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EFFECT OF BIOFERTILIZATION AND BORON ON GROWTH, SEED PRODUCTIVITY AND SEED QUALITY OF PEAS (*Pisum sativum* L.)

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ABSTRACT

Two field experiments were carried out during the winter seasons of 2008/09 and 2009/10 at farm in Disuq district, Kafr El-Sheikh Governorate to investigate the response of pea plants, cv. Master B, to inoculation with biofertilizer (Halex-2) and different concentrations with boron (0, 5, 10 and 15 ppm) as a foliar application. The results indicated that inoculation of pea seeds with biofertilizer (Halex-2), improved most vegetative characters, as well as green pods yield and its components, shelling ratio, seed yield and its components, seed germination percentage, leaf contents of chlorophyll and seed content of protein. Increasing boron concentration up to 10ppm was accompanied with significant increases in vegetative growth characters, as well as green pods yield and its components, shelling ratio, seed yield and its components, seed germination percentage, leaf contents of chlorophyll and seed content of protein. The highest boron concentration at 10ppm combined with Halex-2 biofertilizer appeared to be the most efficient treatment for more vigorous growth, green pods yield and its components, shelling ratio, seed yield and its components and seed germination percentage, as well as chlorophyll contents in leaves and protein content in seeds.

INTRODUCTION

Peas (*Pisum sativum* L.), a cool weather crop, is one of the most popular crops grown in Egypt due to its high contents of protein, carbohydrates, vitamins and minerals. It can grow throughout different types of soils ranging from the light sandy loom to the heavy clay in texture. Most pea cultivars are grown for fresh and/or dry seeds yield. The pea cultivar used (Master B) is a short growing period, determinate growth habit and low fertilizer requirements (Fayad, 2004).

Supplementing or substitutions on inorganic N with organic sources become so urgent. Significant effects of untraditional fertilizers, particularly the biofertilizers, on growth and yield of legumes have been reported by several investigators (Hassouna and Aboul-Nasr, 1992 on soybean; El-Oksh *et al*., 1991; Shiboob, 2000 on bean; Choudhary *et al*., 1984; Elneklawy *et al*., 1985; Chandra *et al*., 1987; Feng *et al*., 1997; Merghany *et al*., 1999 and Bin Ishaq, 2002, on pea and El-Waraky and Kasem, 2007, on cowpea). They indicated that application of biofertilizer Halex-2 at 10 $g.kg^{-1}$ (containing a mixture of non symbiotic N_2^- fixing bacteria of the genera *Azotobacter*, *Azospirillum* and *Klebsilla*) significantly resulted in taller plants with more N concentrations in leaves, higher protein contents in seeds, and greater total yields than in the case of untreated control. Likewise, Mahmoud *et al*. (1994) found that inoculation of soybean seeds with appropriate bacterial strains (containing a N-fixing bacteria)before planting, in addition to 20 or 40 kg N $fed.^{-1}$ gave the highest mean value of total pod yield.

Nutrition of crops with micro-nutrients is mostly performed either through soil or foliar application. High pH level and calcium carbonate content are known to render the micro-nutrients added to the soil into unavailable form. Therefore, the required small quantities from micro- nutrients are preferably supplied in the from of a dilute spray to enhance plant response to the added micro-nutrients. Boron is one of the micro-elements that have important roles in the physiological and metabolic processes of plants. Accordingly, boron is of a great necessity for adequate plant growth and productivity. Boron, also, facilitates the transport of carbonates through cell membranes. Thus, maximum production of starch and sugars are restricted if crops are suffering from boron deficiency (Dugger and Palmer, 1983 and Bolanos *et al*., 1994).

Thus, the main objective of this study is to investigate the influences of seed inoculation with the biofertilizer Halex-2 and foliar nutrition with boron on growth, green pods and dry seed yield and seed quality of the pea plants.

MATERIALS AND METHODS

This work was carried out at Disuq district, Kafr El-Sheikh Governorate, during the winter seasons of 2008/09 and 2009/10. The main goals of these experiments were to investigate the influences of seed inoculation with the biofertilizer Halex-2 and foliar nutrition with boron and their interactions on vegetative growth characters, green pods and dry seed yield and their components of pea (*Pisum sativum* L.) cultivar Master B.

The soil of the experimental site was loamy clay in texture. Some properties of the experimental soil are presented in Table(1).

Table (1): Some characteristics of the experimental soils.

Season	Mechanical analysis			Texture	pH*	EC** dSm^{-1}	OM (%)	Available elements (ppm)		
	Sand (%)	Silt (%)	Clay (%)					N	P	K
1st	10.0	50	40.0	Loamy Clay	7.9	1.2	1.70	29	5.7	440
2nd	9.5	51	39.5	Loamy Clay	7.9	1.3	1.68	23	5.5	390

*** 1: 2.5 soil: water suspension.**
**** Soil past extract**

Halex-2; a biofertilizer containing a mixture of non symbiotic N_2-fixing bacteria of the genera *Azospirillum, Azotobacter* and *Klebsiella*; was used. The biofertilizer was supplied by the Biofertilization Unit, Plant Pathology Department, Alex. Univ. Each experiment included eight treatments representing the combinations between two biofertilizer treatments, i.e., uninoculated (control) and inoculated with Halex-2 and four concentrations foliar nutrition with boron (0, 5, 10 and 15 ppm). The biofertilizer was used at the rate of 10 $g.kg^{-1}$ seeds. Seed inoculation was performed by adding an adequate amount of distilled water to the biofertilizer and mixed with the seeds just before sowing. Boric acid (H_3BO_3, 17%B) was the respective B source and was foliar sprayed to run-off two times at 35 and 50 days after sowing. Few drops of salient film were added to the spraying (200 litter/fed.) as a wetting agent. Plants of the control treatment were sprayed with distilled water. In all treatments, pea seeds were inoculated by an effective of *Rhizobium* bacteria just before sowing. The sowing dates were 5 and 11 of November in the first and second seasons, respectively.

The experiments were conducted using split-plot system in a randomized complete blocks design, with four replications. The main plots were devoted for the biofertilizer treatments, whereas, the sub-plot were allocated for boron concentrations. Each sub-plot contained 5 rows, 5m in long and 0.6 m in wide, comprising an area of 15 m^2. Spacing between plants within rows was 15 cm, and sowing was done on one side of row. Plants were thinned to two plants per hill after three weeks from sowing. The other recommended agricultural practices were done.

After 60 days from sowing, the following data were recorded:

1. Total chlorophyll content of leaves measured by the SPAD-501, a portable leaf chlorophyll meter (Minolta crop) was used for greenness measurements (Marquard and Timpton, 1987) on fully expanded (the fifth from the shoot tip) leaves without destroying them.
2. Vegetative traits, i.e., plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1} and plant fresh weight.
3. Green pods yield and its components, the plants of the second and third rows were allocated to measure the following data, i.e., total green pods yield plant^{-1} and feddan^{-1}, number of green pods plant^{-1}, weight of green pod, number of seeds pod^{-1}, weight of seeds pod^{-1}. Shelling ratio were measured by dividing the fresh weight of the green seeds extracted from 30 pods on the total weight of these pods.
4. After harvesting, dry seed yield and its components, and germination % were determined, the plants of the fourth and fifth rows allocated to measure the following data, i.e., dry seed yield plant^{-1} and feddan^{-1}, weight of seeds pod^{-1}, seed index (weight of 100 seeds), dry seeds protein and seed germinability which measured by a random sample of 100 seeds from each treatment that was germinated on a filter paper in a sterilized Petri dish, using an incubator at a temperature of 24^{o}C. Germinated seeds were daily counted starting 5 days after initiating the experiment and continued for 2 weeks. Germination percentage, thereafter, was calculated.

All obtained data were statistically analyzed using COSTAT Software (1985), and revised L.S.D. test was used to compare the differences among treatment means (Snedecor and Cochran, 1972). Seed samples were oven dried, crashed and digested using sulphoric + perchloric acid methods according to Cottenie *et al*. (1982). Nitrogen in the digested seeds was determined by micro-kjeldahl method according to Jackson (1958), nitrogen content of pea seeds was multiplied by a factor of 6.25 to calculate the crude protein content. Soil samples were collected before sowing, air dried and finely ground for chemical and mechanical analysis according to Jackson (1958).

RESULTS AND DISCUSSION

I. Vegetative characters:

a. Effect of biofertilizer (Halex-2)

The results in Table (2) clearly indicated that, in both seasons, the inoculation of pea seeds with the biofertilizer (Halex-2) was responsible for significant increments in plant height, number of leaves, number of branches, leaf area, chlorophyll content and plant fresh weight, compared with the uninoculated treatment (control plants). The beneficial effects of the biofertilizer on the above- mentioned growth traits may be related to the enhancing effects of non-symbiotic N_2-fixing bacteria on the morphology and/or physiology of the root system which promoted the vegetative growth to go forward. Moreover, Jagnow *et al*. (1991) and Noel *et al*.(1996) indicated that the non-symbiotic N_2-fixing bacteria, *Azotobacter* and *Azospirillum* strains, produced adequate amounts of IAA and cytokinins which increased the surface area per unit root length and enhanced root hair branching with an eventual increase in the uptake of nutrients from the soil. Carletti *et al*. (1996) demonstrated that plants inoculated with *Azospirillum* displayed an increase in total root length by 150%, compared with the uninoculated control. The results reported by Shiboob (2000), on bean; Micanovic *et al*. (1997); Bin Ishaq (2002), on pea and El-Waraky and Kasem (2007), on cowpea confirmed our findings concerning the stimulating effects of biofertilizer on vegetative growth characters.

b. Effect of foliar application of boron

Data presented in Table (2) showed that all growth parameters were significantly affected by increasing concentrations of boron in both growing seasons, the concentration of 10 ppm gave the tallest plants, the highest number of leaves, number of branches, leaf area and chlorophyll content as well as the largest plant fresh weight in both seasons, whereas the untreated plants produced the lowest value of each character. The improving effects of boron may be attributed to the direct action of boron on the development of N-fixing root nodules (Bolanos *et al*., 1994) and translocation of sugars through cellular membranes (Dugger and Palmer, 1983), consequently, the fresh weight of the canopy and probably its whole size may increase. In the same line, Bakry *et al*., (1987); El-Mansi *et al*.,(1990); Singh *et al*., (1992) and Bin Ishaq, (2002) stated that spraying pea plants with various concentrations of boron resulted in more vigorous vegetative growth compared with the untreated ones.

c. Effect of biofertilizer (Halex-2) and boron interaction

The effects of interaction between biofertilizer and boron application on vegetative growth characters appeared significant in both seasons (Table3). At any concentrations of boron, inoculation of pea seeds with biofertilizer (Halex-2) increased plant height, number of leaves, number of branches, leaf area, chlorophyll content and plant fresh weight content compared with those of the uninoculated ones. The combination of Halex-2 plus 10 ppm boron concentration was the best treatment for improving most studied vegetative characters.

2,3

The enhancing effects of the aforementioned treatment combinations could be expected, since each of the studied factors reflected promoting effects on the morphology and/or physiology of root system, which in turn encouraged the vegetative growth to go forward. The present results are in accordance with those reported by Bin Ishaq (2002) who reported that the seed inoculation with biofertilizer (Halex -2), followed with foliar spray with boron at the concentration of 5ppm, significantly, increased all studied characters of vegetative characters as compared with the other treatment combinations.

II. Green pods yield and its components

a. Effect of biofertilizer (Halex-2)

Data presented in Table (4) clearly indicated that significant increments in total yield of green pods, number of green pods plant$^{-1,}$ weight of green pod, number of seeds pod^{-1}, weight of seeds pod^{-1} and shelling percentage, were obtained as a result of seed inoculation with the biofertilizer (Halex-2), in both growing seasons. Increasing growth and total yield after the inoculation of pea seeds with the biofertilizer (Halex-2), which contains three genera of non-symbiotic N_2-fixing bacteria, might be due to increasing the biological N_2-fixation, the production of phytohormones or both; as mentioned by Jagnow *et al*., (1991). The present results agreed to a great extent with those reported by Shiboob (2000); on bean and Bin Ishaq (2002) on pea who showed significant positive effects on green pods yield and its components due to the inoculation of seeds with different biofertilizer types.

b. Effect of boron foliar application

Concerning the influence of foliar spray with boron on the productivity characters of pea plants, the data in Table (4) declared that foliar feeding with boron at any given concentration significantly affected all studied parameters of green pods yield, number of green pods plant^{-1} , weight of green pod, number of seeds pod^{-1}, weight of seeds pod^{-1} and shelling percentage in both seasons. The highest mean values of all measured characters were recorded for the boron application at 10 ppm. The present results are in accordance with those reported by Omar (1980) who reported that spraying the growing broad bean plants with boron, significantly, increased the number of green pods plant^{-1}, and total yields plant^{-1}.

Similar findings, concerning the positive effects of boron, were recorded by Hassan (1985) who found that the application of boron at 150 ppm increased the total green yield and the average number of beans pods plant^{-1}.

c. Effect of biofertilizer (Halex-2) and boron interaction

The interaction effects between the biofertilizer (Halex-2) and the applied boron concentrations on green pods yield and its components are presented in Table (5). The results, generally, showed that seed inoculation with Halex-2 and foliar application of boron at any concentration significantly increased total green pods yield, number of green pods plant^{-1} , weight of green pod, number of seeds pod^{-1}, weight of seeds pod^{-1} and shelling percentage in both growing seasons, compared with those of uninoculated ones. The treatment combination of the inoculation with biofertilizer (Halex-2) plus the foliar application at10 ppm of boron gave the highest values for all yield traits.

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5

The present results are in accordance with those reported by Hassan (1985) who reported that spraying the growing bean plants with boron at 150 ppm accompanied with seed treatment with biofertilizer (*Rhizobium phaseoli*), significantly, increased the total green yield and average number of pods plant^{-1}. Similar conclusion was obtained by Bin Ishaq (2002) on pea.

III. Seed yield and its components

a. Effect of biofertilizer (Halex-2)

Data recorded in Table (6) indicated that inoculation of pea seeds with the biofertilizer (Halex-2) significantly increased average seed yield plant^{-1}, total seed yield fed.$^{-1}$, weight of seeds pod^{-1}, seed index (weight of 100-seeds), dry seed protein content and seed germination percentage over those of the uninoculated plants (control), in both seasons. The detective positive effects of biofertilizer on quantity and quality of pea yield (Table 6) might be related to its beneficial effects on vegetative growth characters (Table 2), which probably supplied more photosynthesis and hence might help in increasing yield potential, as mentioned by Jagnow *et al*. (1991). The present results agreed to a great extent with those reported by Chauhan *et al*. (1996), who reported that inoculation of seeds of *Barssica juncea* L. with *Azotobzcter* and *Azospirillum* bacteria, significantly, increased number of pods plant^{-1} and seed yield compared with the control treatment. In this concern, Bin Ishaqu (2002) on pea, and El-Waraky and Kasem (2007) on cowpea showed significant positive effects on dry seed yield and its components due to the inoculation of seeds with different biofertilizer types.

b. Effect of boron foliar application

Data in Table (6) cleared that foliar application with boron at the concentration of 10 ppm, significantly, increased average seed yield plant^{-1}, total seed yield fed.$^{-1}$, weight of seeds pod^{-1}, seed index (weight of 100-seeds), dry seeds protein and seed germination percentage over those obtained from either the control treatment or the lower or/ and higher concentration of boron foliar application (5 or 15 ppm), in both seasons. Similar results were reported by Schon and Blevins (1987) who found that boron treatment applied at 10 ppm of boron as a foliar spray to soybean plants caused significant increase in the number of pods plant^{-1} and total seed yield weight. Moreover, Dwivedi *et al*. (1992) found that soil application of boron at 105 kg/ha., increased the number of dry pods and seed yield of pea plants. Also, Singh *et al*. (1992) reported that the application of boron, at the rate of 10 kg tetraborate/ha., resulted in higher dry pods and seeds yields of peas than those of the control plants. The results reported by Abd-Elfattah (1997) on broad bean; and Bin Ishaq (2002), on pea confirmed our findings concerning the stimulating effects of boron on seed yield and its components.

c. Effect of biofertilizer (Halex-2) and boron interaction

Table (7) showed the comparisons among the various treatments combinations of biofertilizer (Halex-2) and boron concentrations on seed yield and its components and germination percentage of pea plants.

6

7

The comparisons among the mean values of each character indicated that seed inoculation with the biofertilizer (Halex-2) and foliar spray with boron at the concentration of 10 ppm resulted in significant increases in average seed yield plant^{-1}, total seed yield fed.$^{-1}$, weight of seeds pod^{-1}, seed index (weight of 100-seeds), dry seeds protein and seed germination percentage compared with those of all treatment combinations which were treated with only one factor (Table 7) and the control treatment (without Halex-2 and boron). Apparently, the promoting effects of biofertilizer and boron application on growth of pea plants were reflected on the increased total seed yield and its components. These results are in the same line with those obtained by Bin Ishaq (2002) on pea, who reported that the application of 5 or 10 ppm boron combined with the biofertilizer Halex-2, significantly, increased dry seed yield plant^{-1} and feddan^{-1}, number of dry pods plant^{-1}, weight of seeds pod^{-1}, seed index and seed germination percentage.

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تأثير التسميد الحيوى والبورون على نمو وانتاج وجودة البذور فى البسله

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أجريت دراسةحقلية لمدة عامين خلال الموسم الشتوى لعامى ٢٠٠٩/٢٠٠٨ ، ٢٠١٠/٢٠٠٩ م فى منطقة دسوق – محافظة كفر الشيخ لدراسة استجابة نباتات البسله صنف ماستر ب للتلقيح بالسماد الحيوى (هالكس-٢) وتركيزات مختلفة من البورون (صفر، ٥ ،١٠، ١٥ جزء فى المليون).

أوضحت النتائج أن تلقيح بذور البسله بالسماد الحيوى (هالكس-٢) قد أدى الى تحسين صفات النمو الخضرى ومحصول القرون الخضراء ومكوناته ونسبة التصافى ومحصول البذور ومكوناته ونسبة انبات البذور علاوة على زيادة محتوى الاوراق من الكلورفيل ومحتوى البذور من البروتين.

وقد بينت النتائج ان زيادة تركيز البورون المضاف حتى ١٠ جزء فى المليون صاحبه زيادة معنوية فى النمو الخضرى ومحصول القرون الخضراء ومكوناته ونسبة التصافى ومحصول البذور ومكوناته ونسبة انبات البذور، بالاضافه الى زيادة معنوية فى محتوى الاوراق من الكلورفيل ومحتوى البذور من البروتين. هذا ولقد وجد أن استخدام البورون بتركيز ١٠ جزء فى المليون مع التلقيح بالسماد الحيوى (هالكس-٢) كان أكثر المعاملات كفاءة حيث أعطت أعلى نمو خضرى و محصول للقرون الخضراء ومكوناته و نسبة تصافى للقرون ومحصول البذور ومكوناته و نسبة انبات للبذور بالاضافه الى زيادة محتوى الأوراق من الكلورفيل ومحتوى البذور من البروتين.

قام بتحكيم البحث

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Table (2): Effect of biofertilizer (Halex-2) and boron foliar application on vegetative characters on pea plants in 2008/09 and 2009/10 seasons.

Treatments	Plant height (cm)		Number of leaves/plant		Number of branches/plant		Leaf area/plant (cm^2)		Chlorophyll Content SPAD unit		Plant fresh weight (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Biofertilizer:												
Control	58.9b	44.6b	25.3b	18.8b	2.3b	2.0b	749.b	749.7b	43.86b	41.67b	96.6b	89.3b
Halex-2	64.7a	49.9a	32.1a	23.5a	3.0a	2.3a	832.5a	832.5a	45.18a	42.01a	110.7a	93.8a
Boron concentrations (ppm):												
0	58.3d	44.9b	26.7d	19.2d	2.5c	2.1b	1014.2d	760.3d	43.58d	41.16d	98.1d	86.1d
5	59.9c	45.9ab	28.1c	20.5c	2.6bc	2.2ab	1039.5c	784.1c	44.28c	41.36cd	101.6c	91.8c
10	65.8a	50.4a	30.7a	22.9a	3.0a	2.3a	1090.3a	823.5a	45.31a	42.59a	109.9a	95.3a
15	63.2b	47.4ab	29.2b	21.9b	2.7b	2.2ab	1058.9b	796.6b	44.91b	42.25b	104.9b	92.9b

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.

Table (3): The effect of interaction between biofertilizer (Halex-2) and boron foliar application on vegetative characters on pea plants in 2008/09 and 2009/10 seasons.

Treatments: Biofertilizer	Treatments: Boron concentrations (ppm)	Plant height (cm)		Number of leaves/plant		Number of branches /plant		Leaf area/plant (cm^2)		Chlorophyll Content SPAD unit		Plant fresh weight (g)	
		1st	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**
Control	0	54.1h	41.4b	22.0h	16.0g	2.0g	1.9b	875.2h	715.1h	42.80g	41.10e	88.9h	84.0h
	5	56.3g	42.5b	24.7g	17.7f	2.2fg	2.0b	910.7g	739.0g	43.62e	41.25de	93.5 g	89.7f
	10	63.5d	49.8a	28.3e	21.2d	2.7c	2.2ab	988.5e	790.3e	44.70de	42.38b	104.5e	92.7d
	15	61.8f	44.7ab	26.1f	20.1e	2.4d	2.0b	935.7f	754.5f	44.30f	41.95c	99.3f	90.6e
Halex-2	0	62.6e	48.3ab	31.7d	22.3c	2.9b	2.0ab	1153.1d	805.4d	44.36f	41.22e	107.2d	88.2g
	5	63.8cd	49.2ab	31.6cd	23.4ab	3.0ab	2.3a	1168.2c	829.2c	44.93c	41.47de	109.6c	93.9c
	10	68.1a	51.0a	33.1a	24.6a	3.2a	2.4a	1192.0a	856.6a	45.92a	42.80a	115.3a	97.9a
	15	64.9b	50.1a	32.4b	23.6ab	3.0ab	2.3a	1182.0b	838.7b	45.51b	42.55ab	110.6b	95.1b

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.

Table (4): Effect of biofertilizer (Halex-2) and boron foliar application on green pods yield and its components of pea plants in 2008/09 and 2009/10 seasons.

Treatments	Total green pods yield Per plant (g)		Total green pods yield Per feddan (ton)		No. of green pods per plant		Weight of green pod (g)		No. of seeds Per pod		Weight of seeds per pod (g)		Shelling ratio (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Biofertilizer:														
Control	75.8b	62.1b	3.49b	3.25b	16.3b	14.1b	4.7b	4.3b	9.7b	9.5b	6.1b	5.5b	58.7b	58.0b
Halex-2	105.5a	85.3 a	3.74a	3.74a	20.8a	17.4a	5.2a	4.9a	10.2a	10.0a	6.6a	6.0a	60.1a	58.7a
Boron concentrations (ppm):														
0	64.7d	50.3d	3.40d	3.00d	15.1d	12.2d	3.2d	4.0d	9.6d	9.3c	5.6d	5.1d	57.3d	56.0d
5	82.4c	62.1c	3.61cd	3.39c	17.7c	14.4c	4.7c	4.3c	9.9c	9.7b	5.9c	5.3cd	59.2c	57.7c
10	114.1a	97.4a	4.36a	3.95a	21.8a	19.2a	5.6a	5.3a	10.4a	10.1 a	7.2a	6.6a	61.0a	60.3a
15	101.6b	85.1b	3.99b	3.65b	19.6b	17.2b	5.2b	4.9b	10.1b	9.9ab	6.6b	6.1b	60.1b	59.4b

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.

Table (5): The effect of interaction between biofertilizer (Halex-2) and boron foliar application on green pods yield and its components of pea plants in 2008/09 and 2009/10 seasons.

Treatments		Total green pods yield				No. of green pods per plant		Weight of green pod (g)		No. of seeds Per pod		Weight of seeds per pod (g)		Shelling ratio (%)	
		Per plant (g)		Per feddan (ton)											
Biofertilizer	Boron concentrations (ppm)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	0	52.8h	45.5h	3.10h	2.85h	13.2h	11.9f	4.0f	3.7g	9.3e	9.1f	5.3h	4.8g	56.9h	55.7h
	5	67.8g	55.2fg	3.25gh	3.17fg	15.4g	13.8e	4.4e	4.0f	9.6d	9.4e	5.6g	5.0fg	58.3f	57.1f
	10	98.4c	81.5c	3.98cd	3.65d	19.5d	16.3b	5.3b	5.0c	10.1b	9.8cd	7.0b	6.3b	60.2cd	60.0bc
	15	84.3e	66.2e	3.63f	3.33e	17.2ef	14.4ef	4.9c	4.6d	9.8cd	9.6de	6.4d	5.8c	59.3e	58.9d
Halex-2	0	76.5f	55.1g	3.69ef	3.15g	17.0f	12.5gh	4.5de	4.3e	9.8cd	9.5e	5.9f	5.3e	57.7g	56.2g
	5	97.0d	69.0de	3.97d	3.62cd	20.0cd	15.0de	4.9c	4.6d	10.1b	9.9bc	6.1e	5.5de	60.1d	58.3e
	10	129.7a	113.2a	4.74a	4.24a	24.0a	22.0a	5.8a	5.6a	10.6a	10.3a	7.5a	6.9a	61.8a	60.6a
	15	118.8b	104.0b	4.35b	3.96b	22.0b	20.0b	5.4b	5.2b	10.3b	10.3a	6.8c	6.3b	60.9b	59.8c

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.

Table (6): Effect of biofertilizer (Halex-2) and boron foliar application on dry seed yield and its components of pea plants in 2008/09 and 2009/10 seasons.

Treatments	Dry seed yield				Weight of seeds per pod (g)		Seed index (gm)		Dry seeds protein (%)		Seed germination (%)	
	Per plant (g)		Per feddan (ton)									
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Biofertilizer:												
Control	25.9b	22.4b	0.91b	0.79b	1.77b	1.67b	17.98b	17.68b	23.53b	23.5b	80.8b	80.2b
Halex-2	33.0a	31.0a	1.81a	1.04a	1.96a	1.86a	19.32a	18.60a	23.90a	23.8a	85.5a	84.5a
Boron concentrations (ppm):												
0	25.9d	23.0d	0.83d	0.76c	1.71b	1.62d	17.88d	17.66d	23.30d	23.1d	80.9d	80.5d
5	28.8c	25.5c	0.98c	0.86b	1.82b	1.73c	18.52c	17.89c	23.65c	23.5c	82.3c	81.3c
10	32.9a	30.2a	1.23a	1.03a	2.06a	1.91a	19.28a	18.78a	24.05a	23.9a	85.8a	84.6a
15	30.4b	28.1b	1.13b	1.01a	1.88ab	1.81b	18.92b	18.23b	23.85b	23.7b	83.6b	83.0b

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.

Table (7): The effect of interaction between biofertilizer (Halex-2) and boron foliar application on dry seed yield and its components of pea plants in 2008/09 and 2009/10 seasons.

Treatments		Dry seed yield				Weight of seeds per pod (g)		Seed index (g)		Dry seeds protein (%)		Seed germination (%)	
		Per plant (g)		Per feddan (ton)									
Biofertilizer	Boron concentrations (ppm)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	0	22.5h	19.6h	0.74g	0.70c	1.61b	1.50h	17.28h	17.14h	23.1e	22.9f	78.5h	78.1h
	5	25.4g	21.1g	0.83f	0.76c	1.69b	1.64g	17.85g	17.39g	23.4d	23.1ef	79.7g	79.2g
	10	29.4de	25.5e	1.10c	0.85bc	1.99ab	1.84cd	18.53de	18.31de	23.9b	23.7b	83.9de	82.7e
	15	26.4 f	23.3f	0.96de	0.84bc	1.78b	1.71f	18.26f	17.86f	23.7bc	23.4cd	81.0f	80.8f
Halex-2	0	29.3e	26.4d	0.92e	0.81bc	1.81b	1.74ef	18.48ef	18.18e	23.5cd	23.3de	83.2e	82.8de
	5	32.2c	29.9c	1.13bc	0.95bc	1.94ab	1.82d	19.19c	18.38cd	23.9b	23.8ab	84.9c	83.4c
	10	36.3a	34.8a	1.36a	1.20a	2.12a	1.98a	20.02a	19.25a	24.2a	24.1a	87.6a	86.5a
	15	34.3b	32.9b	1.30a	1.18a	1.98ab	1.90b	19.58b	18.60b	24.0ab	23.9ab	86.1b	85.1b

Values having a similar letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level.