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EFFECT OF SPRAYING WITH MICROELEMENTS AND DIFFERENT FERTILIZER SOURCES ON PEA YIELD AND QUALITY

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ABSTRACT

Two field experiments were carried out at El-Bramoon Agricultural Research Farm of Mansoura Horticultural Research Station during the two successive winter seasons of 2004 and 2005, to investigate the effects of spray with some microelements (Fe, Zn and Mn each at 100 ppm), different fertilizer sources (FYM, mineral fertilizer and control) and biofertilization with Rhizobium as well as their interactions on yield and yield components and chemical constituents of pea plant (*Pisum sativum* L.) cv. Master-B.

Results revealed that spraying pea plants with a mixture of microelements significantly increased yield and yield components expressed as pod length, pod weight, number of green seeds /pod, weight of 100- green seed , seed index (1000-dry seed weight) and chemical constituents i.e., NPK, carbohydrates % and protein % of green seeds of pea plant in both seasons .

Results showed that fertilization with FYM was the most reliable treatment compared with chemical fertilizer and control treatments in both seasons

All studied characteristics of pea plants were generally greater with biofertilizer treatment (Rhizobium) than without it.

The best results were obtained from spraying pea plants with a mixture of microelements and application of FYM in the presence of Rhizobium inoculation.

INTRODUCTION

Pea (*Pisum sativum*, L.) is one of the most important leguminous vegetable crops grown during winter season in Egypt. It occupies a great figure in the local consumption and export.

Great efforts have been directed to improve pea production and quality for the purpose of increasing exported yield. Application of adequate amounts of microelements is one of the most important factors involved in improving plant growth, yield and quality of pea.

The nutrition of plants by foliar application is not only an addition channel of nutrients but also a mean of regulating root absorption by such plants (El-Hawary, 1999). The importance of spraying microelements, i.e., Fe, Zn and Mn can be accounted by its essential role in respiration, their metabolism activation of the enzyme, photosynthesis, chloroplast formation, chlorophyll synthesis and natural hormone biosynthesis (Epstien, 1972 and Nijjar 1985).

Organic manures contain higher levels of relatively available nutrients, which are essentially required for plant growth. The addition of organic matter improves the physical, chemical and biological properties of soils and natural organic material are broken down slowly by soil microorganisms (Shafeek *et al*., 2001 and Rizk *et al.,* 2002) resulting more release of plant available nutrients.

Rhizobium (*Rhizobium leguminosarum*) play a principle role in N-fixation in soil which increases the uptake of N through plant roots. Many investigators reported that Rhizobium increased plant growth, yield components and chemicals composition of legumes plants (Tartoura, 2002, on pea and Sobh *et a*l. 2000, on faba bean). .

Therefore, this study was conducted to investigate the effects of some microelements, bio-and mineral fertilizer source treatments and their interactions on yield and yield components and chemical constituents of pea plant .

MATERIALS AND METHODS

Two field experiments were carried out at El-Bramoon Agricultural Research Farm of Mansoura Horticultural Research Station during the two successive winter seasons of 2004 and 2005. The experiments were designed to investigate the effects of some microelements, bio-and mineral fertilizer source treatments and their interactions on yield and yield components and chemical constituents of pea plant (*Pisum sativum,* L.) c.v. Master-B.

The physical and chemical properties of the experiment soil at the depth of 0-50 cm are shown in Table (1) with determined according to Black (1965) and Page *et al.* (1982).

Table (1): Some physical and chemical analysis of experiments soil .

Soil / Properties	Texture class	Clay %	Silt %	sand %	PH	EC dS/m	O.M	N (ppm)	Available P (ppm)	Available K (ppm)
Value	Clayey	65.63	12.37	22	7.6	0.85	1.78	75.1	16.4	350

The experimental design and treatments:

The split-split plot system in a randomized block design with three replicates was used in both growing seasons. The foliar treatments were randomly located in the main plots whereas the sub-plots were devoted for the fertilizers sources and the biofertilizer treatments were assigned to the sub-sub plot. The sub-sub plots area was 15.60 m^2, which consisted of 8 ridges, 3.25 m length and 0.60 m width.

The experiment included 12 treatments, which were the combination between two treatments of foliar applications, three sources of fertilizers and two levels of biofertilizers .

Planting method:

Seeds were sown on November 10th in 2004 and 2005 seasons, respectively. Seeds were sown in hills 5 cm apart on one side of each ridge.

Microelements: A mixture of chelated microelements, i.e., Zn-EDTA (13% Zn), Mn-EDTA (13% Mn) and Fe-EDTA (13% Fe), was sprayed on plants after 30, 40, 50 and 60 days from sowing. The mixture of microelements was applied at 0 and 100 ppm.

Mineral fertilizers: The experimental plots were fertilized according to the recommendation of Ministry of Agriculture(30 kg N/fed. in the form of ammonium sulphate (20.5% N), 30 kg P_2O_5 /fed as a form of calcium

superphosphate (15.5 % P_2O_5). and 50 kg K_2O /fed. as potassium sulphate (50 % K_2O).

Cattle manure: 20 m^3/fed. were mixed with the soil during bed shaping. The chemical analysis samples is shown in Table (2)**.**

Table (2):Chemical analysis of cattle manure used during the xperiment

Haracter / Organic fertilizer	PH	EC dS/m	O.M	Total N %	Total P %	Total K %	Fe ppm	Zn ppm	Mn ppm	Cu ppm	C:N ratio
Cattle manure	7.8	13.95	20.10	1.2	0.85	1.1	811	100	150	89	17.6:1

Biofertilizers: The pea seeds were inoculated at sowing with nitrogen fixing bacteria *(Rhizobium leguminosarum*).

Studied traits:

1- Green pods of four ridges of each plot were harvested three times and the dry pods of the other four ridges were harvested at the end of experiment, threshed and the following characters were calculated:

a-Average pod length

b-Average pod weight

c-Number of green seeds/pod .

d-Weight of 100- green seed

e-Seed index (1000-dry seed weight).

2 - Seed chemical constituents

A representative samples of 100 g. of green seeds from each experimental plot were taken randomly to determine the following characteristics:

1- Total nitrogen was determind as described by A.O.A.C. (1975).

2- Phosphorous was determined colorimetrically according to the standard method of Jackson (1967) using 660 nm was length.

3- Potassium was determined using flame photometer according to Jackson (1967).

4- Total carbohydrates content was determined colorimetrically according to the method described by Michel *et al*. (1956).

5- Total protein % was calculated by multiplying nitrogen % content by 6.25.

3.8. Statistical analysis:

The obtained data were subjected to statistical analysis as technique of split split plot design with three replicates in both growing seasons. All data were subjected to the analysis of variance according to Gomez and Gomez (1984), and L.S.D values were used for comparison.

RESULTS AND DISCUSSION

1. SEED CHEMICAL COMPOSITION

1.1 NPK content

1.1.1. Effect of microelements*:*

Data concerning total N, P and K contents in green seeds as affected by foliar treatments are illustrated in Table (3) **.**

It's evident from such data that foliar application with microelements significantly increased N, P and K content of pea green seeds compared with control. These results are true in the two seasons.

These increases in elemental constituents of pea seeds may be due to the effect of micronutrients on stimulating biological activities, i.e., enzyme activity, chlorophyll synthesis, rate of translocation of photosynthetic products and increased nutrient uptake through roots after foliar fertilization (Follett *et al*, 1981).

The obtained results are in accordance with those of Omran *et al.* (1991), Nofal *et al.* (1998), Radwan and Tawfik (2004) and Hassan *et al*. (2005) who found that spraying potato and sweet potato plants with micronutrients significantly increased N, P and K concentrations in different plant parts.

1.1.2. Fertilizer sources:

Data in Table (3) indicated also that N, P and K contents in the green seeds were significantly increased by the application of both FYM and mineral fertilizer compared with control plants, but FYM recorded the higher values during the two seasons of study.

Table 3: Effect of foliar applications, fertilizer sources, biofertilizer and their interactions on NPK content in green seeds during 2004 and 2005 seasons.

Characters	N%		P%		K%	
Seasons	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
A: Foliar applications:						
Control	3.284	2.955	0.417	0.436	1.513	1.435
With Micronutrients	3.561	3.180	0.494	0.455	1.630	1.549
LSD 5%	**0.101**	**0.110**	**0.020**	**0.022**	**0.050**	**0.043**
B: Fertilizer sources:						
Control	3.250	2.797	0.414	0.405	1.536	1.400
FYM	3.606	3.291	0. 483	0.477	1.596	1.594
With N.P.K. fertilizer	3.411	3.113	0. 469	0.455	1.584	1.454
LSD 5%	**0.081**	**0.082**	**0.029**	**0.021**	**0.041**	**0.045**
C: Biofertilizer :						
With	3.430	3.133	0.476	0.478	1.604	1.530
Without	3.415	3.002	0.435	0.413	1.539	1.454
F. Test	*	**	*	**	**	**
D: Interactions:						
A x B	*	*	NS	NS	NS	NS
A x C	NS	NS	NS	NS	NS	NS
B x C	NS	*	NS	**	*	NS
A x B x C	*	*	*	NS	*	*

NS = No significant
*** = Significant at 5%**
**** = High significant at 1%**

The obtained results are in harmony with those of Kotb (1994) who stated that application of organic manure increased the total uptake of N, P and K by pea plants than control treatment.

1.1.3. Effect of biofertilizer

Data in Table (3) clearly showed that application of biofertilizer with Rhizobium increased significantly N, P and K content of pea seeds. These results were true in the two seasons of study.

Such obtained results are in agreement with those mentioned by El-Neklawy *et al*. (1985), Sarg and Hassan (2003), Abo El-Salehein *et al*. (2005) on pea.

1.1.4. Effect of interactions

Table (3) showed the effect of interactions on N, P and K in pea seeds, the data showed that the concentrations of N, P and K in seeds were not significantly affected by the interaction among all studied factors in the two growing seasons except the interaction between foliar application x fertilizer sources on N content in both seasons, fertilizer sources x biofertilizer on NPK contents in one season only and the interaction between the three factors on N and k contents in both seasons and
P content in the first one .

1.2. Total carbohydrates% and total protein %

1.2.1. Effect of microelements*:*

Data in Table (4) clearly illustrated that spraying with microelements significantly increased the concentration of total carbohydrates % and total protein % in green seeds of pea plants compared with control plants in both seasons.

Table 4 : Effect of foliar applications, fertilizer sources, biofertilizer and their interactions on Carbohydrates % and Protein % of pea seeds during 2004 and 2005seasons.

Characters	Carbohydrates %		Protein %	
Seasons	**2004**	**2005**	**2004**	**2005**
A: Foliar applications:				
Control	49.378	47.413	20.52	18.47
With Micronutrients	52.236	49.123	22.26	19.87
LSD 5%	**1.235**	**1.052**	**1.250**	**0.965**
B: Fertilizer sources:				
Control	49.099	47.409	20.31	17.48
FYM	51.902	49.901	22.53	20.57
N.P.K. fertilizer	51.244	47.507	21.32	19.45
LSD 5%	**1.312**	**1.211**	**0.125**	**0.198**
C: Biofertilizer :				
With	51.383	48.850	21.44	19.58
Without	50.231	47.693	21.35	18.76
F. Test	*	*	*	*
D: Interactions:				
A x B	NS	NS	*	*
A x C	NS	*	NS	NS
B x C	*	*	NS	*
A x B x C	NS	NS	*	*

The positive effect of micronutrients on chemical contents of green pea seeds may be due to their involvement in one or more of important biological functions such as synthesis of chlorophyll, electron transport system, oxidation-reduction reactions, protein synthesis, degradation and Co-

enzyme of several important enzymes (Follett *et al*., 1981 and Tisdale *et al*., 1985).

The obtained, results agree with those of Dwivedi (1991), Nofal *et al*, (1998) and Radwan and Tawfik (2004).

1.2.2. Fertilizer sources:

As shown in Table (4), seeds content of total carbohydrates % and total protein % was significantly increased due to using the fertilizer treatments compared with control plants. FYM recorded the highest values in this respect compared with mineral fertilizer or control in both seasons. These results agree with reported by Atia (2005) on cowpea who indicated that the highest values of protein and carbohydrates in seeds were observed with addition FYM in both seasons

1.2.3. Effect of biofertilizer

Data in Table (4) revealed that inoculation of pea plants with Rhizobium bacteria led to significant increases in the concentration of total carbohydrates % and total protein % in green seeds of pea plants in both seasons of the study compared with control.

The increase in seed chemical constituents is a result of nitrogen fixation by Rhizobium bacteria from the atmospheric nitrogen in the root media, since more than 90% of fixed nitrogen is rapidly translocated from bacteria to the different plant organs(Marschner, 1995).

The obtained results are in agreement with those mentioned by Abou El-Salehein *et al*. (2005) on pea who reported that nutritive value of pea seeds, i.e., protein and total carbohydrates percentage were significantly affected by Rhizobium inoculation.

1.2.4. Effect of interactions

As presented in Table (4), No significant differences were found except the interaction between foliar applications x fertilizer sources on protein content in both season, The interaction between foliar application x biofertilizer recorded

A significant effect on the carbohydrates % in the second season . Also, the interaction between the fertilizer sources x biofertilizer affected significantly on carbohydrate content in both season and protein % in the second one . The interaction effect among the three factors was significant on protein in both seasons .

2. Weight of 100-green seed and 1000-dry seed

2.1. Effect of microelements

It's clear from data in Table(5) that both weights of 100-green seed and 1000-dry seed were significantly increased as a result of application of microelements treatments comparing with untreated plants in both seasons of study.

2.2. Fertilizer sources:

The results in Table (5) revealed that fertilization with FYM was the most reliable treatment among the three fertilizer sources on weight of 100 green and 1000 dry seed in both seasons .

2.3. Effect of biofertilizer

Data in the same Table showed that inoculation with biofertilizers led to significant increases in the weight of 100-green seed and 1000-dry seed of pea in both seasons of the study compared with check plants.

2.4. Effect of interactions

As presented in Table (5), significant differences were observed in the two seasons except the interaction between foliar applications x fertilizer sources in the first season and the interaction among the three factors on both characters.

3. Green pod character (fresh pod length, pod weight and number of seeds/pod)

3.1 Effect of microelements

Concerning the effect of microelements on yield components, data presented in Table (6) indicated that application of micronutrient mixture as foliar spray was generally more effective than the control plants in both seasons of study**.**

Improving effect of Fe, Zn and Mn on yield and its components might be attributed to their positive role on enhancing photosynthesis, biosynthesis of proteins and carbohydrate assimilation (Epstien, 1972).

This is in coincidence with the findings of Hassan *et al. (*2005) on sweet potato, Abd El-Hadi *et al.* (1986) and Nofal et al. (1998) on potato plants, where they found that yield and its components increased markedly by foliar spray of micronutrients compared with the untreated plants.

Table 5 : Effect of foliar applications, fertilizer sources, biofertilizer and their interactions on weight of 100-green seed and 1000-dry seed during 2004 and 2005 seasons.

Characters	**100-green seed weight (g)**		**1000-dry seed weight (g)**	
Seasons	**2004**	**2005**	**2004**	**2005**
A: Foliar applications:				
Control	47.14	45.32	326.04	302.41
With Micronutrients	51.34	48.82	360.47	347.52
LSD 5%	**2.76**	**1.69**	**20.15**	**22.11**
B: Fertilizer sources:				
Control	45.51	45.20	313.36	314.25
FYM	51.69	48.43	365.98	332.85
N.P.K. fertilizer	50.52	47.58	350.58	327.80
LSD 5%	**1.12**	**1.60**	**10.32**	**8.52**
C: Biofertilizer :				
With	50.50	48.39	358.24	346.48
Without	47.98	45.75	328.27	303.45
F. Test	**	**	**	**
D: Interactions:				
A x B	NS	*	NS	*
A x C	*	*	*	*
B x C	*	*	*	*
A x B x C	NS	*	NS	*

Table-6 : Effect of foliar applications, : fertilizer sources: biofertilizer and their interactions on fresh pod length, pod weight and number of seeds/pod during 2004 and 2005 seasons.

Characters	Fresh pod length (cm)		Fresh pod weight (g)		No. of seeds /pod	
Seasons	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
A: Foliar applications:						
Control	8.80	8.33	5.17	4.66	8.94	8.90
With Micronutrients	9.50	8.97	5.69	5.20	9.50	9.40
LSD 5%	**0.10**	**0.13**	**0.27**	**0.29**	**0.15**	**0.19**
B: Fertilizer sources:						
Control	8.92	8.54	4.78	4.53	8.92	8.90
FYM	9.33	8.97	5.28	5.02	9.41	9.36
N.P.K. fertilizer	9.19	8.82	5.12	4.90	9.32	9.20
LSD 5%	**0.18**	**0.24**	**0.13**	**0.16**	**0.19**	**0.23**
C: Biofertilizer :						
With	9.32	8.84	5.12	5.01	9.34	9.21
Without	8.98	8.46	5.00	4.85	9.10	9.09
F. Test	**	**	*	*	**	**
D: Interactions:						
A x B	*	*	*	*	NS	*
A x C	NS	NS	NS	NS	*	*
B x C	NS	*	NS	NS	NS	*
A x B x C	NS	*	*	NS	*	NS

3.2 Fertilizer sources:

The results in Table (6) showed that application of FYM was generally more effective as compared with chemical fertilizer or control where they significantly increased the previous measurements in the two growing seasons.

The obtained results are in harmony with those of El-Mansi *et al*.(1999) and Soubeih (2004) on pea plants who pointed out that application of FYM significantly increased average pod weight, pod length and number of seeds/pod.

3.3. Effect of biofertilizer

Data in Table (6) revealed that inoculation with Rhizobium bacteria led to significant increases in yield components of pea in both seasons of the study compared with untreated plants.

These results are in agreement with those reported by Abo El-Salehein *et al.* (2005), on pea, El-Oksh *et al. (*1991), and Shafeek *at a*l. (2004), on bean, who observed that inoculation of seeds with Rhizobium reflected significant effect on pod characters compared with control plants.

3.4. Effect of interactions

Data in Table (6) showed that there were a significant effects as a result of the interaction between microelements × fertilizer sources on fresh pod length and fresh pod weight in both seasons and No. of seeds in the second season only . The interaction between microelements x biofertilizer caused a significant effects on No. of seeds/ pod in both seasons. Also , the

interaction between fertilizer sources x biofertilizer showed a significant effect on fresh pod length and No. of seeds /pod in the second season only. The interaction among the three factors affected significantly on fresh pod length in the second season and fresh pod weight and No. of seeds/pod in the first season only.

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تاثير الرش بالعناصر الصغرى ومصادر اسمده مختلفه على جوده و محصول البسله.

الشبراوى امين – عبد الله حلمى المرسى – محمد حامد طلبه

قسم بحوث الخضر- معهد بحوث البساتين- مركز البحوث الزراعيه- الجيزه- مصر

.اجريت تجربتان حقليتان بمزرعة البرامون الزراعيه بمحطه بحوث البساتين بمحافظة الدقهلية خلال الموسم الشتوى لعامى 2004و 2005 م و ذلك لدراسة تاثير الرش بالعناصر الدقيقه (حديد و زنك و منجنيز بتركيز 100 جزء فى المليون لكل منهم) بالاضافة الى بعض مصادر التسميد (التسميد الكيماوى و السماد البلدى بمعدل 20 م 3 / فدان) مع او بدون التلقيح الحيوى بالريزوبيوم على الصفات الطبيعيه و الكيماويه للبسله صنف ماستر B.

واشتملت التجربة على 12 معاملة وقد تمثلت فى معاملتين رش ورقى وهما (كنترول – الرش بالعناصر الصغرى) 3 معاملات لمصدر السماد (المعدني- البلدي- كنترول) و تطبيق كل منها منفرده او مع التلقيح الحيوي بالريزوبيوم. اجرى الرش الورقى فى اربعه مواعيد هى 30 ، 40 ، 50 و 60 يوم من الزراعة

واستخدم لاجراء التجربة تصميم القطع المنشقة مرتين فى ثلاث مكررات وتم توزيع معاملات الرش فى القطع الرئيسية و مصادر السماد فى القطع المنشقة وخصصت القطع التحت شقية للتسميد الحيوى.

وتم اجراء التحليل الاحصائى للبيانات المتحصل عليها واوضحت النتائج مايلى:

- سجلت افضل صفات للمحصول و هى طول القرن ووزن القرن وعدد البذور الخضراء/ قرن و وزن 100 بذرة خضراء ووزن 1000 بذرة جافة وايضا افضل صفات جوده و هى محتوى البذورالخضراء من النيتروجين والفسفور والبوتاسيوم وكذلك محتواها من الكربوهيدرات و البر وتين عند اضافه السماد البلدى مقارنه بالمصادر الاخري مع الرش بالعناصر الصغرى و استخدام التسميد الحيوى