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EFFECT OF INTERCROPPING, BORON AND IRON ON GROWTH, YIELD, YIELD QUALITY AND ECONOMIC RETURN of PEA WITH CABBAGE

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ABSTRACT

Two field experiments were carried out during the winter seasons of 2008/2009 and 2009/2010 at farm in Disuq district. Kafr El-Sheikh Governorate to investigate the effect of intercropping system between cabbage (Brunsiwek cv) and pea (Master B cv) and foliar application of boron (0, 50 and 80 ppm) and iron (0, 100 and 200 ppm) on growth, yield and yield quality as well as the economic value.

The results could be summarized as follows:

1. Intercropping pea with cabbage increased plant height, but decreased number of leaves, leaf area and plant fresh weight compared to pea solid cropping in both seasons. The highest green pod yield of intercropped pea was obtained from planting cabbage on one side and three rows of pea on the other side which gave 2.731 and 2.079 ton/fed. in the two seasons, respectively.
2. Spraying pea plants with boron at 50 ppm or iron with 200 ppm increased plant height, number of leaves, leaf area plant fresh weight, pod length, number of seeds/pod and total green pod yield in both seasons.
3. The highest yield of intercropped cabbage was obtained from planting one row of cabbage on one side and one row of pea on the other side which gave 44.31 and 40.74 ton/fed in the two seasons, respectively.
4. Spraying cabbage plants with boron at 50 ppm or iron at 100 ppm increased number and weight of inedible and edible leaves, total head weight, head yield./fed. and cabbage head quality in both seasons.
5. Intercropping pea with cabbage where cabbage grew one side and two rows of pea on the other side or cabbage in one side and three rows of pea on the other side gave high economic values. These two intercropping systems exceeded the solid planting of cabbage with 48.9 and 65.4 % in the first season, and 43.8 and 36.8% in the second one, respectively.

Keywords: Intercropping, pea, cabbage, micro-nutrients, vegetative growth, yield, economic return

INTRODUCTION

In the last two decades, investigators paid intensive attention to intercropping as a way for increasing yield per unit land area. The current status of intercropping research shows that it can give substantial yield advantages, and more stability from season to another than solid cropping. The causes of yield advantages could be due to several factors as suggested by many workers, crops grown in association may utilize water and soil resources efficiently than in Solid cropping (Andrews and Kassam, 1976; Ahmed and Gunasena, 1979 and Willey, 1979). In this connection, Abdel-Aal (1990) indicated that a yield advantage under intercropping system may be due to the differences between crops in their rooting system, nutrient requirements and photosynthetic cycles, thereby, they are able to

complement each other and to make better overall use of environmental resources when grown in combination than when grown separately.

Intercropping pea with cabbage could be considered one of the successful example. Thus, the pea cultivar used (Master B) is a short growing period, determinate growth habit and low fertilizer requirements (Fayad, 2004). These characters gave the chance for intercropping with other crops. Moreover, both pea and cabbage (Brunswich cultivar) are considered suitable crops for intercropping with respect to the intensive utilization of nutrients, sunlight and water which are usually wasted in monocropping system of cultivation.Many investigators stated that the use of vegetables intercropping system greatly increased land productivity by increasing total yield per unit area (El-Zawilly *et al.*, 1993; El-Waraky, 1996; Abdel-Baky, 2000 and El-Waraky *et al.*, 2005).

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 soil into unavailable form. Therefore, the required small quantities from micro-nutrients are preferably supplied in the form of a dilute spray to enhance plant response to the added micro-nutrients. Boron and iron are one of the micro-element that have important roles in the physiological and metabolic processes of plants. Accordingly, boron and iron are of a great necessity for adequate plant growth and productivity. Boron 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).

Iron deficiency chlorosis is a nutritional disorder characterized by a significant decrease of chlorophyll in the leaves, which is often observed in plants grown on alkaline and calcareous soils (Schenkeveld *et al.*, 2008). Iron deficiency has the negative effect on nitrogenase activity and N_2 fixation by soybean (Caliskan *et al.*, 2008). Synthesis of chlorophyll, tylakoid and many ferrous proteins depends on this element (Kabraee *et al.*, 2011). The effect of foliar iron application has been in consistent, being successful at some locations in reducing a sign of chlorosis in soybean and increasing yield in some cases (Meliesch, 2011).

Thus, the main objective of the present study was to investigate the effect of intercropping between pea and cabbage (Brunswick cv.) plants and foliar nutrition with boron and iron on growth, yield and yield quality and economic return of both crops.

MATERIALS AND METHODS

Two field experiments were performed at a farm in Disuq district, Kafr El-Sheikh Governorate, during two winter seasons of 2008/2009 and 2009/2010 to investigate the effect of intercropping between cabbage (Brunswick cultivar) and pea (Master B cultivar) and foliar nutrition with boron and iron and their interactions on growth, yield and yield quality. The physical and chemical analysis of the experimental soil are shown I Table (1).

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

Season	Physical analysis			Texture	pH*	EC** (dS m^{-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 paste extract**

Each experiment included 36 treatments representing the combinations of four intercropping systems, three boron concentrations and three iron concentrations. The various treatments were arranged in a split-split plot design with four replications in which intercropping systems (cabbage or, pea alone and cabbage with pea) were randomly distributed in the main plots. Each main plot was splitted to three boron concentrations (0, 50 and 80ppm) as a sub-plot, and he three iron concentrations (0, 100 and 200 ppm) were randomly assigned as a sub-sub plot. Boron and iron were foliar sprayed twice at 35 and 50 days after sowing of pea plants. Plants of the control treatment were sprayed with distilled water. The experimental plot contained 5 rows, 6 m in length and 0.7 in width, comprising an area of 21 m^2.

In this study, cabbage was transplanted as common on 70 cm wide rows at 50 cm spacing between plants on the northern side of the rows. Pea plants were allowed to grow with cabbage in three intercropping systems.

1. Sowing pea on one side of the row (southern side) with two plants/hill, 10 cm apart and cabbage on the other side (Northern side) of the same row 50 cm apart. This provides 133% total population (33% for pea and 100% for cabbage) (system I).
2. Two rows of peas plants in the middle and southern side of ridge with two plants/hill, 10 cm apart and cabbage on the other side of ridge. This provides 166% total population (66% for pea and 100% for cabbage) (system II).
3. Three rows of peas plants in the middle and southern side of ridge two plants/hill, 10 cm apart and cabbage in the northern ridge side. This provides 200% total population (100% for pea and 100% for cabbage) (system III).

Two control treatments were sown; i.e. solid planting of cabbage on one side of the row, 50 cm apart (100% cabbage population) and solid planting of pea on both sides and middle of the row, two plants/hill, 10 cm apart (100% pea population). Seedling of cabbage (Brunswick cultivar) were planted on November 1st in both seasons, while pea (Master B cv.) planted on November 10th in both seasons.

The common cultural practices were done for both crops whenever needed and as usually conducted by commercial growers. However, the common fertilizer rates for cabbage plants only were added for both intercropped crops, since pea (companion crop) is a legume crop.

The following data were recorded:

1. Pea:

Samples of 10 plants from each sub-sub plot (experimental unit) were picked at 50 days after sowing in which plant height, number of leaves/plant, leaf area/plant and plant fresh weight were measured. To estimate the yield of green pods, they were picked at intervals of 10 days up to 50 days after sowing. During the harvesting seasons, three samples of green pods consisted of twenty-five green pods were taken at random from each experimental unit to estimate the pods quality, i.e., pod length, pod diameter (cm) and number of seeds/pod.

2. Cabbage

Five plants were taken randomly from each experimental unit at harvesting time to determine the following data:

a. Vegetative traits:

Number of inedible and edible leaves/plant, average fresh weight of inedible and edible leaves/plant (kg/), leaf area/plant.

b. Head quality:

Gross head weight (kg), head outside diameter (cm), head inside diameter (cm), head compression = $\frac{\text{Head weight}}{\text{Head diameter}} x100$, stem length (cm), and stem weight (g)

c. Head yield:

The fresh of the whole head the outer and inner leaves and the stem) were estimated and expressed as ton/fed. from all plants of each plot (the total of eleven batches).

Economic value of combined intercrop yields:

It was calculated by expressing the yield of the unit land area in monetary terms. This does, of course, put different crops on a comparable basis. The sale prices used in computing cash values were 2.0 L.E, for each kg of green pod yield of pea, one head of cabbage, grade I and 1.5 LE for each one head of cabbage grade 2.

All data obtained were statistically analyzed according to procedures outlined by Snedecor and Cochran (1967). Revised least significant differences (Revised LSD) test was used for comparing means among treatments.

RESULTS AND DISCUSSION

Cabbage plants (main crop) completed their life cycle within 150 days after sowing in this experiment, while that for pea plants (Companion crop) was about 80 days from sowing. Thus, both cabbage and pea plants remain together after pea planting with about 60 days. In this period both crops subjected to inter and intra specific competition, while after harvesting pea plants, cabbage plants suffer from inter competition only.

I. Pea:

1. Effect of intercropping:

Data presented in Table (2) show generally that solid pea plants gave the lowest values of plant height in both seasons, which gave 48.9 and 42.0 cm compared to systems of intercropping which gave 49.5 and 42.7 cm in system I and 51.1 and 44.5 in system II and 54.2 and 47.4 cm in system III in both seasons, respectively. Intercropping pea with cabbage significantly decreased most of the studied growth characters of pea in terms of number of leaves and leaf area compared to pea solid cropping in both seasons. These results may be due to the higher number of plants per feddan with intercropping that caused higher inter and intra competition between plants for light water and minerals. This is in harmony with the results of El-Shimi (1983) on tomato and cucumber or bean, Gawish *et al.* (1992) on tomato, El-Waraky (1996) on cowpea, beans and eggplant or squash, Abdel-Baky (2000) on beans and pepper and El-Waraky *et al.* (2005) on pea and garlic.

Green pods yield of peas (ton/fed) was significantly decreased by intecropping compared to pea Solid cropping which gave 3.020 and 2.397 ton/fed. in the two seasons, respectively compared to systems of intercropping which gave 1.700 and 1.265 ton/fed. in system I and 2.230 and 1.647 ton/fed. in system II and 2.731 and 2.079 ton/fed. in system III in both seasons, respectively.

Intercropping had a significant effect on pod length and number of seeds/pod in both seasons, which gave the lowest value compared to solid plants. The reduction in pea yield was resulted from the decrease in vegetative growth by intercropping. This result is in agreement with that obtained by Rosset *et al.* (1987) who found that the yield of intercropped bean with tomato was 75% of monocultural bean production. Similar conclusion was obtained by Gawish *et al.* (1992) on pea and tomato, El-Zawily *et al.* (1993) on cowpea and cucumber, El-Waraky (1996) on cowpea, beans and eggplants or squash, Abdel-Baky (2000) on beans and pepper and El-Waraky *et al.* (2005) on pea and garlic.

2. Effect of boron foliar application

Data presented in Table (2) show that all growth parameters were significantly affected by boron application in both growing seasons. The concentration of 50 ppm gave the tallest plants, and the highest number of leaves/plant, leaf area/plant and plant fresh weight in both seasons, whereas the untreated plants produced the lowest value of each character. Foliar spray solution at 50 ppm led to the increase in pea plant height from 48.4 and 41.4 cm to 52.8 and 46.6 cm in the first and second season, respectively. Also, it increased number of leaves/plant from 19.6, 17.2 to 23.9, 19.7 in the first and second seasons, respectively. Leaves area/plant, and plant fresh weight had the same behavior. The improving effect of boron may be attributed to the direct effect 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 canopy and probably its whole size may increase in the same line.

In this concern, 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. Pea green pods yield was highly significant increased due to boron foliar spray, where it was increased from 2.12 and 1.69 ton/fed. to 2.70 and 2.02 ton/fed. in the first and second seasons, respectively.

Pod length, pod diameter and pods number plant^{-1} showed the same behavior. 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 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 pea than those of the control plants. Similar results were reported by Abd El-Fattah (1997) on broadbean, Bin Ishaq (2002) on pea and El-Waraky *et al.* (2013) on pea.

3. Effect of iron foliar application:

Data presented in Table (2) show dramatic increase in pea plant height, number of leaves plant^{-1}, leaves area plant^{-1}, plant fresh weight, yield of green pods fed^{-1}, pod length, pod diameter and number of seeds pod^{-1} in both seasons due to foliar application of iron.

Increasing iron foliar spray solution from 0 to 100 and 200 ppm led to the increase in pea plant height from 48.6, 41.8 to 51.0, 44.4 and 53.2, 46.2 cm in the first and second seasons, respectively. Likewise, iron concentration increased number of leaves plant^{-1} from 19.9, 17.2 to 21.8, 18.4 and 23.4, 19.3 in the first and second seasons, respectively.

Increasing concentration of iron foliar spray from 0 to 100 and 200 ppm led to highly significant increase in plant leaves area, where it was increased from 669.8, 605.6 to 705.7, 641.9 and 737.8, 662.8 in the first and second seasons, respectively.

Plant fresh weight had the same sequence with the mentioned characters. Pea green pods yield was highly significant increased due to iron foliar spray, where it was increased from 2.18, 1.62 to 2.38, 1.84 and 2.7, 2.1 ton/fed. in the first and second seasons, respectively. Pod length, pod diameter and pods number plant^{-1} manifested the same behavior. This may be due to the soil contains less available of Fe which causes pea response to iron spraying and the importance of iron as essential micronutrient for the plants as one of constituents of chlorophyll molecule. Soils of arid and semi-arid regions are characterized with low organic matter content high pH and high $CaCO_3$ in some cases. Under such conditions foliar fertilization of macro and micro-nutrients leads to considerable yield response (Girgis *et al.*, 1993; Saad, 1994 and Williams and Kalkafi, 1997; and El-Fouly and El-Sayed, 1997).

II. Cabbage:

1. Effect of intercropping system:

Data presented in Table (3) show generally that solid cabbage plants and system I gave the highest values of number and average fresh weight of

inedible and edible leaves, head edible weight and total head weight in both seasons compared to other systems of intercropping which gave number of inedible leaves 18.4 and 16.4 in solid plant and 16.7 and 14.9 in system I and average fresh weight of inedible leaves 1.7 and 1.56 in Solid plant and 1.46 and 1.34 in system I and number of edible leaves 36.9 and 34.8 in Solid plant and 35.4 and 32.9 in system I and average fresh weight of edible leaves 3.18 and 2.98 in Solid plant and 2.70 and 2.50 in system I and head edible weight 3.42 and 3.22 in Solid plant and 2.95 and 2.74 in system I and total head weight 5.09 and 4.79 in Solid plant and 4.343 and 4.07 in system I and heads yield (ton/fed.) 51.39 and 48.16 insole plant and 44.31 and 40.74 in system I in the first and second seasons, respectively. The observed superiority in head yield of cabbage per feddan of solid cabbage and system I may be a result of the increase in dimension of fresh weight of inedible and edible leaves with the same treatment. Similar results were reported by Haridy *et al.* (1990), Rahangdale *et al.* (1995), El-Zawily *et al.* (2000).

Head quality of cabbage (head dimensions, fresh weight of edible heads, stem length and stem weight) showed similar trends as that obtained for head yield per feddan, as solid cabbage and system I. These results may be due to planting of cabbage alone and low population of pea plants per feddan in system I.

2. Effect of foliar application of boron:

Data presented in Table (3) show that all growth and yield traits of cabbage plants (number of inedible and edible leaves, average fresh weight of inedible and edible leaves, head edible weight and total head weight) were significantly affected by foliar application with boron in both seasons.

The boron concentration of 50 ppm resulted in the highest value, which gave number of inedible leaves of 17.3 and 15.3 and average fresh weight of inedible leaves of 1.55 and 1.42 and number of edible leaves 35.5 an 33.2 and average fresh weight of edible leaves of 2.89 and 2.68 and head edible weight of 3.1 and 2.89 and total head weight of 4.67 and 4.34 in the first and second seasons, respectively compared to 0 and 80 ppm. Head quality of cabbage (head weight, head compression, stem length and stem weight) showed similar trends as that obtained from growth of cabbage due to spraying with boron at 50 ppm.

3. Effect of foliar application of iron

Data presented in Table (3) show that increasing iron foliar spraying levels from 0 to 100 ppm in the spraying solution led to high significantly increased cabbage inedible leaves from 13.8 and 11.9 to 18.2 and 16.3, average weight of leaves/plant from 1.26 and 1.13 to 1.58and 1.46 kg/plant, number of edible leaves/plant from 33.1 and 30.6 to 36.3 and 33.1, average fresh weight of edible leaves (kg plant^{-1}) from 2.54 and 2.33 to 2.89 and 2.62 in the first and second seasons, respectively, head edible weight from 2.77 and 2.55 to 3.1 and 2.83 kg plant^{-1}, total head weight from 4.03 and 3.69 to 4.69 and 4.31 kg plant^{-1} and heads yield (ton fed^{-1}) from 40.49 and 36.86 to 47.13 and 43.38 in the first and second seasons, respectively. On the other hand, increasing iron foliar spray solution from 100 to 200 ppm led to decrease in all the studied characters, whereas it was increased over the control (without iron foliar spray).

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This may be due to that 100 ppm concentration was the suitable concentration for completing the plants needs. The effectiveness Fe fertilization of soil is not always successful, it depends on the Fe compound, application method and soil characteristics, mainly pH and comparing cations (Alvarez-Fernandez *et al.*, 1996). Similar results were reported by El-Fouly and Sayed (1997) and Perez-Sanz *et al.* (1997).

III. Effect of the interaction between intercropping and foliar application of boron on pea

Data presented in Table (4) show that all interaction treatments between intercropping and foliar application of boron had significant or highly significant effects on all studied traits in both growing seasons, with exception of plant fresh weight in second season and pod diameter in both growing seasons. It is clear from the results that application of boron at 50 ppm gave the best results under the all intercropping systems as well as the solid cultivation of pea in both growing seasons which gave the highest values of plant height, number of leaves/plant, leaf area/plant, plant fresh weight, total green pods, pod length, pod diameter and number of seeds/pod.

IV. Effect of the interaction between intercropping and foliar application of iron on pea

Data presented in Table (5) show that all interaction treatments between intercropping and iron foliar application had significant or highly significant effect on all studied traits in both growing seasons, with exception of plant fresh weight in the second growing season and pod diameter in both growing seasons. In both growing seasons and under the three intercropping systems as well as solid cultivation, pea plants sprayed with 200 ppm iron produced the highest values of vegetative traits, green pods and green pods quality.

V. Effect of the interaction between boron and iron foliar application on pea

Data presented in Table (6) show that the effects of all interaction treatments between boron and iron foliar application on vegetative traits, green pod yield and green pod quality were significant or highly significant in both growing seasons with exception of leaf area/plant and plant fresh weight in second growing season and pod diameter in both growing seasons.

In both growing seasons, pea plants sprayed with the three boron concentrations and 200 ppm iron gave the highest values of vegetative traits, green pod yield and green pod quality.

VI. Effect of the interaction between intercropping system and boron foliar application on cabbage

Data presented in Table (7) show that all intercropping treatments between intercropping system and boron foliar application had significant or highly significant in both growing seasons, with exception of head compression in the first season and stem weight in the second one. Cabbage plants treated with 50 ppm boron produced the highest values of vegetative traits, yield and quality in both growing seasons.

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VII. Effect of the interaction between intercropping and iron foliar application on cabbage:

Data presented in Table (8) show that the interaction treatments between intercropping system and iron foliar application had significant or highly significant with exception of head edible weight and head inside diameter in the second growing season and stem weight in the first one. Also, it is clear from the results that cabbage plants sprayed with 100 ppm iron under all intercropping systems had the highest values of vegetative traits, yield and yield quality in both growing seasons.

VIII. Effect of the interaction between boron and iron foliar application on cabbage

Data presented in Table (9) show that the effect of all interaction treatments between boron and iron foliar application on vegetative traits, yield and head quality of cabbage plants were significant or highly significant for all studied traits in both growing seasons, with exceptions of head edible weight in both growing seasons, head outside diameter and head compression in the second growing season and stem weight in the first growing season. Cabbage plants treated by boron at the three concentrations and iron at 100ppm produced the highest values of all the studied traits in both growing seasons

IX. Economic values of cabbage and pea yield:

Data presented in Table (10) show generally that cabbage crop had higher economic values than pea crop. The intercropping of pea with cabbage where pea grew with two rows of pea in the southern side and cabbage in the northern side or three rows of pea in southern side and cabbage in the northern side gave higher economic values. These two intercropping systems exceeded the solid planting of cabbage by 48.9 and 65.4% in the first season and 43.8 and 36.8% in the second one, respectively.

The obtained results of net return and monetary advantage under the effect of intercropping of both crops and foliar application of boron and iron showed somewhat similar results as that of yield of both crops. These results are in accordance with those of El-Zawily *et al.* (2000) on cabbage and lettuce and Badr and Masoud (2004) on cowpea and cotton and El-Waraky *et al.* (2005) on pea and garlic.

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Table (10): Economic value of combined intercrop yield (LE/fed) as affected by different intercropping systems in 2008/2009 and 2009/2010 seasons

Inter-cropping systems	2008/2009 season						2009/2010 season					
	Pea		Cabbage		Both crops		Pea		Cabbage		Both crops	
	LE	%	LE	%	LE	%	LE	%	LE	%	LE	%
Solid crop	6040	100	20000	100			4790	100	20000	100		
System I	3400	56.3	15003	75.0	18403	131.3	2530	52.82	15014	75.07	17544	127.8
System II	4460	73.8	15007	75.0	19467	148.9	3290	68.77	15128	75.07	18418	143.8
System III	5460	90.4	15000	75.0	20470	165.4	4160	86.81	9991	49.96	14151	136.8

Cabbage grade I = cabbage produced from solid cultivar
Cabbage grade II = Cabbage produced from intercropping systems

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تـأثير التحميـل والـرش بـالبورون والحديـد علـى النمـو والمحصـول والجـودة والعائـد الاقتصادى لنباتات البسلة والكرنب

على محمد محمد الدسوقى مسعود
قسم الخضر ـ معهد بحوث البساتين ـ مركز البحوث الزراعية ـ الجيزة ـ مصر

أجريت دراسة حقلية لمدة عامين خلال الموسم الشتوى ٢٠٠٨/٢٠٠٩م ، ٢٠٠٩/٢٠١٠م فى منطقة دسوق محافظة كفرالشيخ لدراسة تأثير التحميل بين الكرنب صنف برونزويك والبسلة صنف ماستربى والتغذية الورقية بالبورون (صفر ، ٥٠ ، ٨٠ جزء فى المليون) والحديد (صفر ، ١٠٠ ، ٢٠٠ جزء فى المليون) على النمو والمحصول والجودة بالإضافة إلى القيمة الاقتصادية الناتجة من المحصولين من وحدة المساحة المنزرعة وكان نظام التجميل كالأتى: الكرنب على أحد جوانب الخط والبسلة على الجانب الآخر ، الكرنب على جانب الخط وخطين بسلة على الجانب الآخر والوسط ، الكرنب على جانب الخط وثلاثة خطوط بسلة على الجانب الآخر والوسط بالإضافة إلى الكنترول من الكرنب والبسلة.

وتتلخص النتائج كالأتى:

١- ازداد ارتفاع نبانات البسلة بالتحميل مع الكرنب فى الموسمين ولكنه تسبب فى انخفاض عدد الأوراق والمساحة الورقية والوزن الطازج للنبات وذلك بالمقارنة بنباتات البسلة المنزرعة بدون تحميل وذلك فى الموسمين. أعطت معاملة التحميل بزراعة الكرنب على أحد جانبى الخط وثلاثة خطوط من البسلة على الجانب الآخر والوسط أعلى محصول من البسلة حيث أعطت ٢.٧٣١ ، ٢.٠٧٩ طن للفدان فى الموسمين على التوالى.

٢- أدى الرش بالبورون بتركيز ٥٠ جزء فى المليون والحديد بتركيز ٢٠٠ جزء فى المليون إلى زيادة ارتفاع نباتات البسلة ، عدد الأوراق ، المساحة الورقية ، الوزن الطازج للنبات وأيضا زيادة طول القرن وعدد البذور فى القرن الواحد وبالتالى المحصول الكلى فى الموسمين.

٣- أعطت معاملة التحميل بنظام خط كرنب على جانب الخط وخط بسلة على الجانب الآخر أعلى محصول من الكرنب.

٤- أدى الرش بالبورون بمعدل ٥٠ جزء فى المليون والحديد بتركيز ١٠٠ جزء فى المليون إلى زيادة عدد الأوراق الداخلية والخارجية ووزنها الطازج لرأس الكرنب وبالتالى زيادة محصول وجودة الكرنب فى الموسمين.

٥- أوضحت النتائج أن أعلى قيمة اقتصادية لتحميل البسلة مع الكرنب عند زراعة خطين بسلة على جانب ووسط الخط والكرنب على الجانب الآخر أو ثلاثة خطوط بسلة على جانب ووسط الخط والكرنب على الجانب الآخر ، حيث أعطيا هذين النظامين من التحميل زيادة عن زراعة الكرنب فقط بدون تحميل بمقدار ٤٨.٩ ، ٦٥.٤% فى الموسم الأول و ٤٣.٨ ، ٣٦.٨% فى الموسم الثانى على التوالى.

قام بتحكيم البحث

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Table (2):Effect of intercropping system, boron and iron foliar application on vegetative growth, yield and yield quality of pea plants in 2008/2009 and 2009/2010 seasons.

Treat.	Plant height (cm)		No. of leaves plant^{-1}		Leaves area (dm^2) plant^{-1}		Plant fresh weight (g)		Total green pods yield (ton)		Pod length (cm)		Pod diameter (cm)		No. of seeds pod^{-1}	
	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
1- Intercropping system*																
Solid pea	48.9 d	42.0 d	27.1 a	23.4 a	856.66 a	733.77 a	95.03 a	82.45 a	3.020 a	2.397 a	10.3 a	8.9 a	1.4 a	1.2	9.2 a	8.3 a
System I	49.5 cd	42.7 cd	22.8 b	18.4 b	708.03 b	651.90 b	79.36 b	72.75 bc	1.700 c	1.265 d	10.0 b	8.5 b	1.3 a	1.1	8.9 b	8.0 b
System II	51.1 b	44.5 b	19.6 c	16.1 c	656.12 c	604.39 c	75.25 c	68.62 c	2.230 d	1.647 c	9.9 c	8.0 c	1.1 b	1.1	8.6 c	7.8 c
System III	54.2 a	47.4 a	17.5 d	15.4 d	596.89 d	556.96 d	67.22 d	59.40 d	2.731 b	2.079 b	9.4 d	7.9 d	1.1 b	1.0	8.2 d	7.7 d
F. test	**	**	**	**	**	**	**	**	**	**	**	**	*	NS	**	**
2- Boron concentrations (ppm)																
0	48.4 c	41.4 c	19.6 c	17.2 c	682.72 c	606.38 b	75.35 c	69.03 b	2.119 c	1.696 c	9.7 c	8.2 c	1.2 b	1.1	8.6 c	7.9 c
50	52.8 a	46.6 a	23.2 a	19.7 a	732.91 a	654.83 a	83.37 a	72.86 a	2.709 a	2.020 a	10.1 a	8.5 a	1.3 a	1.1	8.9 a	8.1 a
80	51.6 b	44.3 b	21.6 b	18.1 b	697.64 b	649.07 a	78.92 b	70.53 b	2.434 b	1.825 b	9.9 b	8.3 b	1.2 b	1.1	8.7 b	8.0 b
F. test	**	**	**	**	**	**	**	**	**	**	**	**	*	NS	**	**
3. Iron concentrations (ppm)																
0	48.6 c	41.8 c	19.9 c	17.2 c	669.81 c	605.64 c	76.27 c	68.17 b	2.184 c	1.622 c	9.7 c	8.2 c	1.2 b	1.1	8.6 c	7.9 c
100	51.0 b	44.4 b	21.8 b	18.4 b	705.68 b	641.86 b	78.40 b	71.53 a	2.379 b	1.843 b	9.9 b	8.4 b	1.2 b	1.1	8.7 b	8.0 b
200	53.2 a	46.2 a	23.4 a	19.3 a	737.78 a	662.72 a	82.97 a	72.73 a	2.698 a	2.076 a	10.0 a	8.5 a	1.3 a	1.1	8.8 a	8.1 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**	*	NS	**	**

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

*** Solid pea: three rows of pea plants on two sides and middle, system I: one row of pea in one side and cabbage in the other side, system II: two rows of pea on one side and middle and cabbage in the other side and system III: three rows of pea in one side and middle and cabbage in other side.**

Table (3): Effect of the intercropping system, boron, and iron foliar application on vegetative growth, yield and yield quality of cabbage plants in 2008/2009 and 2009/2010 seasons.

Treat.	No. of inedible leaves		Av. fresh weight of inedible leaves (kg)		No. of edible leaves		Av. fresh weight of edible leaves (kg)		Head edible weight (kg)		Total head weight (kg)		Head yield (ton/fed.)		Head outside diameter (cm)		Head inside diameter (cm)		Head compression		Stem length (cm)		Stem weight (g)	
	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
1- Intercropping system*																								
Solid cabbage	18.4 a	16.4 b	1.70 a	1.57 a	36.9 a	34.8 a	3.18 a	2.98 a	3.42 a	3.22 a	5.09 a	4.79 a	51.39 a	48.16 a	88.4 a	83.3 a	31.0 a	28.6 a	0.146	0.112 a	16.4 c	15.9 c	254.4 a	329.3
System I	16.7 b	14.9 a	1.46 b	1.34 c	35.4 b	32.9 b	2.70 b	2.50 b	2.95 b	2.74 b	4.43 b	4.07 b	44.31 b	40.74 b	86.1 bc	80.3 b	29.2 b	27.2 b	0.101	0.099bc	18.2 b	17.6 a	248.9 b	235.6
System II	14.6 c	13.0 c	1.27 c	1.10 d	34.0 c	30.7 c	2.45 c	2.21 c	2.65 c	2.40 c	3.96 c	3.63 c	39.62 c	36.31 c	85.8 c	78.2 c	26.8 cd	25.8 cd	0.100	0.092cd	18.6 a	17.6 a	238.9 c	223.1
System III	13.9 d	12.3 d	1.24 c	1.49 b	31.9 d	28.7 d	2.36 d	2.08 d	2.55 c	2.30 c	3.79 d	3.45 d	37.90 d	34.47 d	79.1 d	74.2 d	26.4 d	25.2 d	0.097	0.091 d	18.2 b	17.4 b	228.9 d	218.7
F. test	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	NS	*	**	**	**	NS
2- Boron concentrations (ppm)																								
0	15.6 b	13.8 b	1.40 b	1.30 b	33.9 c	30.8 c	2.60 b	2.35 b	2.83 b	2.58 b	4.23 b	3.87 b	42.36 b	38.67 b	83.08 b	77.5 c	27.2 c	25.6 c	0.131	0.099 b	17.5 c	16.9 c	234.2 c	222.8
50	17.3 a	15.3 a	1.55 a	1.42 a	35.5 a	33.2 a	2.89 a	2.68 a	3.10 a	2.89 a	4.67 a	4.34 a	46.78 a	43.59 a	85.69 a	81.0 a	29.5 a	27.8 a	0.104	0.103 a	18.3 a	17.5 a	254.2 a	304.4
80	14.8 c	13.5 c	1.32 d	1.22 c	34.2 b	31.3 b	2.53 b	2.30 b	2.75 c	2.53 b	4.05 c	3.75 c	40.76 c	37.51 c	85.75 a	78.6 b	28.4 b	26.8 b	0.097	0.093 c	17.8 b	17.0 b	240.0 b	227.9
F. test	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	NS	*	**	**	**	NS
3. Iron concentrations (ppm)																								
0	13.8 c	11.9 c	1.26 c	1.13 c	33.1 c	30.6 c	2.54 b	2.33 b	2.77 b	2.55 b	4.03 c	3.69 c	40.49 c	36.86 c	81.81 c	77.2 c	26.8 c	25.2 c	0.102	0.098 b	17.3 b	16.8 c	237.5 b	226.3
100	18.2 a	16.3 a	1.58 a	1.46 a	36.3 a	33.1 a	2.89 a	2.62 a	3.10 a	2.83 a	4.69 a	4.31 a	47.13 a	43.38 a	87.64 a	81.0 a	30.7 a	28.8 a	0.130	0.098 b	18.9 a	17.7 a	256.7 a	309.6
200	15.7 b	14.3 b	1.44 b	1.35 b	34.3 b	31.6 b	2.59 b	2.39 b	2.81 b	2.61 b	4.23 b	3.96 b	42.30 b	39.52 b	85.08 b	78.5 b	27.5 b	26.1 b	0.101	0.099 a	17.3 b	16.9 b	234.2 c	219.2

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

*** Solid cabbage: one row of cabbage on one side, system I: one row of cabbage in one side and one row of pea on the other side, system II: one row of cabbage in one side and two rows of pea on the other side and middle, system III: one row of cabbage in one side and three rows of pea on other side and middle.**

Table (4): Effect of the interaction between intercropping system and boron foliar application on vegetative growth, yield and green pods quality of pea in 2008/2009 and 2009/2010seasons.

Inter-cropping system	Boron conc. (ppm)	Plant height (cm)		No. of leaves plant^{-1}		Leaves area plant^{-1} (dm^2)		Plant fresh weight (g)		Total green pods yield (ton/fed.)		Pod length (cm)		Pod diameter (cm)		No. of seeds/pod	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Solid pea	0	45.3 h	39.1 m	23.3 d	20.5 c	784.10 c	673.30 cd	83.07 cd	77.67	2.618 d	2.173 c	10.1 d	8.6 d	1.3	1.1	9.1 c	8.1 c
	50	51.7 c	45.4 ef	31.0 a	26.7 a	934.40 g	800.53 a	106.57 a	86.692	3.33 a	2.604 a	10.4 a	9.3 a	1.5	1.2	9.4 a	8.5 a
	80	49.8 e	41.6 h	26.8 b	22.8 b	851.47 b	787.49 b	95.47 b	83.07	3.105 b	2.412 b	10.3 b	8.9 b	1.4	1.2	9.2 b	8.3 b
System I	0	46.1 gh	40.0 L	20.1 g	17.5 f	698.70 f	631.53 fg	77.53 fg	73.11	1.513 n	1.156 o	9.9 f	8.4 e	1.2	1.1	8.8 e	7.9 d
	50	52.4 bc	45.6 ef	25.5 c	19.4 d	726.17 d	656.97 ef	81.57 de	75.27	1.935 L	1.404 m	10.2 c	8.7 c	1.3	1.2	9.1 c	8.1 c
	80	50.1 de	42.4 g	22.6 e	18.3 e	699.23 ef	667.20 de	78.97 ef	69.88	1.653 m	1.236 n	10.0 e	8.4 e	1.3	1.2	8.9 d	8.1 c
System II	0	48.6 f	41.7 gh	18.4 L	15.7 m	643.97 L	588.17 h	73.96 L	66.70	2.000 hi	1.547 L	9.7 g	7.9 h	1.1	1.0	8.5 g	7.8 e
	50	52.6 b	46.0 cd	20.5 f	16.7 g	669.18 g	611.57 gh	76.96 gh	69.10	2.440 e	1.777 g	10.0 e	8.1 f	1.1	1.1	8.6 e	7.9 d
	80	52.2 bc	45.8 de	19.8 h	16.1 h	655.20 h	613.43 gh	74.83 hi	70.07	2.250 g	1.618 h	9.9 f	8.0 g	1.1	1.1	8.6 e	7.8 e
System III	0	53.5 b	45.0 L	16.7 n	14.8 o	604.11 mn	532.50 m	66.84 no	58.66	2.344 f	1.907 f	9.2 m	7.8 L	1.1	1.0	8.1 L	7.7 f
	50	54.6 a	49.5 a	18.4 L	16.01 L	601.88 n	550.23 Lm	68.40 mn	60.43	3.123 b	2.297 d	9.6 h	8.0 g	1.1	1.1	8.3 h	7.8 e
	80	54.4 a	47.6 b	17.3 m	15.3 n	584.68 o	588.16 h	66.41 o	59.10	2.726 c	2.033 e	9.5 L	7.9 h	1.1	1.0	8.1 L	7.7 f
F. test		**	**	**	**	**	**	**	NS	**	**	**	*	NS	NS	**	*

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

*** Solid pea: three rows of pea plants on two sides and middle, system I: one row of pea in one side and cabbage on the other side, system II: two rows of pea on one side and middle and cabbage on the other side and system III: three rows of pea in one side and middle and cabbage on the other side.**

Table (5): Effect of the interaction between intercropping and iron foliar application on vegetative growth, yield and yield quality of pea plants in 2008/2009 and 2009/2010 seasons..

Inter-cropping system	Iron conc. (ppm)	Plant height (cm)		No. of leaves plant^{-1}		Leaves area plant^{-1} (dm^2)		Plant fresh weight 9g)		Total green pods yield (ton)		Pod length (cm)		Pod diameter (cm)		No. of seeds pod^{-1}	
		2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
Solid pea	0	46.1 m	39.5 m	24.0 d	21.4 c	778.13 c	672.33 de	89.10 c	77.80	2.793 d	2.034 e	10.1 c	8.7 c	1.3	1.1	9.1 b	8.2 c
	100	49.1 gh	42.3Lm	27.2 b	23.4 b	866.73 b	730.33 b	93.37 b	82.36	2.949 c	2.415 b	10.3 b	8.9 b	1.4	1.2	9.3 a	8.3 b
	200	51.7 de	44.2 f	30.0 a	25.3 a	925.10 a	798.66 a	102.63 a	87.20	3.317 a	2.740 a	10.4 a	9.1 a	1.4	1.2	9.3 a	8.4 a
System I	0	46.91 n	40.3Lm	21.2 f	17.3 f	673.00 g	627.73 fg	76.73 g	71.14	1.544 o	1.127 n	9.9 e	8.3 f	1.2	1.1	8.8 e	7.9 e
	100	49.8 h	42.8 gh	22.6 e	18.6 e	710.57 e	655.07 e	78.87 ef	74.28	1.670 n	1.229 m	10.0 d	8.5 e	1.3	1.2	8.9 d	8.1 d
	200	51.9 d	44.8 ef	24.5 c	19.3 d	740.53 d	672.90 de	82.47 d	72.83	1.888 m	1.439 L	10.1 c	8.6 d	1.3	1.2	9.0 c	8.1 d
System II	0	48.9 h	42.2 h	18.4 L	15.4 m	636.93 L	589.53 hi	73.89 L	66.27	1.946Lm	1.475 h	9.7 f	7.9 L	1.1	1.0	8.5 g	7.7 g
	100	51.4 e	44.8 gh	19.7 h	16.3 h	652.43 h	601.75 gh	74.38 hi	70.27	2.193 h	1.633 g	9.9 e	8.0 h	1.1	1.1	8.6 f	7.9 e
	200	53.0 bc	46.5 c	20.5 g	16.8 g	678.98 fg	621.90 fg	77.48 fg	69.33	2.551 f	1.833 f	10.0 d	8.2 g	1.1	1.1	8.6 f	7.9 e
System III	0	52.4 cd	45.2 de	16.4 n	14.7 n	591.18 o	532.96 m	65.34 o	57.46	2.453 g	1.853 f	9.3 h	7.7 m	1.1	1.0	8.1 i	7.7 g
	100	53.9 b	47.7 b	17.6 m	15.4 m	592.98 no	580.30 Lm	67.00 no	59.20	2.703 e	2.093 d	9.5 g	7.9 L	1.1	1.0	8.2 h	7.7 g
	200	56.3 a	49.2 a	18.4 L	15.9 L	606.51 m	557.63 Lm	69.31 mn	61.53	3.037 bc	2.290 c	9.5 g	8.0 h	1.1	1.1	8.2 h	7.8 f
F. test		*	*	**	**	**	**	*	NS	*	**	**	*	NS	NS	**	*

Values having a similar letter, within a comparable group of means are not significantly different using revised LSD test at 0.05 level.
*** Solid pea: three rows of pea plants in two sides and middle, system I: one row of pea on one side and cabbage on the other side, system II: two rows of pea on one side and middle and cabbage on other side and system III: three rows of pea on one side and middle and cabbage on the other side.**

Table (6): Effect of the interaction between boron and iron foliar application on vegetative growth , yield and yield quality of pea plants in 2008/2009 and 2009/2010 seasons.

Boron conc. (ppm)	Iron conc. (ppm)	Plant height (cm)		No. of leaves plant^{-1}		Leaves area plant^{-1} (dm^2)		Plant fresh weight (g)		Total green pods yield (ton/fed.)		Pod length (cm)		Pod diameter (cm)		No. of seeds pod^{-1}	
		2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
0	0	46.2 h	39.2 L	17.8 L	16.0 h	661.01 L	582.18	73.36 c	66.32	1.910 L	1.505 L	9.6 g	8.0 f	1.2	1.0	8.5 e	7.8 e
	100	48.2 g	41.8 h	19.8 h	17.4 f	678.8 g	609.23	73.48 c	69.28	2.063 h	1.644 g	9.7 f	8.2 e	1.2	1.1	8.6 d	7.9 d
	200	50.8 d	43.4 f	21.2 f	18.1 e	709.08 d	627.73	79.22 bc	71.50	2.382 f	1.937 d	9.8 e	8.3 d	1.2	1.1	8.6 d	8.0 c
50	0	49.9 ef	44.3 e	22.2 d	18.6 d	682.13 f	617.10	79.44 bc	69.68	2.442 de	1.765 f	9.9 d	8.3 d	1.2	1.1	8.7 c	8.0 c
	100	53.3 b	46.9 bc	23.8 b	19.8 b	742.18 b	652.45	80.68 ab	72.84	2.634 c	2.066 b	10.1 b	8.6 b	1.3	1.2	8.9 a	8.2 a
	200	55.3 a	48.7 a	25.6 a	20.7 a	774.42 a	694.93	87.99 a	76.05	3.049 a	2.230 a	10.2 a	8.7 a	1.1	1.2	8.9 a	8.2 a
85	0	49.8 f	41.9 gh	20.0 g	16.9 g	666.30hi	617.64	76.00 c	68.51	2.200 g	1.597	9.8 e	8.2 e	1.2	1.1	8.6 d	7.9 d
	100	51.6 c	44.5 de	21.7 e	18.1 e	696.78 e	663.90	79.05 bc	72.45	2.438 ef	1.819 e	10.0 c	8.3 d	1.2	1.1	8.7 c	8.0 c
	200	53.5 b	46.6 c	23.2 c	19.3 c	729.85 c	665.67	81.71 b	70.63	2.663 bc	2.059 c	10.1 b	8.4 c	1.2	1.1	8.8 b	8.1 b
F. test		*	*	**	**	**	NS	*	NS	**	**	**	*	NS	NS	**	*

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

Table (7): Effect of the interaction between intercropping system and boron foliar application on vegetative growth, yield and quality of cabbage plants in 2008/2009 and 2009/2010 seasons.

Inter-cropping. system*	Boron	No. of inedible leaves		Av. fresh weight of inedible leaves (kg)		No. of edible leaves		Av. fresh weight of edible leaves (kg)		Head edible weight (kg)		Total head weight (kg)		Head yield (ton/fed.)		Head outside diameter (cm)		Head inside diameter (cm)		Head compression		Stem length (cm)		Stem weight (g)	
		08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10
Solid cabbage	0	16.0 b	18.3 b	1.68 b	1.55 b	36.3 bc	34.0 cd	3.01 b	2.80 bc	3.24 bc	3.03 c	4.93 b	4.58 b	49.30 b	45.70bc	87.33 c	81.0 d	28.7 c	26.0 e	0.221	0.117 a	15.7 g	15.2 f	240.0 c	231.7
	50	18.0 a	20.0 a	1.88 a	1.73 a	38.3 a	36.7 a	3.51 a	3.35 a	3.76 a	3.60 a	5.63 a	5.33 a	56.77 a	54.17 a	89.49 a	85.3 a	32.6 a	30.7 a	0.110	0.117 a	17.3 e	16.7 d	273.3 a	258.3
	80	15.3 c	17.0 d	1.55 d	1.42 d	36.0 d	33.7 d	3.01 b	2.80 bc	3.26 b	3.04 bc	4.72 d	4.46 d	48.10 d	44.56 d	88.33 b	83.7 b	31.7 ab	29.0 b	0.107	0.102 b	16.3 f	16.0 e	250.0 d	240.0
System I	0	14.3 d	16.3 e	1.43 a	1.30 ef	35.0 e	32.0 e	2.72 c	2.48 de	2.96 c	2.71 d	4.43 e	4.01 e	44.35 e	40.08 e	85.00 c	79.0 f	28.0 d	26.3 e	0.103	0.100cd	17.7 d	17.3 c	240.0 c	228.3
	50	16.0 b	17.7 c	1.58 c	1.47 cd	36.2 cd	34.1 bc	3.00 bc	2.79 cd	3.26 b	3.04 bc	4.84 c	4.51 c	48.43 c	45.05cd	88.33 b	82.3 c	31.0 b	28.3 c	0.107	0.107 b	18.7 a	18.0 a	260.0 b	245.0
	80	14.3 d	16.0 f	1.38 f	1.25 g	35.0 e	32.7 f	2.38 gh	2.23 gh	2.63 gh	2.46 fg	4.01 gh	3.71 gh	40.13 g	37.69gh	85.00 c	79.7 e	28.7 c	27.0 d	0.093	0.090ef	18.3 b	17.3 c	246.1 a	233.3
System II	0	12.7 g	14.0 h	1.22 i	1.20 m	32.9 gh	30.0 L	2.37 h	2.15 L	2.60 hi	2.37 g	3.81 m	3.56 L	38.13m	35.56Lm	83.33 f	76.7 h	26.0 g	25.3 h	0.100	0.090ef	18.7 a	17.7 b	226.7 h	211.1
	50	13.7 a	16.0 f	1.38 f	1.27 fg	35.0 e	31.7 g	2.56 de	2.32 ef	2.70 de	2.44 g	4.19 f	3.82 f	41.93 f	38.16 f	86.67 d	81.0 d	27.7 e	26.3 e	0.100	0.093 e	18.7 a	17.7 b	250.0 d	233.3
	80	12.7 g	13.7 i	1.22 i	1.13 no	34.5 f	30.3 hi	2.42 fg	2.16 hi	2.66 fg	2.39Lm	3.88Lm	3.82 f	38.80 L	35.18 m	87.33 c	77.0 g	26.7 f	25.7 g	0.100	0.093 e	18.3 b	17.3 c	240.0 c	225.0
System III	0	12.0 h	13.7 i	1.25 h	1.13 no	31.3 m	27.2 n	2.29 m	1.98 n	2.52Lm	2.20 o	3.77 m	3.33 m	37.67 n	33.26 no	76.67 L	73.3 n	26.0 g	24.7 L	0.100	0.090ef	18.0 c	17.3 c	230.0 g	220.0
	50	13.3 f	15.3 g	1.34g	1.22 im	32.6 h	30.3 h	2.50 ef	2.26 fg	2.67 e	2.48 ef	4.00 hi	3.70 h	40.00 h	36.95 h	78.33 h	75.3 L	26.7 f	25.7 g	0.100	0.097 d	18.7 a	17.7 b	233.3 f	221.7
	80	11.7 i	12.7 m	1.14 m	1.10 o	31.7 L	28.6 m	2.30Lm	2.02 m	2.46 m	2.23 no	3.59 n	3.33 m	36.02 o	33.18 o	82.33 g	74.0 m	26.7 f	25.3 h	0.090	0.087 f	18.0 c	17.3 c	223.3 h	213.3
F. test		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	NS	*	**	**	**	NS

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

*** Solid cabbage: one row of cabbage on one side, system I: one row of cabbage on one side and one row of pea on the other side, system II: one row of cabbage in one side and two rows of pea on the other side and middle, system III: one row of cabbage on one side and three rows of pea on the other side and middle.**

Table (8): Effect of the interaction between intercropping and iron foliar application on vegetative growth, yield and quality of cabbage plants in 2008/2009 and 2009/2010 seasons.

Inter-cropping*	Iron	No. of inedible leaves		Av. fresh weight of inedible leaves (kg)		No. of edible leaves		Av. fresh weight of edible leaves (kg)		Head edible weight (kg)		Total head weight (kg)		Head yield (ton/fed.)		Head outside diameter (cm)		Head inside diameter (cm)		Head compression		Stem length (cm)		Stem weight (g)	
		08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10
Solid cabbage	0	13.3 g	15.3 f	1.49 de	1.37 e	35.7 ef	34.3 b	3.09 cd	2.93 b	3.33 c	3.17	4.81 d	4.54 c	48.63 d	45.37 d	85.56 g	81.7 c	29.3 d	26.3	0.110	0.117	16.3 e	15.6 g	250.0	236.7 c
	100	19.3 a	21.7 a	1.92 a	1.73 a	38.3 a	35.0 a	3.33 a	3.01 a	3.59 a	3.30	5.42 a	5.03 a	55.07 a	51.28 a	80.56 a	85.7 a	33.2 a	31.7	0.118	0.103	17.0 e	16.3 e	270.0	255.0 a
	200	16.7 c	18.3 c	1.70 bc	1.60 b	36.7 c	35.0 a	3.10 bc	2.97 ab	3.34 b	2.20	5.05 b	4.80 b	50.47 b	47.84 b	89.00 c	82.7 bc	30.3 c	27.7	0.110	0.116	16.0 f	16.0 f	243.3	238.3 c
System I	0	11.7 i	13.7 h	1.23Lm	1.07 m	34.09 g	32.1 f	2.54 g	2.39 f	2.78 gh	2.62	4.06 h	3.69 h	40.65 a	36.85 h	81.67 L	77.7 ef	28.0 f	25.7	0.100	0.100	17.7 d	17.3 c	243.3	231.7 d
	100	17.7 b	20.0 b	1.68 c	1.53 c		34.0 c	2.95 d	2.71 c	3.21 d	2.95	4.89 cd	4.49 d	48.90 cd	44.87 d	90.00 b	82.7	31.0 b	29.3	0.103	0.100	19.3 b	18.3 a	263.3	246.7 b
	200	15.3 d	16.3 d	1.48 e	1.41 d	36.9 b	32.7 f	2.61 f	2.41 e	2.85 fg	2.64	4.34 f	4.05 ef	43.37 f	40.51 c	86.67 c	bc	28.7 e	26.7	0.100	0.097	17.7 d	17.0 d	240.0	228.3 e
						35.3 f											80.7 d								
System II	0	11.3 m	13.7 h	1.18mn	1.04 o	32.0 m	28.7 h	2.29 no	2.05mn	2.52mn	2.27	3.71 n	3.32 n	37.07 m	33.17 n	83.33 h	76.7 g	25.0 h	24.3	0.100	0.090	17.7 d	17.3 c	230.0	218.9 g
	100	14.3 e	15.7 e	1.40 f	1.32 f	36.2 d	33.0 ef	2.72 e	2.47 de	2.87 ef	2.59	4.38 ef	4.02 f	43.77 ef	40.15 f	88.33 d	80.7 d	29.3 d	27.7	0.103	0.097	20.0 a	18.0 b	253.3	231.7 d
	200	13.3 g	14.3 g	1.23Lm	1.23 h	33.7 hi	30.3 g	2.34Lm	2.11 h	2.57Lm	2.33	3.88Lm	3.56 L	38.03 h	35.60 L	85.67fg	77.3 fg	26.0 g	25.3	0.097	0.090	18.0 c	17.3 c	233.3	218.9 g
System III	0	11.3 m	12.7 L	1.13 n	1.05	30.7 o	27.2 i	2.24 o	1.94 n	2.43 o	2.15	3.56 o	3.21 o	35.60 h	32.05 o	76.76 n	72.7 L	25.0 h	24.3	0.097	0.087	17.7 d	17.0 d	226.7	216.8 i
	100	13.7 f	15.3 f	1.34 g	no	33.6 L	30.3 g	2.55 gh	2.25 g	2.74 h	2.48	4.07 g	3.72	40.77 g	37.23 g	81.67 i	76.7 g	29.3 d	26.7	0.097	0.093	19.3 b	18.0 b	240.0	225.0 f
	200	12.0 h	13.7 h	1.26 hi	1.24 g	31.3	28.6 h	2.30mn	2.06 lm	2.47 no	2.27	3.73mn	gh	37.32Lm	34.12 m	79.00m	73.3 hi	25.0 h	24.7	0.097	0.093	17.7 d	17.3 c	220.0	213.3m
					1.15 L	no							3.42 m												
F. test		**	**	**	**	**	**	**	**	**	NS	**	**	**	**	**	*	**	NS	NS	NS	**	**	NS	*

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

*** Solid cabbage: one row of cabbage in one side, system I: one row of cabbage on one side and one row of pea on the other side, system II: one row of cabbage on one side and two rows of pea on the other side and middle, system III: one row of cabbage on one side and three rows of pea on other side and middle.**

Table (9): Effect of the interaction between boron and iron foliar application on vegetative growth, yield and quality of cabbage plants in 2008/2009 and 2009/2010 seasons.

Boron	Iron	No. of edible leaves		Av. fresh weight of inedible leaves (kg)		No. of edible leaves		Av. fresh weight of edible leaves (kg)		Head edible weight (kg)		Total head weight (kg)		Head yield (ton/fed.)		Head outside diameter (cm)		Head inside diameter (cm)		Head compression		Stem length (cm)		Stem weight (g)	
		08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10
0	0	11.5 g	13.3 g	1.24 g	1.12 h	32.3 h	29.7 L	2.49 gh	2.27 gh	2.72	2.49	3.99 g	3.61 h	39.94 gh	36.07 h	80.0 g	76.0	26.5 f	24.5 L	0.102cd	0.100	17.3 g	16.4 e	232.5	219.2 g
	100	15.8 b	18.0 b	1.59 bc	1.44 c	35.7 bc	32.0 de	2.76 cd	2.41 ef	3.01	2.70	4.59 b	4.13 cd	45.88 bc	41.35 c	86.3 cd	79.3	28.5 d	27.3 cd	0.188 bc	0.098	18.5 c	17.5 b	245.0	231.3 d
	200	14.0 d	15.5 d	1.36 ef	1.32 e	33.8 f	30.8 g	2.55 fg	2.32 f	2.76	2.54	4.13 a	3.86 f	41.28 f	38.59 f	83.0 e	77.3	26.5 f	25.0 hi	0.102 cd	0.100	16.8 L	16.8 d	225.0	217.9 f
50	0	12.8 f	15.3 e	1.36 ef	1.21 f	34.0 ef	31.8 e	2.73 e	2.53 c	2.95	2.76	4.30 a	3.97 e	43.38 e	39.71 a	82.92 f	79.3	27.0 e	25.8 fg	0.105 bc	0.103	17.8 d	17.3 c	245.0	233.7 b
	100	17.5 a	19.5 a	1.71 a	1.59 a	37.6 a	34.8 a	3.16 a	2.90 a	3.33	3.07	5.13 a	4.74 a	51.25 a	48.11 a	87.92 b	83.5	32.4 a	30.5 a	0.105 bc	0.102	19.5 a	18.0 a	275.0	253.8 a
	200	15.5 c	17.0 c	1.56 c	1.46 bc	35.0 d	33.0 b	2.79 b	2.62 b	3.01	2.84	4.57 c	4.30 b	45.73 c	42.93 g	86.25cd	80.3	29.0 c	27.0 d	0.102 cd	0.105	17.8 d	17.3 c	242.5	231.3 d
80	0	11.5 g	13.0 h	1.18 h	1.07 L	33.0 g	30.3 h	2.41 L	2.19 L	2.63	2.42	3.82 h	3.48 L	38.15 i	34.80 L	82.5 f	76.3	27.8 e	25.3 gh	0.098 de	0.093	17.0 h	16.8 d	235.0	225.0 e
	100	15.5 c	17.0 c	1.45 d	1.35 de	35.5 c	39.5 c	2.74 de	2.49 d	2.96	2.72	4.35 de	4.07 a	44.25 d	40.69 d	88.8 a	81.5	31.3 b	28.8 b	0.097 e	0.095	18.8 b	17.5 b	250.0	233.8 d
	200	13.5 e	14.5 f	1.54 f	1.34 f	34.0 ef	31.20 f	2.43 L	2.92 h	2.65	2.45	3.99 g	3.71 g	39.89 h	37.04 g	86.0 d	78.0	27.0 e	26.3 ef	0.098 de	0.092	17.5 f	16.8 d	235.0	225.0 e
F. test		**	**	**	**	**	**	**	**	NS	NS	**	**	**	**	**	NS	**	**	*	NS	**	**	NS	*

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