradation. All these problems have produced unsafely food and expensive due to the increase of the recommended rate and the cost of agrochemicals.

Hence, attempts were made to find an effective farming system, safe and environment friendly, in the same time, raise the agriculture production of crop and improve chemical, physical and biological properties of cultivated soil. The most common nature technologies are the biofertilizer uses of Effective Microorganisms (EM) and Nitrogen Fixers (NF).

The common NF is the dual inoculation of *Rhizobium* and *Azospirillum*. Researches have shown the benefits of using NF on nodulation, growth of legumes and in increasing production as a result of both convenient and organic farming systems. Galal (1993) and Galal and El Ghandour (1997) reported that the mixed culture occurrence of *Rhizobium* and *Azospirillum* could be saved more than 50% of chemical N-fertilizers and consequently, the pollution with nitrate in soil and water, as well as the escape of nitrogen oxides to atmosphere could be minimized. Jauhri et *al.*, (1979); Burns *et al.*, (1981) Patra(1990) and Abd El-Rasoul *et al.*, (2002) stated that the *Azosprillium* increase the nodulation and efficiency of *Rhizobium*. The dual inoculation significantly increased seed and pod yields of legumes compared with single inoculation. Also significant amount of residual available N left in the soil by legume symbiosis.

EM was developed in 1970's at the University of Ryukyus, Okinawa, Japan. EM is based on four principal types of organisms commonly found in all ecosystems, namely Lactic Acid Bacteria, Yeast, Actinomyces, Photosynthetic bacteria and Ray fungi (*Lactobacilli* and *Streptomyces*) these are blended in a molasses and maintained at a low pH (3.0-4.0) Higa,1996, Sangakkora and Higa,2000. EM is used widely in crop and animal production systems, aqua culture units and for recycling of wastes of both solids and liquids, Hussein *et al.*, (1999) and Okuda and Higa (1999). These microorganisms multiply in soil and develop beneficial effects such as releasing nutrients from organic sources (Sangakkara and Weeraskekera,1999), promoting leaf photosynthesis (Xu *et al.*, 1999), enhancing soil properties and penetration of roots (Ho In Ho and Hwan,2000). Also it develops antagonistic effects toward pests, diseases (e.g. fusarium, phytopthora and pickleworm) and herbs, they also promots plant growth (El-abyad *et al.*, 1993, Wood *et al.*, 1999 and Wang *et al.*, 2000)

On the previous mention, the aim of this study is to investigate the effect of two common biofertilizer (N-fixers and EM) in combination with two main organic sources (waste town and compost) under two rates of nitrogen [Recommended (RR) and half recommended (1/2RR)] on peanut yield and nutrients uptake.

MATERIAL AND METHODS

A field experiment was carried out at experimental farm of Agricultural Research Station, Ismailia, and Governorate, Egypt during season of 2002, to study the effect of bio-fertilizers; Effective Microorganisms (EM) and N-fixers in combination with two organic fertilizers under two levels of nitrogen on peanut plant.

A split split-plot design with three replicates was done, where the organic fertilizers are allocated in the main plots as follow:-

1. control
2. Compost (Comp.) at rate of $15m^3$/fed.
3. Town Waste (T.W) at rate of $15m^3$/fed.

The biofertilizer treatments were allocated in the sub plots as follow:-

- Without biofertilizer
- Effective Microorganisms (EM): EM diluted 1:100 sprayed over the soil at rate 10L/fed before sowing of peanut. EM diluted 1:1000 sprayed over plants at rate 2L/fed. Spraying was at 15 days interals from seedling stage till maturity stage.
- N-fixers treatment: the liquid culture of bacterial inoculations (*Rhizobium* and *Azospirllum*) were sprayed at rate 2L/fed periodically every 15 days, starting from seedlings up to maturity stage, spraying was included all plant with specific concentration on the root rhizosphere.

Nitrogen fertilizers were randomly distributed in the sub-sub plots as follows:-
i- Full dose recommended (RRn)
ii- Half dose recommended (1/2 RRn)
The sub- sub plot dimension was 3x2.5m = $7.5m^2$

Peanut seeds c.v Giza 5 were planted in hills 20 cm apart in rows 70 cm apart. Sprinkler irrigation was carried out four days intervals.

The recommended chemical fertilizers were carried out at level 30,15 and 24kg N, P_2O_5 and K_2O per faddan respectively . phosphours as superphosphate (15%P_2O_5) and potassium (as potassium sulphate 48%K_2O) were added before planting while nitrogen fertilizer as ammonium sulphate(20.5%N) was added in two equal doses.

All agricultural practices were carried out as recommended in this district. At maturity, plants were picked, pods were separated, air dried, weighted and pealed into seeds and husks. Samples of seeds were oven dried, weighted and ground. Seed content of N,P and K were determined according to method mentioned by Chapman and Pratt(1961) and Jackson(1973).

All obtained data were subjected to statistically analysis according to Snedecor and Cochran(1980).

Table (1): Some chemical and physical properties of the investigated soil.

<table>
<tr><td rowspan="2">pH (1:2.5)</td><td rowspan="2">EC ds/m</td><td colspan="4">Soluble cations (meq/100g soil)</td><td colspan="4">Soluble anions (meq/100g soil)</td></tr>
<tr><td>Ca^{++}</td><td>Mg^{++}</td><td>Na^+</td><td>K^+</td><td>CO_3^-</td><td>HCO_3^-</td><td>Cl^-</td><td>$SO_4^=$</td></tr>
<tr><td>8.10</td><td>1.40</td><td>4.56</td><td>2.60</td><td>3.07</td><td>0.36</td><td>--</td><td>6.60</td><td>2.83</td><td>1.16</td></tr>
<tr><td colspan="10">Particle size distribution</td></tr>
<tr><td colspan="2">Coarse sand %</td><td>Fine sand %</td><td>Silt %</td><td>Clay %</td><td>$CaCO_3$ %</td><td>O.M</td><td colspan="3">Textural class</td></tr>
<tr><td colspan="2">73.22</td><td>21.15</td><td>4.80</td><td>0.65</td><td>0.90</td><td>0.10</td><td colspan="3">Sandy</td></tr>
<tr><td colspan="3">Available N (ppm)</td><td colspan="4">Available P (ppm)</td><td colspan="3">Available K (ppm)</td></tr>
<tr><td colspan="3">25</td><td colspan="4">5.7</td><td colspan="3">49</td></tr>
</table>

Table (2): Chemical analysis for organic fertilizers

Characters	Town waste	Compost
Moisture %	11.5	39.23
Total nitrogen %	0.96	1.30
Organic carbon %	28.40	25.5
Organic matter %	48.96	43.96
C/N ratio	1:29	1:19
$NH_4^+ + NO_3^-$ (ppm)	53.0	201.4
Available P (ppm)	89.83	310.8
Available K (ppm)	75.0	110.5
Total phosphorus %	0.01	0.05
Total potassium %	0.18	0.29
Available microelements (ppm)		
Fe	34	18
Mn	9	15
Zn	3	7
Cu	1	3
Available heavy metals(ppm)		
Pb	7	nil
Ni	2	"
Cd	1	"
Cr	1	"

RESULTS AND DISCUSSION

The discussion would deal with the main effects of the treatments and the interaction between them on peanut crop.

1- Solitary effect of bio, organic and chemical fertilizers:

a. The effect on peanut yield:

Figs. 1a,b,and c represent the relationship between the individual effect for each of biofertilizer, chemical nitrogen and organic matter from one side, and peanut crop yield and its components from anther one. Biofertilizer included the inoculums of Effective microorganisms (EM) and nitrogen fixers (NF), chemical nitrogen fertilizer was in full recommended rate (RRn) and half recommended one (1/2RRn). Organic fertilizer was from two sources, these are town-refuse (TR) and compost of fermented organic wastes (Comp.).

It can be stated, from Fig.1a and Table (3) that there are significant effects for each solitary treatment on yield parameters (seed, pods, foliage and husk) in the following descendent arrangement; Comp., EM, NF, RRn, T.W and 1/2RRn. The values of Comp, EM, NF and RRn are nearly similar on all parameters, recording with seed yield 1086.7, 1080.5, 1022.6 and 1018.3kg/fed respectively. The effect of T.W (978.5kg/fed) and 1/2RRn(913.3kg/fed) were much less. The obtained results assured the importance microorganisms of fermented compost or inoculums of EM and NF on legumes. These organisms play a beneficial role in promoting plant growth in equal with the treatment recommended nitrogen rate (RRn) taken into consideration the expensive cost of chemical fertilizers.

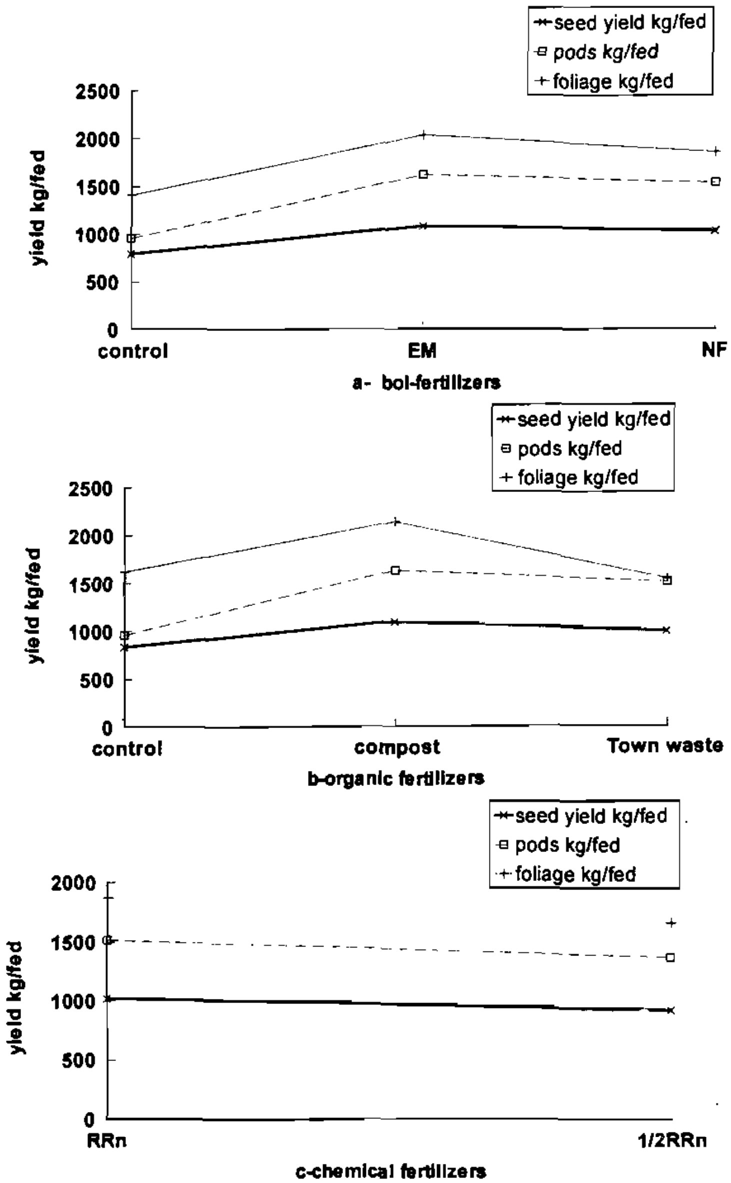

Fig (1): Solitary effect of bio, organic and chemical fertilizer on yield and yield components of peanut

The impact of EM in enhancement peanut growth is attributable to the efficacy of microorganisms for nutrients supplying from organic amendments towards sustaining the crop yield, Hussein *et al.*, (1999) and Myint (1999). It is known also, that EM have hormonal action as giberellic acid, therefore the seedling emergence speed was superior, leaf photosynthesis onset early and resistant to damping off and root rot pathogens became better, consequently EM produced larger plants than the conventional systems, Tokeshi and Chagas(1999). EM solution contains many species of beneficial microbes can control and suppresses pests and diseases such as fusarium, Sakurai (1999) and phytopthora (Wang *et al.*, 2000) and pickle warm (Wood *et al.*, 1998). In addition to the action of EM in improving soil aggregate using fungal hyphaes and polysaccharides releasing of fungi and bacteria, Frighetto *et al.*, (1999)

Table (3) : Effect of organic, bio and chemical N-fertilizer on peanut yield and its components

rganic fertilize	Bio fert.	N-levels	Seed yield kg/fed.	Pods yield kg/fed	Foliage kg/fed	Husk kg/fed	Shealing %
Control	Non	100%	661.5	958.7	1256.85	297.2	69.0
		50%	551.0	784.9	1019.35	233.8	70.2
	EM	100%	1022.5	1451.8	2024.55	429.3	70.4
		50%	976.5	1485.5	1904.18	508.9	65.7
	N-Fixers	100%	941.5	1367.5	1861.30	426.0	68.85
		50%	840.0	1195.5	1660.34	355.5	70.26
Compost	Non	100%	913.3	1356.4	1817.53	442.9	67.33
		50%	859.7	1257.7	1710.94	397.9	63.89
	EM	100%	1115.0	1745.2	2118.50	630.2	67.18
		50%	1406.5	2093.6	2741.70	687.1	70.02
	N-Fixers	100%	990.33	1414.3	1960.86	423.9	65.57
		50%	1235.50	1884.2	2446.29	648.7	65.04
Town waste	Non	100%	940.00	1445.2	1411.00	506.1	65.00
		50%	840.00	1292.3	1260.00	452.3	65.66
	EM	100%	1046.5	1593.7	1779.10	547.2	65.69
		50%	1211.9	1881.0	2060.30	669.1	64.43
	N-Fixers	100%	832.2	1224.0	1206.64	391.9	67.99
		50%	1000.3	1525.5	1450.73	525.0	65.55
L.S.D. 0.05							
Organic fert.			**89.05**	**138.83**	**171.0**	**53.7**	**2.04**
Bio. Fert.			**85.2**	**114.9**	**127.8**	**50.7**	**n.s**
Chemical N-fert.			**54.0**	**88.50**	**87.34**	**45.3**	**n.s**
Interaction effect							
O.F x Bio			**42.0**	**160**	**185.4**	**60.5**	**n.s**
Chemical x O.fert.			**54.3**	**134.3**	**140.6**	**n.s**	**n.s**
Bio. x Chemical Fert			**33.0**	**115.0**	**110.5**	**n.s1**	**n.s**
Bio x O Fert x ch.N			**96.0**	**185.2**	**188.0**	**55.0**	**n,s**

Concerning N-fixers, the results was oriented the attention to importance of using biofertilizer in promoting peanut and for substituting a part of nitrogen requirements which reaches to 42-65% of recommended rate of nitrogen according to Galal and Ghendour, 1997. The results denoted that the dual inoculation with *Rhizobium* and *Azospirillum* significantly increased seed yield compared with organic manuring and that is gone well with Abd El-Rasoul *et al.*, (2002). It is due to *Rhizobium* which plays an importance role in providing a great part of nitrogen for peanut growth via-biological N_2fixation by legumes. In the same time, *Azospirillum* increases the nodulation and efficiency of *Rhizobium*, Burns *et al.*, (1981).

Actually, incorporating organic matter into soil improves its structure and soil available water, as well as chemical and biological properties, consequently the plant growth of peanut was enhanced and the seed yield was increased. However compost fertilized peanut showed higher growth and grain yield than Town refuse fertilized ones. It is may be attributed to that the fermented composted fertilizer contents higher amounts of available N (201.4ppm), P (310.8ppm), K (110.15ppm), Fe(18ppm), Mn(15ppm), Zn (7ppm) and Cu(3ppm) compared with Town refuse fertilizer(Table 2). Also, the fermentation process of compost fertilizer led to multiply of beneficial microorganisms with decreasing of C/N ratio (1:19.6).

b. The effect on NPK uptake

The individual effect for each of bio, organic and chemical fertilizers on NPK uptake by peanut seeds and foliage is illustrated in Figs. 2a,b and c. Nitrogen uptake of seeds was arranged in the following descending order; Comp. (43.76 kg fed^{-1}) N-fixers (40.36 kg fed^{-1}), EM (40.15 kg fed^{-1}), RRn (39.95 kg fed^{-1}), WT (33.23 kg fed^{-1}) and 1/2RRn(30.65 kg fed^{-1}). Meanwhile the phosphorus and potassium uptake were trended to the following descending order; EM, Comp., RRn, NF, WT and 1/2RRn.

The results showed the positive effect between N-fixers inoculation and fermented compost to enhance the utility of nitrogen in peanut seeds. Also, data depicted the role of EM inoculation in sustaining NPK uptake in peanut seeds and increase the seed yield. These results could be attributed the importance of specialized microbes such photosynthetic bacteria, lactic acid bacteria, N-fixers bacteria (*Rhizobium* and *Azospirillum*), Yeast, Ray fungi and Actinomyces. These microorganisms multiply and encourage beneficial conditions for uptake nutrients when applied to agricultural soils. These results are in agreement with those obtained by El-abyad et al., (1993), Sakurai(1999), El-Aggory, *et al.*, (2001), El-Sewify *et al.*, (2003) and Abd El-Rasoul *et al.*,(2003)

2. Dual effect of bio- chemical, bio- organic and chemical- organic fertilizers

a. The effect on peanut yield:

The combined application of bio-chemical, bio-organic and chemical-organic fertilizers and their effect on peanut yield parameters (seed, pods and foliage) are plotted in figures 3a,b and c. The presented results revealed that the integrated use of biological inoculations with organic matter and or/ mineral fertilizers gave higher seeds, pods and foliage yield as compared with any fertilizer application alone. This explain that the specialized microorganisms of EM or N-fixers inoculums have an important role when applied in combination with organic and /or inorganic fertilizers in increasing the availability of nutrients, and in the biological resistance posed to pathogens and herbs, Tokeki and Chaga(1999).

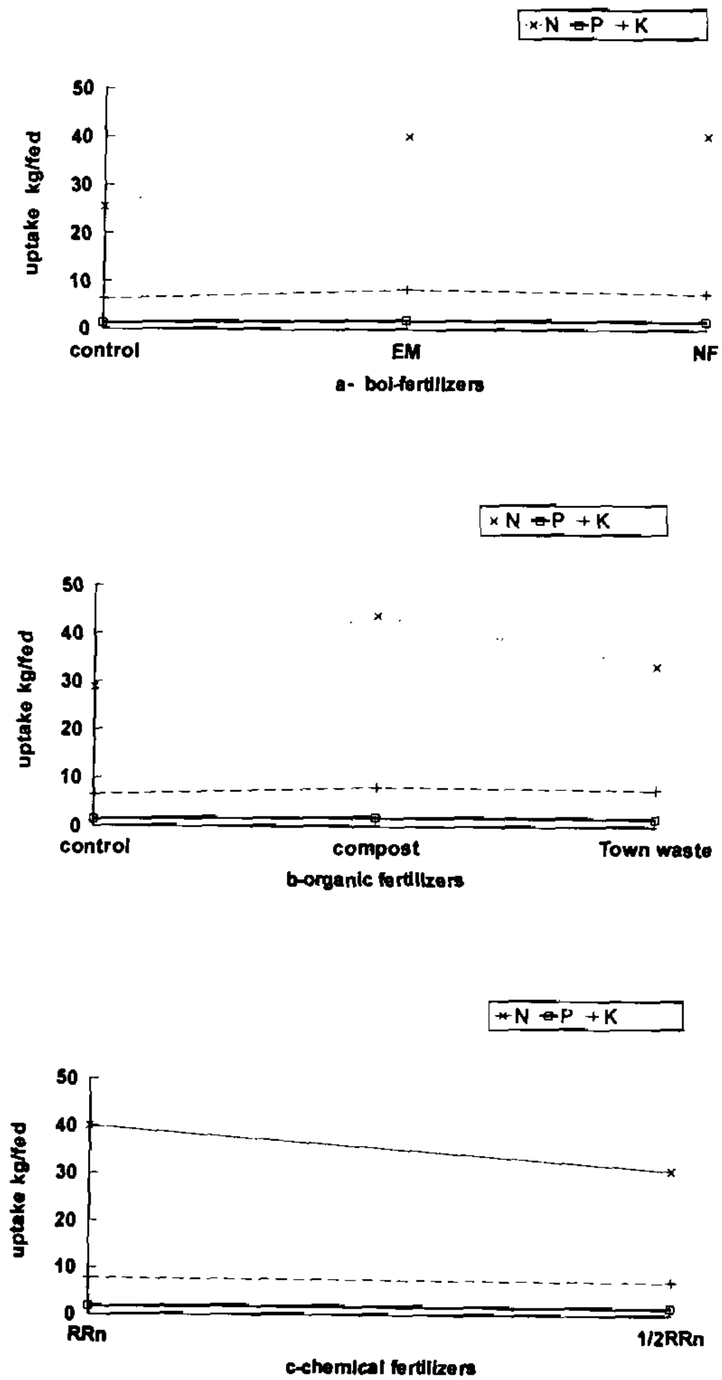

Fig (2): Solitary effect of bio, organic and chemical fertilizer on NPK uptake by seeds of peanut

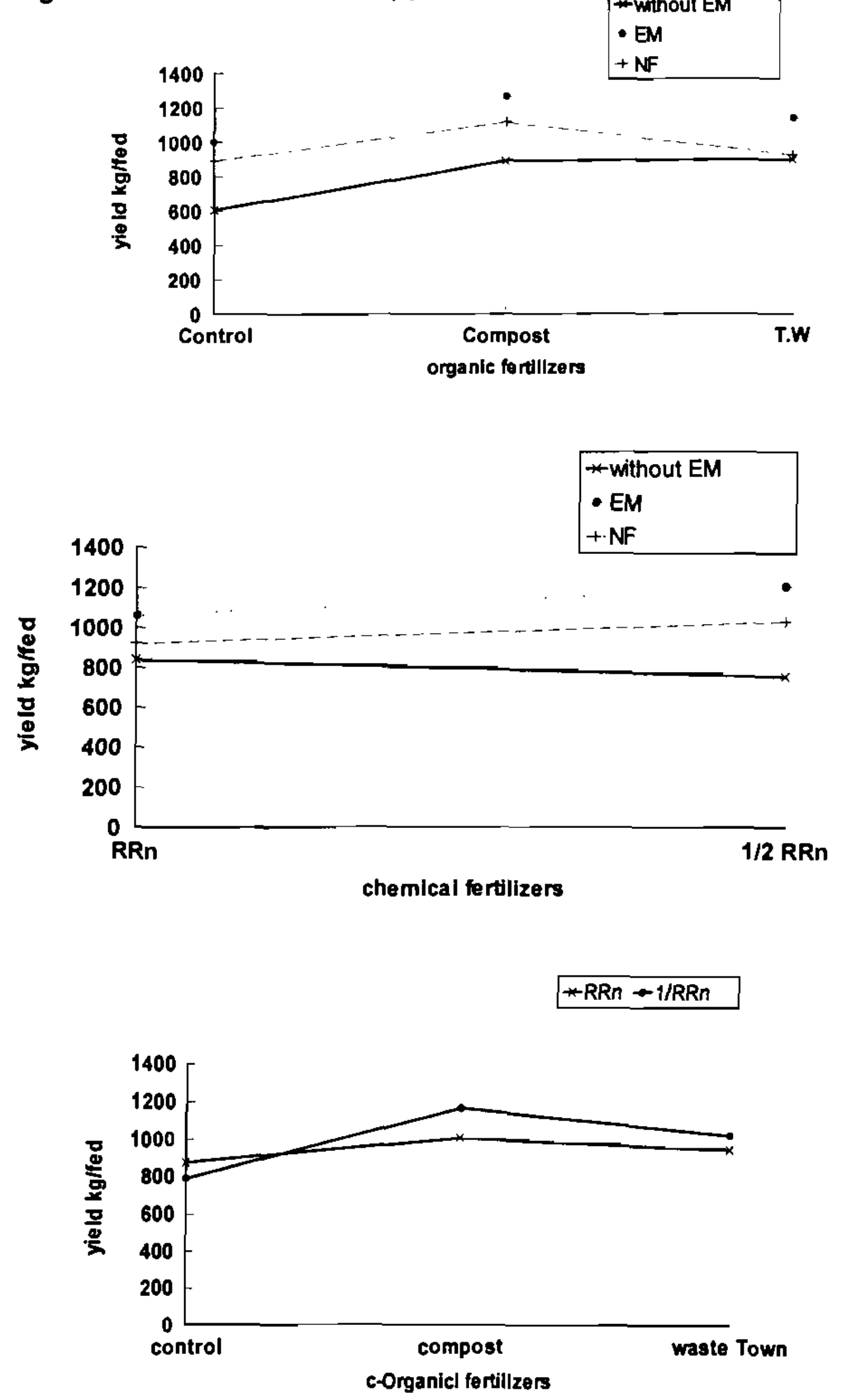

Fig (3a): Dual effect of bio, chemical and organic fertilizers on seed yield of peanut.

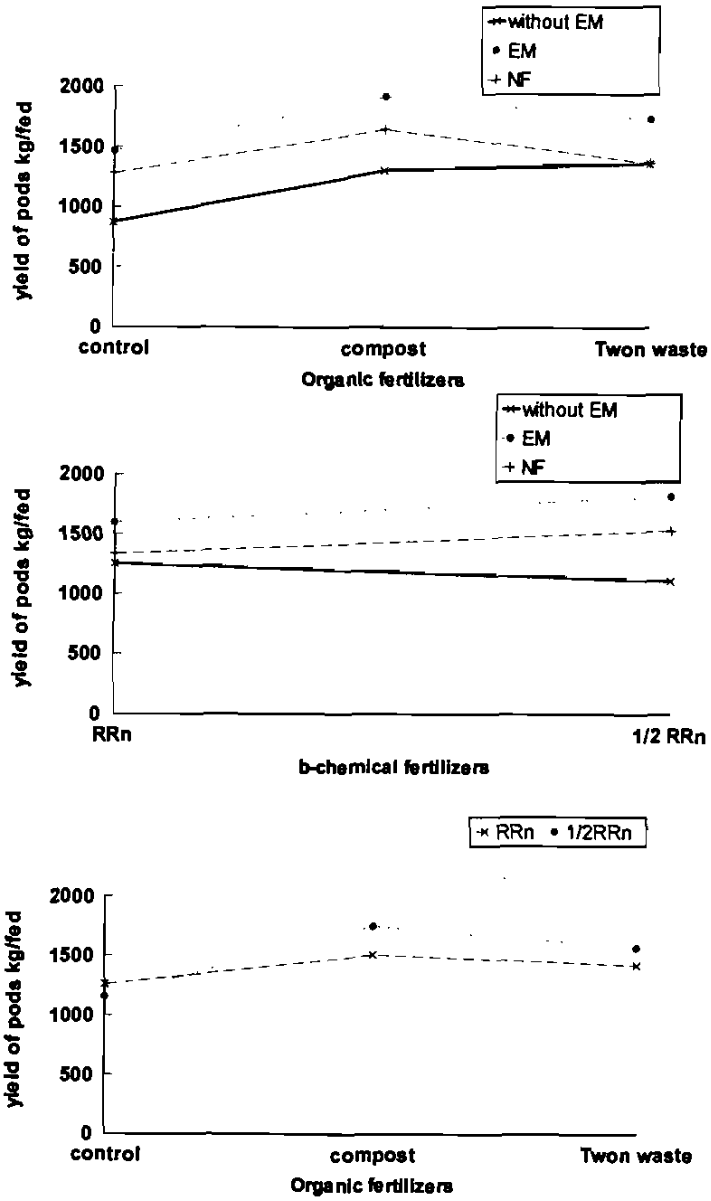

Fig (3b): Dual effect of bio, chemical and organic fertilizers on pods yield of peanut.

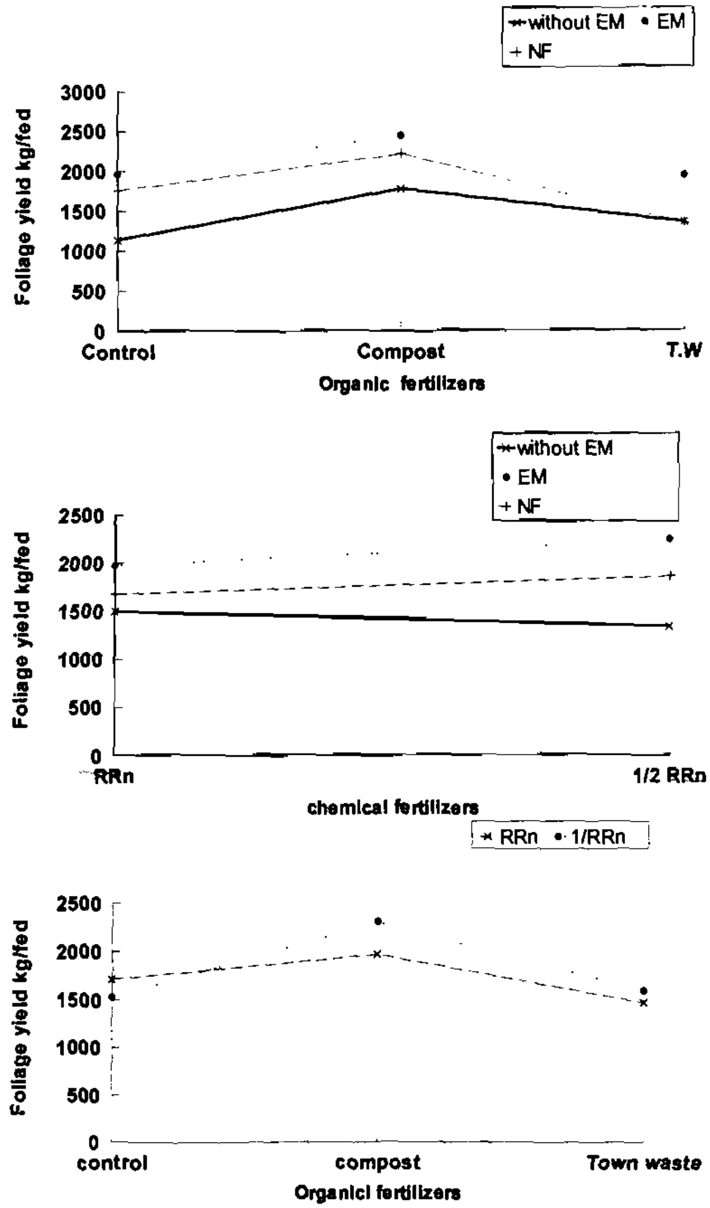

Fig (3c): Dual effect of bio, chemical and organic fertilizer on foliage yield of peanut.

It is worth to mention that peanut seed yield with treatments of EM or N-fixers alone was lower than interaction treatments between microbes inoculums and organic and /or inorganic fertilizers. Possibly, it is due to the competion between microorganisms and plants for nutrients.

Also, it is obvious that the application of EM or N-fixers in combination with full recommended rate of nitrogen (RRn) gave peanut seeds yield comparatively smaller than with 1/2RRn. It possibly, due to the fact that microbes were suppressed when high level of nitrogen was existed in soil, Myint (1999).

b. The effect on NPK uptake:

The effect of dual treatments of fertilizers on NPK uptake by peanut plants is shown in Table (4). The results indicated that EM inoculums in combination with fermented compost gave higher nitrogen into peanut seeds than other dual treatments. Nitrogen uptakes were 55.77 and 48.89 kg fed^{-1} (EM-Comp.) and (N-fixers–Comp) treatments, respectively. Phosphorous and potassium uptake into seeds were (2.08 and 206 kg fed^{-1}) and 9.00 and 8.64 kg fed^{-1}) respectively with the same treatments. Meanwhile NPK uptake was relatively smaller for other dual treatment. Similar trend was dominant with peanut foliage yield.

Table (4) : Effect of organic, bio and chemical N-fertilizer on NPK-uptake by peanut seed and foliage (kg/fed).

ganic fertiliz	Bio fe	N-levels	Nutrient uptake by seed (kg/fed)			Nutrient uptake by straw (kg/fed)		
			N	P	K	N	P	K
Control	Non	100%	22.5	1.19	5.62	33.93	1.13	17.57
		50%	15.98	0.99	4.30	22.43	0.93	12.3
	EM	100%	38.34	1.64	7.98	37.45	1.42	28.35
		50%	33.69	1.56	7.42	40.56	1.52	26.66
	N-Fixers	100%	34.84	1.70	7.34	45.60	1.68	22.34
		50%	28.14	1.43	6.30	40.35	1.33	23.25
Compost	Non	100%	27.40	1.37	7.12	37.80	1.45	2363
		50%	25.79	1.29	6.28	40.21	1.37	22.24
	EM	100%	44.04	1.45	8.47	54.66	2.12	38.40
		50%	67.51	2.67	9.56	54.85	2.00	40.25
	N-Fixers	100%	39.12	1.68	7.59	50.58	1.90	37.25
		50%	58.68	2.4	9.76	49.66	1.96	34.46
Town waste	Non	100%	33.40	1.23	7.53	39.23	1.41	26.80
		50%	27.30	1.51	6.84	28.98	1.28	21.42
	EM	100%	33.78	1.57	8.79	38.48	1.77	21.35
		50%	37.79	2.55	8.61	52.62	2.06	28.84
	N-Fixers	100%	28.51	1.70	7.50	32.37	1.45	2.88
		50%	39.10	1.88	6.91	33.06	0.96	26.88

It is, also detected that nutrient uptake was better for dual treatments of compost than that with town waste fertilizer (W.T). it is may be related with higher content of available micro and macronutrients in compost comparing with T.W (Table 2).

As well, it is observed that T.W contains heavy metals relatively much accounts (7ppm Pb, 2ppm Ni, 1ppm Cd and 1 ppm Cr), undoubtedly it is affect on emerge of seedlings, plant growth, and effect on nutrient uptake too.

The importance role of the interaction between microorganisms and both of organic and inorganic fertilizers has been demonstrated by and Lal and Mathur (1988), Fanous and Mikhail(1997) and El-Bakry *et al.*,(2001)

3. The interaction between Bio, organic and inorganic fertilizers:-

a. The effect on peanut yield:

Data in Table (3) showed that the triad interaction between the inoculation of microorganisms (EM and N-fixers) and each of organic and inorganic fertilizers pronounced the maximum peanut yields. Significant increments were recorded for the triad integration of bio, chemical and organic fertilizers (Table 3). The relative percentages of mean peanut seeds weight increased in the triad (1450 kg fed^{-1}) interaction over control (551 kg fed^{-1}), solitary (1086 kg fed^{-1}) and dual (1260 kg fed^{-1}) treatments about 163, 34 and 17% respectively. Namely the individual treatments recorded the highest step-up. However, it can be risen the crop yield about 41% through the dual or triad interactions between bio, organic and chemical fertilizers.

The best peanut seed yield obtained from the interaction between EM + Compost +50%of nitrogen recommended rate (1/RRn) was 1450 kg fed^{-1}. Meanwhile the combination between N-fixers + comp. + ½ RRn gave 1235.5 kg fed^{-1}.

These values were decreased with application town waste fertilizer to reach 1214 and 1000 kg fed^{-1} only with the treatments (EM + T.W + ½ RRn) and (N-fixers + T.W + ½ RRn) respectively, Fanous and Mikhail (1997) and Sergia and Edwin (1999).

b. The effect on NPK uptake:

The values of NPK uptake are given in Table (4). The results demonstrated that nitrogen uptake into seeds yield was the highest account in both treatments of EM + Comp. + ½ RRn (67.51 kg fed^{-1}) and N-fixers + Comp. +1/2 RRn(58.68 kg fed^{-1}).

Concerning the treatments including waste town fertilizer (T.W) decreased the nitrogen uptake to 37.79 and 39.10 kg fed^{-1} for treatments of (EM+ T.W + ½ RRn) and (N-fixers + T.W + ½ RRn), respectively. The same tendency was noticed with phosphorous and potassium uptake into peanut seeds and foliage.

From the previous results and discussion the following conclusion were obtained:

Biological inoculums of EM and N-fixers gave higher rates of nutrient uptake specially nitrogen element.

EM and N-fixers enhanced the utility of nutrition elements towards sustaining the peanut yield with decreasing of inorganic nitrogen fertilizer at about 50% of RRn

Microorganisms of EM and N-fixers have beneficial role in emergence speed of seedling, leaf photosynthesis and resistance diseases and herbs consequently, produced healthy growth and wealthy yield.

Fermented compost fertilizer was superior quality than town waste fertilizer due to it's high content of available macro and micronutrients besides town waste included heavy metals.

The fine integration between bio, chemical and organic gave rise to peanut yield about 40% over the individual fertilization.

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تحسين انتاجية الفول السودانى من خلال التكامل بين التسميد الحيوى والعضوى والكيماوى

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تتجة الزراعة الحديثة الى الاعتماد على التسميد الحيوى فى تكامل مع التسميد العضوى والكيماوى للوصول لاقصى استفادة ممكنة من العناصر مع تقليل التلوث البينى الناتج من الاسمدة الكيماوية والمبيدات المستخدمة فى الزراعات التقليدية. ومن اشهر اللقاحات الحيوية المستخدمة هو مثبتات النتروجين (N-fixers) والكائنات الحية الدقيقة النافعة (EM) . حيث أن مثبتات النتروجين هو لقاح مزدوج من بكتيريا الريزوبيوم (*Rhizobium*) والاسوزبرليبيوم (*Azospirillum*) فى حين أن ال EM يعتمد على أربعة مكونات رئيسية هامة للبيئة وهى بكتريا حمض اللاكتيك (lactic acid) ، الخميرة (Yast) ، الاكتينوميسس (Sctinomyeces) ، بكتيريا التمثيل الضوئى (Photosynthis) و الفطريات (Ray fungi) .

اقيمت تجربة بمحطة البحوث الزراعية بالاسماعلية خلال الموسم الصيفى ٢٠٠٢ لدراسة تأثير نوعين من الاسمدة العضوية وهما الكومبوست وهوسماد نباتى متحلل بطرق بيولوجية وسماد مخلفات المدن (town waste) مع استخدام معدلين من التسميد المعدنى النتروجينى وهما معدل بحسب التوصية السمادية (RRn) ونصف التوصية السمادية (1/2RRn) مع كل من مثبتات النتروجين (N-fixers) والكائنات الدقيقة النافعة (EM) على انتاجية الفول السودانى ومكوناتة وعناصر النتروجين والفوسفور والبوتاسيوم الممتصة بواسطة كل من البذور والقش.تم تصميم التجربة فى قطع منشقة مرتين فى ثلاث مكررات.

وقد أظهرت النتائج تأثيرات معنوية لاستخدام الاسمدة الحيوية والكمبوست حيث سجل محصول البذور ١٠٨٦، ١٠٥٠,٥، ١٠٢٢,٦، ١٠١٨,٣، ٩٧٨,٥، ٩١٣,٣كجم/فدان للمعاملات الكمبوست ، EM، مثبتات النتروجين، التوصية السمادية الكاملة، سماد مخلفات القمامة، ونصف التوصية السمادية على التوالى. وقد قابل ذلك امتصاص لعنصر النتروجين مقدارة ٤٣,٧٦، ٤٠,٣٦، ٤٠,١٥، ٣٩,٩٥، ٣٣,٢٣، ٣٠,٦٥كجم/فدان لمعاملات الكمبوست، مثبتات النتروجين ،EM ، RRn ، سماد مخلفات المدن، 1/2RRn على التوالى. بينما كان امتصاص الفوسفور والبوتاسيوم يتبع الترتيب التنازلى التالى EM ، الكومبوست، RRn ، مثبتات النتروجين، سماد مخلفات المدن، 1/2RRn .

اما بخصوص التأثير المزدوج ما بين التسميد(الحيوى– العضوى)، (الكيماوى – العضوى) ، (الحيوى– الكيماوى) على محصول الفول السودانى فقد اظهرت النتائج أن استخدام اللقاحات الحيوية (EM, N-fixers) مع الكومبوست أو التسميد النتروجينى الكامل أعطى أعلى محصول للبذور والقرون وأعلى وزن نباتى مقابل ذلك محتوى نتروجينى ٥٥,٧٧، ٣٨,٨٩ كجم/فدان فى معاملتى (كومبوست – EM) ، (كومبوست – مثبتات النتروجين) على التوالى وكذلك محتوى الفوسفور والبوتاسيوم بمقدار (٢,٠٦-٢,٠٨) ، (٨,٦٤- ٩,٠) كجم/فدان على التوالى فى البذور فى نفس المعاملتين.

تم الحصول على أعلى محصول للفول السودانى من المعاملة الثلاثية (EM + Comp. + 1/2RRn) حيث وصل الى ١٤٥٠,٠كجم/فدان ويلية المعاملة (N-fixres +Comp.+ 1/2RRn) حيث كان ١٢٣٥ كجم/فدان وقابل ذلك امتصاص للنتروجين بمقدار ٦٧,٥١كجم/فدان فى المعاملة الاولى ، ٥٨,٦٨ كجم/فدان فى المعاملة الثانية. بينما أظهرت المعاملات الداخل فيها سماد مخلفات المدن محتوى عنصرى انتاجية أقل فى البذور او القرون وايضا للنبات الكلى حيث كان محصول البذور ١٢٣٥,٥، ١٠٠٠كجم/فدان فى معاملتى (EM+ W.T +1/2RRn)، (N-fixers + W.T + 1/2Rrn) على التوالى.

أظهرت الدراسة أن كلا من اللقاحين EM< N-fixers عملا على زيادة الاستفادة من عنصر النتروجين مما ساعد فى خفض السماد النتروجينى الى نحو ٥٠% من التوصية السمادية.