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RESPONSE OF TWO MUNGBEAN VARIETIES GRWON ON SANDY SOILTO FOLIAR APPLICATION WITH SOME MICRONUTRIENTS

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ABSTRACT

Field experiments were carried out during the two consecutive summer seasons 2004and 2005 at El-Ferdan, Ismailia Governorate, Egypt to study the effect of foliar application of zinc, manganese and boron on yield, yield components and chemical constituents of seeds of mungbean varieties (Vigna radiata L. Wilczek) Kawmy-1 and King under newly reclaimed sandy soil. Three levels of Zn (0.0, 0. 5 and 1.0 g/L) either zinc sulphate or chelated zinc, Mn (0.0, 1.0 and 2.0 g/L) as manganese sulphate or chelated manganese, B (0.0, 1.50 and 3.00 g/L) as boric acid and mixture of (0.5 g Zn sulphate + 1.0 g Mn sulphate +1.50 g boric acid) in addition to water as control were sprayed twice at 35 and 50 days after sowing. Results indicated that concerning varietals differences, King cv. surpassed Kawmy-1 cv. in yield, yield components and chemical composition of seeds i.e., P, K and Ca. All treatments significantly increased seed yield, yield components and chemical composition of seeds, treatment of B (3g/L) had superiority in all studied characters in both seasons. Interaction between King c.v and B (3g/L) significantly surpassed all other interaction in number of branches; pod/pant; weight of pods; seeds/plant ; 1000-seed weight , seed yield/fed.; as well as seed content of P, K, Ca, Zn, Mn, B, protein and carbohydrates

Keywords: Mungbean – varieties – micronutrients

INTRODUCTION

Mungbean or green gram (*Vigna radiata* L. Wilczek) is early mature high yield pulse crop which is well known in India, China, Thailand, Indonesia and Pakistan. It is an annual leguminous crop, with short growing season range from 90 to 120 days, adapted to cropping systems and a wide range of soil types and relatively drought tolerant. Meanwhile deficiency of micronutrients in newly reclaimed soils has been shown as yield-limiting factor (El-Fouly, 1983). Foliar application of micronutrients was successfully used for correcting their deficits in crops (Alexander, 1986). In addition, (El- Fouly *et al.*, 1995) indicated that micronutrients foliar application can increased the yield of agronomic crops by an average of 22%.

Concerning mungbean, Abd-El-Lateef *et al.*, (1998) found that foliar application of mungbean plant cv. Kawmy-1 with 0.5% Fe, 0.1% Zn, 0.2% Mn and 0.05% Cu alone or in combined with 1% urea increased growth parameter, seed yield and yield components, as well as seed content of micronutrients, protein and carbohydrates. They also observed that the highest percentage of seed protein and carbohydrates content were resulted from Fe and Zn combined with urea, respectively.

Sarkar *et al.*, (1998) indicated that Mn, Zn and B increased mungbean yield and its components over the control. Ashour (2000) in Egypt stated that seed yield of Kawmy-1 mungbean variety ranged from 425 to 852 kg/fed. grown on new reclaimed soils and ranged from 856 to 1143 kg/fed. in clay soil. Abdo (2001) and Rizk and Abdo (2001) reported that foliar spray of micronutrients such as Zn (0.2 or 0.4 g/l), Mn (1.5 or 2.0 g/l). B (3.0 or 5.0 g/l) or their mixture of Zn, Mn and B (0.2, 1.5 and 3.0 g/l) significantly increased most of the growth parameters i.e. stem length, number of branches, number of leaves, leaf area (LA), leaf area index (LAI) and shoot dry weight of some mungbean cultivars. Also increased protein percentage in seeds of the mungbean cultivars. B gave the highest percentage of crude protein.

Zaghloul *et al.*, (2002) studied the effect of foliar application of zinc on growth, yield and yield components of mungbean plants. Foliar applications the highest records of macro- (N, P and K) and micronutrient (Fe, Zn and Cu) contents, yield and yield components as well as protein yield of mungbean plants. El-Kramany *et al.*, (2003) compared 23 introduced mungbean genotypes imported from Asian Vegetable Research for Development Centre (AVRDC), Taiwan and Australian variety (King) alongside the registered local check (Kawmy-1) used as control in sandy soil at Al –Nagah village, south Al-Tahrir province, Al-Behaira Governorate, Egypt. They reported that king variety was superior to the other genotypes in seed index, seed yield /plant, seed yield / fed. and biological yield. Kawmy-1 variety gave the highest number of seeds/plant.

El-Kramany *et al.*, (2005) reported that mungbean varieties King and Kawmy-1 were succeeded as double used crop by cutting forage one time at 45 days after sowing DAS then take plants to recover to abundant seeds. They also found that King variety surpassed Kawmy-1 in forage yield at 45 DAS and gave 9.02 ton/fed. but Kawmy-1 gave the highest dry matter 18.4% and protein 17.8 % content of forage. King variety produced higher seed yield either per plant 1.73 g or per fed. 690 kg/fed. and (seed index) weight of 1000-seed 6.5 g. Thalooth *et al.*, (2006) studied the effect of foliar application of zinc on growth, yield and yield components and some chemical constituents of mungbean plants,. They observed positive effect on growth parameters, yield and yield components, due to zinc foliar spray.

Therefore, the current investigation was designed to evaluate the effectiveness of foliar different levels of Zn, Mn and B on yield, its components, and seed chemical constituents of two mungbean cultivars grown in the newly reclaimed sandy soil under sprinkler irrigation system.

MATERIALS AND METHODS

Two field experiments were carried out in two successive summer season, 2004 and 2005 at El- ferdan, Ismailia Governorate, Egypt to study the effect of foliar spray of each zinc , i.e. (0. 5, 1.0 g/L) as zinc sulphate or chelated zinc, , i.e. (1.0, 2.0 g/L)as manganese sulphate or chelated manganese and boron, i.e. (1.50, 3.00 g/L) as boric acid and mixture of (0.5 g Zn sulphate + 1.0 g Mn sulphate +1.50 g .boric acid) on yield, yield components and chemical composition of seeds of two mungbean (*Vigna radiata* L. Wilczek) cultivars, i.e. Kawmy -1 and King grown under newly reclaimed sandy soil .

Representative soil samples (0-30 cm) were taken from the experimental field before the cultivation for each season to determine some physico-chemical characteristics of the soil (Table -1)

Table (1): Some physico- chemical properties of soil sample from the experimental sites

Properties	2004	2005
Sand %	91.40	90.60
Silt %	2.00	2.00
Clay %	6.60	7.40
Texture	Sandy	Sandy
pH (1:2.5 soil: water)	8.47	8.40
E.C 1:2.5 (dS/m)	0.13	0.12
$CaCO_3$ %	2.08	2. 04
Organic matter %	0.15	0.30
Available macronutrients (mg / 100 g soil)		
P	0.28	0.36
K	2.20	2.50
Na	6.60	7.40
Ca	64.20	58.40
Mg	22.20	20.20
Available micronutrients (mg / kg soil)		
Fe	3.30	2.80
Zn	0.24	0.30
Mn	1.80	2.20
Cu	0.60	0.84
B	0.24	0.26

The soil samples were air dried, ground in a wooden mortar and passed through a 2 mm pores sieve to be analyzed for physical and chemical characteristics. According to many workers, the following properties were recorded: Texture and Total $CaCO_3$ (Black, 1965), pH, E.C, Organic matter, available K, Ca, Na and Mg, (Jackson, 1973), available Phosphorus, (Olsen *et al.*, 1958), Fe, Mn, Zn and Cu, (Lindsay and Norvell, 1978). Available Boron was extracted by hot water and determined by Azomethine-H colorimetric method (Wolf, 1974). The dry ashing technique as described by Chapman and Pratt, (1978) was used to extract macro and micronutrients from dried seeds while Boron was determined colorimetrically using Azomthine-H method described by Wolf (1974).

The experimental plot area was 10.5 m^2 contained 5 ridges, 3 meters in length and 70 cm apart, and mungbean seeds were inoculated prior to sowing with the specific strain of *Rhizobium* leguminousarum and sown on May 15 th in the 1st and 2 nd seasons and the inoculated seeds were sown at the rate of 20 kg / fed on one side of the ridge in hills 20 cm apart and were thinned to one plant of each hill (21days after sowing).. All agricultural practices were done as recommended. The examined rates of micronutrients were added twice as foliar application, 35 days after sowing (200 L/fed) and 50 days after sowing (300 L/fed).The follows treatments were as follows:

T_1 (sprayed with water)	T_7 (2.00 g manganese sulphate /L)
T_2 (0.50 g zinc sulphate/L	T_8 (1.00 g chelated manganese/L)
T_3 (1.00 g zinc sulphate/L)	T_9 (2.00 g chelated Manganese/L)
T_4 (0.50 g chelated zinc/L)	T_{10} (1.50 g boric acid /L)
T_5 (1.00 g cheated zinc/L)	T_{11} (3.00 g boric acid /L)
T_6 (1.00 g manganese sulphate /L)	T_{12} (T_2+ T_6+ T_{10})

The plots were arranged in randomized complete block design with four replications and 12 micronutrients treatments were randomly arranged in each block. The Irrigation system at 6 days intervals as district system.

At harvest (after 100 days from sowing) ten plants from the two central ridges in each plot were randomly taken and the following measurements were recorded: number of branches per plant, number of pods per plant, pods weight per plant, weight of seeds per plant, 1000- seed weight and all plants of each plot were cut to determine seed yield (kg/fed.) was calculated on the base of yield of the three middle rows from each experiment.

Representative seeds sample was taken after harvest and analyzed for macro and micronutrient after washing in sequence with tap water, 0.01 N HCl acidified bidistilled water and bidistilled water, respectively, and then dried in a ventilated oven at 70°C till constant weight. The plant sample were ground in stainless steel mill 0.5 mm sieve and kept in plastic containers for chemical analysis.

Total nitrogen was determined in ashing or dried seed using Micro-Kjeldahal, while P, K, and Ca were measured using flame photometer, Dr Lange instrument. Concentration of Zn and Mn were measured by using atomic absorption spectrophotometer, Perkin Elemer model 1100.

Protein was determined as total nitrogen using Micro-Kjeldahal method and crude protein was obtained by (N %) x 6.25 according to A.O.A.C. (1990). Total Carbohydrates percentage was determined according to Dubois (1956).

The obtained data were statistically analyzed according to Snedecor and Cochran, (1990), treatments means were compared using the least significant differences LSD at 5% of probability.

RESULTS AND DISCUSSION

1- Yield and yield components

Number of branches per plant:

Data in Tables (2, 3) clearly show that all treatments of micronutrients significantly increased number of branches per plant of the two mungbean cultivars under investigation in both seasons. The maximum increase in the number of branches per plant in both seasons was recorded by B,. Being over the control by (4.5 and 5.1) in the two seasons.

Data also revealed that mungbean. King cv. surpassed mungbean Kawmy-1 cv. in this respect with a significant difference between them in both seasons. These results are in accordance with those obtained by Sarkar *et al.*, (1998); Rizk and Abdo (2001) and Thalooth *et al.*, (2006).

Table (2): Effect of Zn, Mn and B on yield and yield components of mungbean in 2004 season

Treatments	Number of branches /plant		Mean	Number of pods / plant		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	4.5	4.6	4.6	16.3	17.0	16.7
T_2	6.0	6.5	6.3	20.8	21.5	21.2
T_3	6.5	6.8	6.7	21.0	25.3	23.2
T_4	6.2	6.6	6.4	21.0	22.3	21.7
T_5	7.9	8.5	8.2	26.0	30.0	28.0
T_6	5.8	6.0	5.9	19.0	20.5	19.8
T_7	6.0	6.3	6.2	20.5	22.8	21.7
T_8	6.2	6.3	6.3	20.5	23.3	21.9
T_9	6.3	6.2	6.3	22.5	26.5	24.5
T_{10}	7.3	7.5	7.4	23.3	30.0	26.7
T_{11}	8.6	9.5	9.1	27.5	33.3	30.4
T_{12} (T_2+T_6+T_{10})	7.4	8.0	7.7	24.0	29.5	26.8
Mean	6.6	6.9	6.7	21.9	25.2	23.5
LSD 0.05	Treat.	0.6		1.2		
	Var.	0.3		0.5		
	Treat.*Var.	1.1		1.7		

Table (3): Effect of Zn, Mn and B on yield and yield components of mungbean in 2005 season

Treatments	Number of branches /plant		Mean	Number of pods /plant		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	5.2	5.3	5.3	16.3	21.9	19.1
T_2	7.8	8.1	7.9	23.8	32.7	28.3
T_3	8.0	8.5	8.3	25.9	33.5	29.7
T_4	7.8	8.5	8.2	23.2	31.4	27.3
T_5	9.6	9.7	9.7	28.8	36.4	32.6
T_6	6.8	8.3	7.6	21.5	31.1	26.3
T_7	7.5	8.3	7.9	22.8	33.2	28.0
T_8	6.8	8.2	7.5	23.8	32.1	27.9
T_9	7.5	8.4	7.9	25.5	33.1	29.3
T_{10}	9.0	9.2	9.1	27.0	38.4	32.7
T_{11}	10.3	10.4	10.4	30.0	41.4	35.7
T_{12} (T_2+T_6+T_{10})	8.0	8.7	8.4	27.5	34.1	30.8
Mean	7.9	8.5	8.2	24.7	33.3	29.0
LSD 0.05	Treat.	0.8		1.4		
	Var.	0.4		0.6		
	Treat.* Var.	0.9		0.8		

Number of pods per plant:

It is realized from Tables (2, 3) that all adopted treatments of micronutrients significantly increased number of pods per plant in both seasons. The highest value was obtained by B followed by the combined three micronutrients in both seasons, being over the control by (13.7 and 16.6) in the first and second seasons, respectively.

Data in Tables (2, 3) indicated that mungbean King cv. surpassed mungbean Kawmy-1 cv. in this respect with significant difference in both seasons. In this connection, Rizk and Abdo (2001) and Thalooth *et al.*, (2006) found that micronutrients application increased the number of pods/ plant. Similarly, Abd-El-Lateef *et al.*, (1998) on mungbean and Sarkar et al., (1998) on green gram, stated that the application of micronutrients increased the number of pods per plant.

Weight of pods per plant (g):

Data presented in Tables (4, 5) indicated that all adopted treatments of micronutrients significantly increased weight of pods per plant of the two mungbean cultivars under investigation in both seasons. It is also obvious that King cv. significantly exceeded Kawmy-1 cv. in weight of pods per plant in both seasons.

Table (4): Effect of Zn, Mn and B on yield and yield components of mungbean in 2004 season

Treatments	Weight of pods / plant (g)		Mean	Weight of seeds /Plant (g)		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	6.8	9.7	8.3	5.2	10.0	7.6
T_2	12.5	14.8	13.7	7.5	13.9	10.7
T_3	13.4	18.4	15.9	8.8	16.1	12.5
T_4	13.2	14.2	13.7	8.2	14.7	11.5
T_5	18.5	22.8	20.7	10.1	16.4	13.3
T_6	11.2	12.7	11.9	7.2	11.5	9.4
T_7	12.9	15.5	14.2	8.0	12.6	10.3
T_8	12.1	15.4	13.8	7.2	11.7	9.5
T_9	14.6	18.3	16.5	8.3	12.9	10.6
T_{10}	15.9	22.5	19.2	9.4	14.9	12.2
T_{11}	20.6	27.3	23.9	10.5	17.1	13.8
T_{12} (T_2+T_6+T_{10})	16.3	21.2	18.8	9.3	14.3	11.8
Mean	14.0	17.7	15.9	8.3	13.8	11.1
LSD $_{0.05}$	Treat.	0.8		0.4		
	Var.	0.3		0.2		
	Treat.*Var.	0.1		0.7		

On the other hand, the highest increases in weight of pods per plant were recorded by B treatment which exceeded by (15.6 and 20.7 g) more than the control in the first and second seasons; respectively .Similar results were also recorded by Abd-El-Lateef *et al.*, (1998), Rezk and Abdo (2001) and Thalooth *et al.*, (2006).

Weight of seeds per plant (g):

Data in Tables (4, 5) revealed that all treatments significantly increased weight of seeds per plant in both seasons. The increases in weight of seeds per plant due to B treatment were (6.2 and 6.9 g) over the control in the first and second seasons, respectively.

Data in Tables (4, 5) indicated that mungbean King cv. surpassed mungbean Kawmy-1 cv. in this respect with significant differences in both seasons. In this concerning, Rizk and Abdo (2001), El-Kramany *et al.*, (2003) and Thalooth *et al.*, (2006) found that micronutrients application increased the weight of seeds per plant.

Table (5): Effect of Zn, Mn and B on yield and yield components of mungbean in 2005 season

Treatments	Weight of pods / plant (g)		Mean	Weight of seeds /Plant (g)		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	8.2	11.3	9.8	5.8	10.2	8.0
T_2	15.7	20.6	18.2	8.9	14.4	11.7
T_3	18.4	21.8	20.1	9.5	15.0	12.3
T_4	15.8	20.3	18.1	9.2	14.4	11.8
T_5	21.6	27.7	24.7	11.2	16.9	14.1
T_6	14.2	19.4	16.8	7.9	13.3	10.6
T_7	15.9	21.3	18.6	8.5	13.9	11.2
T_8	16.6	19.9	18.3	8.1	13.5	10.8
T_9	18.3	21.2	19.8	8.9	14.6	11.8
T_{10}	20.3	28.2	24.3	10.2	15.8	13.0
T_{11}	25.5	35.4	30.5	11.9	17.8	14.9
T_{12} (T_2+T_6+T_{10})	18.4	23.4	20.9	9.8	15.9	12.9
Mean	17.4	22.5	20.0	9.2	14.6	11.9
LSD 0.05	Treat.	1.0		0.5		
	Var.	0.4		0.6		
	Treat.*Var.	0.1		0.8		

Table (6): Effect of Zn, Mn and B on yield and yield components of mungbean in 2004 season

Treatments	1000-seed weight (g)		Mean	Seed yield kg / feddan		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	31.2	53.0	42.1	660.7	764.7	712.7
T_2	37.0	60.5	48.8	720.0	854.6	787.3
T_3	39.1	62.4	50.8	772.9	879.6	826.2
T_4	37.5	61.0	49.3	753.8	856.4	805.1
T_5	41.7	64.0	52.9	828.3	920.2	874.2
T_6	35.7	55.2	45.5	692.5	794.7	743.6
T_7	37.0	57.9	47.5	722.0	824.6	773.3
T_8	35.8	56.3	46.1	702.8	810.2	756.5
T_9	38.2	58.9	48.6	742.6	832.9	787.7
T_{10}	40.3	61.8	51.1	777.9	907.0	842.4
T_{11}	41.6	64.8	53.2	861.4	1015.0	938.2
T_{12} (T_2+T_6+T_{10})	40.9	63.3	52.1	786.5	908.6	847.5
Mean	38.0	59.9	49.0	751.8	864.0	807.9
LSD 0.05	Treat.	1.4		25.9		
	Var.	1.3		16.3		
	Treat.*Var.	1.8		36.4		

1000-seed weight (g):

It is revealed from Tables (6, 7) that the dry weight of seeds was positively affected by micronutrient treatments in both seasons. Whereas, all assigned treatments of micronutrients were significantly increased the average weight of 1000 - seed of the two investigated mungbean cultivars in both seasons.

The increases over the control was (11.1and 11.9 g) in the first and second season, respectively. It is worthy to note that mungbean cv. King exceeded cv.Kawmy-1 in this respect with significant differences in both seasons. These data agreed with the findings of, Abd-El-Lateef *et al*, (1998), Sarkar *et al*, (1998), Rizk and Abdo (2001), Kramany *et al*., (2005) and Thalooth *et al*., (2006).

Table (7): Effect of Zn, Mn and B on yield and yield components of mungbean in 2005 season

Treatments	1000-seed weight (g)		Mean	Seed yield kg / feddan		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	34.0	52.4	43.2	679.1	792.3	735.7
T_2	39.0	61.1	50.1	749.1	873.8	811.4
T_3	40.8	62.9	51.9	778.2	882.5	830.3
T_4	39.8	61.8	50.8	783.6	919.3	851.4
T_5	43.0	64.9	54.0	844.1	965.2	904.6
T_6	36.5	58.3	47.4	716.5	835.2	775.8
T_7	37.6	59.4	48.5	744.2	867.1	805.6
T_8	37.5	59.6	48.6	727.8	845.8	786.8
T_9	38.8	61.0	49.9	753.9	879.5	816.7
T_{10}	42.4	62.6	52.5	810.5	957.5	884.0
T_{11}	44.9	65.2	55.1	905.0	1045.3	975.1
T_{12} (T_2+T_6+T_{10})	41.7	62.6	52.2	805.7	957.5	881.6
Mean	39.7	61.0	50.3	774.8	901.8	838.2
LSD 0.05	Treat.		1.5	27.7		
	Var.		1.6	17.4		
	Treat.*Var.		1.9	40.4		

Seed yield (Kg/feddan):

Data of seed yield per feddan of the two mungbean cultivars King and Kawmy-1 as affected by spraying with the micronutrients are given in Tables (6, 7). The obtained results revealed that all treatments with Zn, Mn, B or their mixture significantly increased yield of seeds per feddan of the two cultivars in both seasons. It is clear that cv. King significantly surpassed cv. Kawmy-1in this respect in both seasons. The highest values of seed yield per fed. were obtained by B treatments followed by the micronutrients treatment.

The increases over the control due to B treatment was (225.5and 239.4 kg) in the first and second season, respectively. It is worthy to note that the increase in seed yield could be mainly attributed to the increase in the number of pods per plant as well as in the number of seeds per pod and partially in weight of 1000 seeds. The present findings are in accordance with those reported Sarkare *et al*., (1998), Zaghloul *et al*., (2002), El-Kramany *et al*., (2005) and Thalooth *et al*., (2006).

2- Nutrient content in mungbean seeds:

A- Macronutrients:

Phosphorus:

Results in Tables (8, 9) indicated that all adopted treatments of micronutrients showed positive statistical effect on seeds phosphorus percentage of the two mungbean cultivars in both growing seasons.

Mungbean King cv. surpassed Kawmy-1 cv. in this respect with a significant difference between the two cultivars in the both season. The present findings agreed with those obtained by Rizk and Abdo (2001), Zaghloul *et al.*, (2002).

Table (8): Effect of Zn, Mn and B on phosphorus and potassium concentration (mg/100g) of mungbean seeds in 2004 season

Treatments	Phosphorus		Mean	Potassium		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	407.0	440.0	423.5	914.0	977.0	945.5
T_2	464.0	497.0	480.5	971.0	1034.0	1002.5
T_3	473.0	506.3	489.7	977.6	1040.7	1009.2
T_4	466.3	499.3	482.8	984.0	1047.0	1015.5
T_5	487.3	520.3	503.8	998.3	1061.3	1029.8
T_6	423.3	456.3	439.8	925.0	988.0	956.5
T_7	434.0	467.0	450.5	973.0	995.0	984.0
T_8	412.0	445.3	428.7	937.0	992.4	964.7
T_9	444.3	477.3	460.8	977.0	1005.5	991.3
T_{10}	473.3	506.3	489.8	987.7	1050.0	1018.9
T_{11}	493.0	526.0	509.5	1010.7	1076.0	1043.4
T_{12} (T_2+T_6+T_{10})	477.0	510.0	493.5	995.0	1015.0	1005.0
Mean	454.5	487.6	471.1	970.9	1023.5	997.2
LSD $_{0.05}$	Treat.		8.2	5.2		
	Var.		12.0	9.0		
	Treat.*Var.		4.2	3.3		

Potassium:

Results in Tables (8, 9) cleared that all adopted treatments of micronutrients revealed statistical effect on percentage of potassium in seeds of the two mungbean cultivars King and Kawmy-1 in the two growing seasons of 2004 and 2005.

Mungbean cv. King surpassed mungbean cv. Kawmy-1 in this respect with a significant difference between the two cultivars in both seasons. The present findings are in accordance with those reported by Zaghloul *et al.*, (2002)

Table (9): Effect of Zn, Mn and B on phosphorus and potassium concentration (mg/100g) of mungbean seeds in 2005 season

Treatments	Phosphorus			Potassium		
	Kawmy-1	King	Mean	Kawmy-1	King	Mean
T_1	416.0	449.0	432.5	933.0	966.0	949.5
T_2	473.0	506.0	489.5	990.0	1053.0	1021.5
T_3	482.0	515.0	498.5	996.0	1059.0	1027.5
T_4	475.0	508.0	491.5	1003.0	1066.0	1034.5
T_5	496.0	529.0	512.5	1017.0	1080.0	1048.5
T_6	432.0	465.0	448.5	954.0	964.0	959.0
T_7	443.0	476.0	459.5	989.0	996.0	992.5
T_8	421.0	454.0	437.5	956.0	974.0	965.0
T_9	453.0	486.0	469.5	990.0	999.0	994.5
T_{10}	482.0	515.0	498.5	1006.0	1069.0	1037.5
T_{11}	502.0	535.0	518.5	1029.0	1092.0	1060.5
T_{12} (T_2+T_6+T_{10})	486.0	519.0	502.5	1014.0	1077.0	1045.5
Mean	463.4	496.4	479.9	989.8	1032.9	1011.3
LSD 0.05	Treat.	9.1		7.2		
	Var.	15.0		11.0		
	Treat.*Var.	4.5		4.3		

Calcium:

Results in Tables (10, 11) revealed that all adopted treatments of micronutrients showed significant effect on seeds calcium content of the two mungbean cultivars in both growing seasons.

Mungbean King cv. significantly surpassed on Kawmy-1 cv. in this respect in both seasons. The present findings are in accordance with those reported by Zaghloul *et al.*, (2002).

Table (10): Effect of Zn, Mn and B on calcium (mg/100g) and zinc (mg/kg) concentration of mungbean seeds in 2004season

Treatments	Calcium			Zinc		
	Kawmy-1	King	Mean	Kawmy-1	King	Mean
T_1	163.0	190.0	176.5	30.3	33.3	31.8
T_2	193.0	220.0	206.5	37.3	40.3	38.8
T_3	198.3	225.3	211.8	42.3	45.3	43.8
T_4	196.3	223.3	209.8	37.7	40.7	39.2
T_5	213.0	240.0	226.5	46.3	49.3	47.8
T_6	175.3	202.0	188.7	35.3	38.3	36.8
T_7	184.0	211.0	197.5	41.3	44.3	42.8
T_8	177.0	204.0	190.5	36.3	39.3	37.8
T_9	194.0	221.0	207.5	41.0	44.0	42.5
T_{10}	202.0	229.0	215.5	43.0	46.0	44.5
T_{11}	223.0	250.0	236.5	50.7	53.7	52.2
T_{12} (T_2+T_6+T_{10})	200.3	227.3	213.8	45.3	48.3	46.8
Mean	193.3	220.2	206.8	40.6	43.6	42.1
LSD 0.05	Treat.	4.2		0.8		
	Var.	9.0		0.3		
	Treat.*Var.	3.1		1.1		

Table (11): Effect of Zn, Mn and B on calcium (mg/100g) and zinc (mg/kg) concentration of mungbean seeds in 2005 season

Treatments	Calcium		Mean	Zinc		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	167.0	195.0	181.0	33.0	36.4	34.7
T_2	197.0	225.0	211.0	41.4	45.2	43.3
T_3	202.0	230.0	216.0	46.2	49.4	47.8
T_4	200.0	228.0	214.0	40.7	46.2	43.5
T_5	217.0	245.0	231.0	48.3	54.2	51.3
T_6	179.0	182.0	180.5	37.3	38.4	37.9
T_7	188.0	194.0	191.0	43.3	44.2	43.8
T_8	181.0	185.0	183.0	38.3	40.3	39.3
T_9	194.0	199.0	196.5	43.0	45.0	44.0
T_{10}	206.0	234.0	220.0	46.0	48.0	47.0
T_{11}	227.0	255.0	241.0	52.7	55.7	54.2
T_{12} (T_2+T_6+T_{10})	204.0	232.0	218.0	48.4	50.3	49.4
Mean	196.8	217.0	206.9	43.2	46.1	44.7
LSD 0.05	Treat.	7.2			0.9	
	Var.	10.0			0.4	
	Treat.*Var.	3.3			1.2	

B- Micronutrients:

Zinc:

Results in Tables (10, 11) revealed that all adopted treatments of micronutrients showed significant effect on seed zinc content of the two cultivars in the two growing seasons.

King cv. surpassed significantly Kawmy-1 cv. in this respect in both seasons. The present findings are in accordance with those found by Zaghloul et al., (2002) and Thalooth *et al.*, (2006).

Manganese

As shown in Tables (12, 13) foliar application of micronutrients had significant effect on manganese seed content of the two mungbean cultivars in the two growing seasons.

Mungbean King cv. significantly surpassed Kawmy-1 cv. in this respect in both seasons. The present findings are in accordance with those reported by Thalooth *et al.*, (2006)

Boron

Results in Tables (12, 13) cleared that all adopted treatments of micronutrients had significant effect on seed boron content of the two cultivars in the two growing seasons.

King cv. significantly surpassed Kawmy-1 cv. in this respect in both seasons. The present findings are in accordance with those reported by Thalooth *et al.*, (2006).

Table (12): Effect of Zn, Mn and B on manganese and boron concentration (mg/kg) of mungbean seeds in 2005 season

Treatments	Manganese		Mean	Boron		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	8.3	9.4	8.9	7.6	7.8	7.7
T_2	11.3	12.5	11.9	9.6	9.6	9.6
T_3	12.3	13.8	13.1	11.0	11.0	11
T_4	12.3	13.7	13	10.4	10.4	10.4
T_5	14.3	14.9	14.6	11.3	11.3	11.3
T_6	15.8	16.0	15.9	8.7	8.7	8.7
T_7	17.3	18.0	17.7	9.3	9.3	9.3
T_8	15.3	16.4	15.9	9.0	9.0	9.0
T_9	18.2	19.2	18.7	9.3	10.0	9.7
T_{10}	13.3	14.0	13.7	13.2	13.5	13.4
T_{11}	14.5	15.0	14.8	14.3	14.6	14.5
T_{12} (T_2+T_6+T_{10})	13.7	14.5	14.1	12.5	12.5	12.5
Mean	13.9	14.78	14.3	10.5	10.6	10.6
LSD 0.05	Treat.	0.8			0.6	
	Var.	0.3			0.3	
	Treat.*Var.	1.2			0.8	

Table (13): Effect of Zn, Mn and B on manganese and boron concentration (mg/kg) of mungbean seeds in 2005 season

Treatments	Manganese		Mean	Boron		Mean
	Kawmy-1	King		Kawmy-1	King	
T_1	11.8	12.9	12.4	8.7	9.5	9.1
T_2	14.7	16.0	15.4	11.9	12.9	12.4
T_3	15.8	17.3	16.6	13.3	14.1	13.7
T_4	15.7	17.2	16.5	12.7	13.1	12.9
T_5	17.8	18.4	18.1	13.7	14.5	14.1
T_6	19.2	19.5	19.4	11.0	11.1	11.05
T_7	20.7	21.5	21.1	11.4	12.1	11.9
T_8	18.7	19.9	19.3	11.2	11.5	11.4
T_9	21.6	22.7	22.2	11.5	11.9	11.7
T_{10}	16.7	17.5	17.1	14.3	14.2	14.3
T_{11}	17.9	18.5	18.2	15.7	16.0	15.9
T_{12} (T_2+T_6+T_{10})	17.1	17.9	17.5	14.8	14.9	14.9
Mean	17.3	18.3	17.8	12.6	13.0	12.8
LSD 0.05	Treat.	0.9			0.7	
	Var.	0.4			0.3	
	Treat.*Var.	1.3			0.9	

3- Seed protein and carbohydrates content:

Crude protein

It is realized from Tables (14, 15) that all micronutrients treatments significantly increased seeds crude protein percentage of the two cultivars under investigation in both studied seasons. Results presented in Tables (14, 15) clearly indicated that seeds of King cv. significantly exceeded Kawmy-1 cv. in crude protein percentage in both seasons. The highest percentage of seed crude

protein was recorded with plants which sprayed with B in both seasons being (8.6%) and (8.9%) more than the control treatment plants in the first and second season; respectively.

Table (14): Effect of Zn, Mn and B on protein and carbohydrates (%) of mungbean seeds in 2004 season

Treatments	protein			carbohydrates		
	Kawmy-1	King	Mean	Kawmy-1	King	Mean
T_1	17.6	19.0	18.3	51.7	53.6	52.7
T_2	21.7	23.7	22.7	58.6	60.7	59.7
T_3	22.3	24.4	23.4	59.0	61.0	60.0
T_4	23.0	25.2	24.1	59.0	61.2	60.1
T_5	25.3	27.3	26.3	62.3	64.3	63.3
T_6	20.3	22.3	21.3	57.0	59.2	58.1
T_7	21.3	23.2	22.3	58.3	60.0	59.2
T_8	20.5	22.4	21.5	57.2	59.4	58.3
T_9	21.8	23.6	22.7	58.8	60.3	59.6
T_{10}	23.3	25.8	24.6	61.3	63.3	62.3
T_{11}	25.9	27.9	26.9	64.2	64.5	64.4
T_{12} (T_2+T_6+T_{10})	24.0	24.4	24.2	60.4	62.0	61.2
Mean	22.3	24.1	23.2	59.0	60.8	59.9
LSD 0.05	Treat.	0.9		1.0		
	Var.	0.4		0.4		
	Treat.*Var.	1.3		1.4		

Table (15): Effect of Zn, Mn and B on protein and carbohydrates (%) of mungbean seeds in 2005 season

Treatments	protein			carbohydrates		
	Kawmy-1	King	Mean	Kawmy-1	King	Mean
T_1	17.4	19.4	18.4	52.0	53.5	52.8
T_2	22.9	25.1	24.0	59.3	62.1	60.7
T_3	23.6	25.9	24.8	60.3	62.5	61.4
T_4	24.3	26.7	25.5	60.3	62.7	61.5
T_5	26.6	28.8	27.7	63.6	65.8	64.7
T_6	21.6	22.0	21.8	58.3	59.0	58.7
T_7	22.6	22.9	22.8	59.3	60.0	59.7
T_8	21.8	22.4	22.1	58.5	59.1	58.8
T_9	22.3	23.3	22.8	59.4	60.5	59.9
T_{10}	24.6	25.3	24.9	62.6	64.8	63.7
T_{11}	26.7	27.8	27.3	65.5	66.0	65.8
T_{12} (T_2+T_6+T_{10})	25.3	25.9	25.6	61.7	63.5	62.6
Mean	23.3	24.6	24.0	60.1	61.6	60.8
LSD 0.05	Treat.	0.9		1.1		
	Var.	0.4		0.5		
	Treat.*Var.	1.4		1.5		

In this concern, Rizk and Abdo (2001) and Zaghloul *et al.*, (2002) reported that application of boron increased the percentage of crude protein in seeds of green gram. Likewise, Abd- El-Lateef *et al*, (1998) found that application of

manganese increased the percentage of crude protein in seeds of mungbean. All, being in agreement with the present findings.

Total carbohydrates

Data in Tables (14, 15) clearly showed that all treatments of micronutrients significantly increased total carbohydrates of the two mungbean cultivars under investigation in both seasons. The maximum increase in the total carbohydrates were in both seasons recorded by B,. Being over the control by (11.7) and (13.0%) in the first and second seasons, respectively.

Data also revealed that mungbean King cv. surpassed mungbean Kawmy-1 cv. in this respect with a significant difference between them in both seasons. These results are in accordance with those obtained by Sarkar *et al.*, (1998) and Thalooth *et al.*, (2006)

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استجابة بعض أصناف فول المانج النامية في الأراضي الرملية للرش ببعض العناصر الصغرى

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أجريت تجربة حقلية خلال الموسم الصيفي لعامي ٢٠٠٤ – ٢٠٠٥ بمنطقة الفردان – محافظة الإسماعيلية – مصر لدراسة تأثير الرش بالزنك ، المنجنيز ،البورون علي المحصول ، مكوناته، التركيب الكيميائي لبعض أصناف فول المانج النامية في الأراضي الرملية الجديدة واشتملت التجربة علي عاملين وهما: أ) الأصناف قومي-١ ، كينج

ب) معاملات الرش الورقي بالعناصر المذكورة وهي:

١) معاملة المقارنة (الرش بالماء)
٢) الزنك (٠,٠ – ٠,٥ – ١,٠ جم /لتر كبريتات الزنك)-(٠,٠ – ٠,٥ – ١,٠ جم/لتر زنك مخلبي)
٣) المنجنيز(٠,٠ – ١,٠ – ٢,٠ جم/لتر كبريتات المنجنيز)-(٠,٠ – ١,٠ – ٢,٠ جم/لتر منجنيز مخلبي)
٤) البورون (٠,٠ – ١,٥ – ٣,٠ جم/لتر حمض البوريك)
٥) المخلوط (٠,٥جم كبريتات الزنك + ١,٠جم كبريتات المنجنيز+ ١,٥ جم حمض البوريك / لتر) والرش مرتين بعد ٣٥، ٥٠ يوم من الزراعة.

وقد أوضحت النتائج ما يلي:

تفوق الصنف كينج علي الصنف قومي- ١ في المحصول ومكوناته والمحتوي الكيميائي للبذور من الفوسفور- البوتاسيوم-الكالسيوم ، وأعطت كل المعاملات زيادة معنوية في محصول البذور ومكونات المحصول والمحتوي الكيميائي للبذور.

تفوقت معاملة الرش بالبورون بمعدل ٣جم /لتر في جميع الصفات المدروسة في الموسمين وأوضح التداخل بين الصنف كينج والرش بالبورون بمعدل ٣جم / لتر أعلي القيم في جميع الصفات المدروسة (عدد الأفرع – عدد القرون – وزن القرون – وزن البذور / النبات – وزن ١٠٠٠ بذرة – وزن محصول الفدان) بالإضافة إلي محتوي البذور من الفوسفور – البوتاسيوم – الكالسيوم – الزنك- المنجنيز- البورون – البروتين – الكربوهيدرات.