Effect of intercropping and ground adding of seaweed extracts on growth and yield of lettuce plant (Lactuca sativus L.)

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ABSTRACT

The experiment was conducted in the vegetable field belonging to the Department of Horticulture and Landscape Gardening, College of Agriculture and Forestry, University of Mosul in the agricultural season of (2018-2019), to study the effect of intercropping by cultivating broad bean plants with lettuce plants and monoculture by cultivating lettuce plants only and adding seaweed extracts (Acadian, Alga zone and Phyllgreen mira, and Ultra-Kelp 40) at a concentration of ($6ml.L^{-1}$) and for all extracts in addition to the control treatment (urea fertilizer at a rate of 200 $kg.ha^{-1}$). The split-plot system was applied once according to the Randomized Complete Block Design (RCBD), with three replicates, the cultivation pattern was placed in the main-plot and other treatments were placed in the sub-plot. The results can be summarized as follows: The monoculture pattern was significantly excelled in the perimeter of the head, the number of leaves per plant, length, and weight of the stem, percentage of wrapped heads%, total weight of the head, the marketing weight of the head, marketing yield of heads with an increase of 70.60% and total yield of heads, with an increase of 91.86% compared to intercropping. The addition of urea fertilizer was significantly excelled in head length, the perimeter of the head, number of leaves per plant, stem length, stem weight, the total weight of the head, marketing weight of the head, marketing yield of heads, and total yield of the head. The addition of seaweed extract (Phyllgreen mira) has excelled only in the percentage of wrapped heads. As for the interaction among the cultivation pattern and the addition of seaweed extracts and urea, the interaction between the addition of urea and monoculture was significantly excelled in all the traits under study.

Keywords: Seaweed extracts, urea, cultivation pattern, lettuce.

تأثير الزراعة المتداخلة والاضافة الارضية للمستخلصات البحرية في نمو وحاصل نبات الخس (*Lactuca Sativus* L.)

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الخلاصة

أجريت التجربة في حقل الخضراوات التابع لقسم البستنة وهندسة الحدائق/ كلية الزراعة والغابات/ جامعة الموصل في الموسم الزراعي 2018-2019، لدراسة تأثير الزراعة المتداخلة بزراعة نباتات الباقلاء مع نباتات الخس والزراعة الأحادية زراعة نباتات الخس فقط، واضافة مستخلصات النباتات البحرية Acadian وAlga zone وPhyllgreen mira و Ultra-Kelp 40 بتركيز 6 مل. لتر$^{-1}$ ولجميع المستخلصات بالإضافة الى معاملة المقارنة (سماد اليوريا بمعدل 200 كغم. هكتار$^{-1}$). تم تطبيق نظام القطع المنشقة مرة واحدة في تصميم القطاعات العشوائية الكاملة RCBD وبثلاث مكررات، وضعت نمط الزراعة في القطع الرئيسية Main plot والمعاملات الأخرى في القطع الثانوية Sub plot. ويمكن تلخيص النتائج كالاتي: تفوقت معنويا نمط الزراعة الأحادية في محيط الرأس، عدد الأوراق للنبات، طول ووزن الساق، نسبة الرؤوس الملتفة%، الوزن الكلي للرأس، الوزن التسويقي للرأس، الحاصل التسويقي للرؤوس وبزيادة 70.60% والحاصل الكلي للرؤوس وبزيادة 91.86 % قياسا بالزراعة المتداخلة. وتفوقت معنويا إضافة سماد اليوريا في طول الرأس، محيط الرأس، عدد الأوراق للنبات، طول الساق، وزن الساق، الوزن الكلي للرأس، الوزن التسويقي للرأس، الحاصل التسويقي للرؤوس والحاصل الكلي للرؤوس، وتفوقت فقط إضافة المستخلص البحري Phyllgreen mira في نسبة الرؤوس الملتفة. وفي التداخل بين نمط الزراعة واضافة المستخلصات البحرية واليوريا تفوقت معنويا التداخل بين إضافة اليوريا في الزراعة الأحادية في جميع الصفات قيد الدراسة.

الكلمات المفتاحية: مستخلصات بحرية – يوريا – نمط الزراعة – Lettuce.

1. INTRODUCTION

Lettuce (*Lactuca Sativus* L.) is one of the most important winter vegetable crops, which belongs to the Asteraceae family, and it is one of the most desirable and important winter vegetable crops grown in Iraq and the world due to its high nutritional value and large consumption (Ryder, 1999), where each 100 g of lettuce contains 95% water, 1g protein, 3g carbohydrates, 22 mg calcium, 25 mg phosphorous and 540 IU vitamin A (Required et al., 1989). Intercropping is defined as the cultivation of two or more crops in one area during the growing season and they spend their life cycle together and may differ in their planting date or their growing date (Mazaheri et al., 2006). Intercropping is considered an agricultural system with high productivity benefits from season to season. The overlap between plants gives optimum utilization of irrigation and fertilization, reducing the risk of disease and weeds competition for the main yield (Raseduzzaman et al., 2013). The intercropping is done in a field by planting two or more crops in reciprocal lines, provided that there is a difference in the nature and rate of growth, the root system, or the environmental and food needs, and it is also possible to exchange the cultivation of the two crops in the same line or the cultivation of more than one crop separately and in the same plot and the same time (Sullivan, 2003). Many traditional farming systems focus on planting a specific crop that is repeated for several seasons and for the same plot while ignoring the diversity in crops which causes the soil to break down physically, biologically, and chemically (Kirschenmann, 2007). In general, there are two types of impact from intercropping, the first is positive between the species, which is the target of the farmer and the producer, and this effect arises when one of the species promotes the growth of the plants of the other type, while the negative effect that arises when one of the species causes harm and competes with the other type and can be avoided when designing Field and crop selection (Garcia-Cervigon et al., 2013). Crops of the leguminous family stabilize atmospheric nitrogen through the symbiotic relationship between Rhizobium and the host (leguminous plant) and the formation of root nodes. Studies indicated that the cultivation pattern had a significant effect on plant growth and yield. Bavec et al., (2009) found when planting Cabbage intercropped with lettuce, a yield amounted to (61.08 tons.ha^{-1}), It was not significantly different from its monoculture, which gave a yield amounted to (66.04 tons.ha^{-1}) compared to its intercropping with the rest, which gave a yield amounted to (44.12 tons.ha^{-1}). Seaweed extracts are considered to have a high content of many macro and micro-nutrients such as nitrogen, magnesium, and manganese and contain growth hormones such as cytokinin that play a role in the growth of roots and stems and build chlorophyll and increase resistance to biological stress and the environment (Strik et al., 2003). The addition of seaweed extracts to light soils helps to retain moisture, supplying them with nutrients, reducing chlorophyll catabolism, and improving the yield in quantity and quality (Travena, 2007). O'Dell, (2003) indicated that seaweed extract (Norwm) contains a high percentage of cytokines and growth hormones that play an important role in the growth and development of the root system and total vegetative that lead to increase photosynthesis, delaying senescence, plant tolerance for harsh conditions and reducing infection with the disease. Al-Allaf, (2009) found that spraying lettuce with seaweed extract (Algamix) caused a significant increase in the traits of vegetative growth, the traits of yield, and its components (average total and marketing weight of the head and total and marketing yield). Squid and Bayati, (2017) reported the ground adding of seaweed extract (Algamax) at a concentration of (3 ml.L^{-1}) caused a significant increase in head length, stem weight, stem length, and the addition of the same seaweed extract at a concentration of (6 ml.L^{-1}) caused a significant increase in the percentage of wrapped heads, average marketing weight of the head, the average total weight of the head, marketing yield of heads and the total weight of the head. Al-Khakani, (2019) observed that there were no significant differences when cultivating broad been with Cabbage in the traits of the total weight for the head, marketing weight of the head, perimeter of the head, head length and

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diameter of the head, marketing yield of heads, and total yield of heads. The study aims to demonstrate the effect of intercropping between broad been and lettuce for the benefit of lettuce plants from the nitrogen that fixing by the Root nodules of broad bean plants because a broad been is a foliar crop, as well as demonstrating the effect of adding seaweed extracts because it's a source of natural nutrients and plant hormones as an alternative to chemical fertilizer.

2. MATERIALS AND METHODS

The experiment was conducted in a vegetable field, Department of Horticulture and Landscape Gardening, College of Agriculture and Forestry, the University of Mosul during the agricultural season (2018-2019), in order to study the impact of two factors: The first two patterns of cultivation are the intercropping for the lettuce crop with the broad bean crop and the monoculture for the lettuce crop separately, and the second factor is four types of seaweed extracts and chemical fertilizers:

1- Fertilizer (urea), with a rate of 9200 kg.ha-1 that recommended (Sebahi et al., 1991).
2- seaweed extract (Acadian), with a concentration of (6 ml.L^{-1}).
3- seaweed extract (Algazone), with a concentration of (6 ml.L^{-1}).
4- seaweed extract (Phyllgreen mira), with a concentration of (6 ml.L^{-1}).
5- seaweed extract (Ultra-Kelp 40), with a concentration of (6 ml.L^{-1}).

The extracts and urea were added to the soil in three batches, the first batch after two weeks of seedlings, the second batch after 3 weeks of the first batch, and the third batch after 3 weeks of the second batch and with the ground addition method. The soil and all treatments were covered with black plastic. The drips irrigation system was used. Random samples were taken from the field soil to see the physical and chemical properties of the soil as shown in Table (1).

Table 1: Physical and chemical properties of soil.

Sand g.kg^{-1}	Loam g.kg^{-1}	Clay g.kg^{-1}	N mg.kg^{-1}	P mg.kg^{-1}	K mg.kg^{-1}	O.M mg.kg^{-1}	pH	EC dsm^{-1}
648.1	229.8	122.1	24.20	15.81	126.65	19.33	7.8	0.744

The soil sample was analyzed in the Laboratories of Soil and Water Resources Department, College of Agriculture and Forestry, Mosul University.

The seeds of the broad bean (local cultivar) were planted in furrows on 11-18-2018, at a distance of 25 cm between one plant and another, while the seeds of lettuce were planted on 1-11-2018. The seedlings were transferred to the field on 10-12-2018, after 39 days of planting the seeds in the second and third real leaf stage, and the distance between seedlings was 40 cm. The sub-plot system was applied according to The Randomized Complete Block Design (RCBD), where the cultivation pattern was placed in the main plots and the seaweed extracts and urea (control) were added in the split plots, with three replicates. Nine plants were cultivated in each experimental unit, and the number of experimental units was 30 experimental units (2 x 5), and the lettuce crop was harvested on 4/16-2019. Five heads were selected from each experimental unit when harvesting and measurements were taken for the following traits:

1- head length (cm)
2- the perimeter of the head (cm)
3- number of leaves per plant
4- stem weight (g)
5- stem length (cm)
6- the percentage of wrapped heads
7- total weight of the head (g)
8- average marketing weight of the head (g)
9- The market yield of heads (tons.ha^{-1})
10- The total yield of heads (tons.ha^{-1}).

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The results were analyzed statistically according to the used design and the averages were compared using the Duncan's New Multiple Range Test at a probability level of 5%(Al-Rawi and Khalaf Allah, 2000).

3. RESULTS AND DISCUSSION

Table (2) shows that there was no significant difference between the two patterns (intercropping and monoculture) in the length of the head and the length of the stem, while the monoculture was significantly excelled in the perimeter of the head which amounted to (33.08 cm) and the number of leaves (49.18 leaves.plant^{-1}), a stem length of (12.70 cm), and a stem weight of (66.10 g) compared to the intercropping pattern with the broad bean crop. As for the adding treatments of seaweed extracts and urea, it is noticed that the addition of urea fertilizer gave the highest values in head length amounted to (30.68 cm), the perimeter of the head (31.46 cm), and leaves number (44.91 leaves.plant^{-1}), stem length (14.64 cm), stem weight (60,60 g). They differed significantly with all treatments in the trait of head length and with the adding treatment of the seaweed extract (Phyllgreen mira) only in the perimeter of the head, the adding treatment of seaweed extracts (Acadian, Alga zone, and Ultra-Kelp) in the number of leaves per plant and stem weight and the adding treatment of seaweed extracts (Acadian and Ultra-Kelp) in stem length. The lowest values for the traits of head length, head weight, and head length were in the adding treatment of seaweed extract (Ultra-Kelp) which amounted to (25.74 cm, 10.35 g, and 40.21 cm), respectively. The lowest values in the trait of the perimeter of the head were in the adding treatment of seaweed extract (Phyllgreen mira) which amounted to (26.85 cm), as for the number of leaves, the lowest value was 38.83 leaves.plant^{-1} when adding Alga zone seaweed extract.

Table 2: Effect of cultivation pattern and seaweed extracts on the traits of vegetative growth for lettuce.

Cultivation pattern	Head length (cm)	Head perimeter (cm)	Number of leaves per plant	Stem length (cm)	Stem weight (gm)
Intercropping	27.60 a	24.91 b	35.25 b	11.76 b	29.08 b
Monoculture	27.11 a	33.08 a	49.18 a	12.70 a	66.10 a
Seaweed extract (6 ml. L^{-1}):					
Urea (Control)	30.68 a	31.46 a	44.91 a	14.64 a	60.00 a
Acadian	26.25 c	29.43 ab	39.72 b	11.85 b	42.21 c
Alga zone	27.96 b	28.54 ab	38.83 b	12.27 ab	45.61 bc
Phyllgreen mira	26.29 c	26.85 b	44.22 a	12.32 ab	52.48 ab
Ultra-Kalp 40	25.74 c	28.40 ab	41.11 b	10.35 b	40.21 c

The average with the same letter for each column is non-significant according to Duncan's multiple range test at the probability level of 0.05.

It is noticed from the results of Table (3) that the interaction treatment between monoculture and urea fertilization was significantly excelled by giving it the highest values of head length amounted to (31.19 cm), the perimeter of head amounted to (37.01 cm), and the number of leaves amounted to (52.61 leaves.plant^{-1}) and stem length (15.52 cm), while the two interaction treatments between (monoculture and the addition of Phyllgreen mira seaweed extract) and (monoculture and the addition of urea) were significantly excelled in stem weight which amounted to (86.11 and 83.22 g), respectively, and they differed significantly with all treatments.

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Table 3: Effect of interaction between cultivation pattern and seaweed extracts on traits of the vegetative growth for lettuce.

Cultivation pattern	Seaweed extracts (6 ml.L^{-1})	Head length (cm)	Head perimeter (cm)	Number of leaves per plant	Stem length (cm)	Stem weight (gm)
Intercropping	Urea (Control)	30.17 ab	25.92 cd	37.22 d	13.76 abc	36.77 c
	Acadian	27.01 def	23.86 d	34.45 d	12.84 abc	29.43 cd
	Alga zone	29.60 abc	24.46 d	33.94 d	14.40 ab	37.22 c
	Phyllgreen mira	25.06 fg	23.44 d	36.77 d	13.22 abc	18.86 d
	Ultra-Kalp 40	27.75 cde	26.26 cd	34.11 d	10.50 c	26.22 cd
Monoculture	Urea (Control)	31.19 a	37.01 a	52.61 a	15.52 a	83.22 a
	Acadian	25.50 fg	35.00 ab	45.00 c	10.86 bc	55.00 b
	Alga zone	26.33 def	32.62 ab	43.72 c	10.15 c	54.00 b
	Phyllgreen mira	27.52 cde	30.25 bc	51.66 ab	11.43 bc	86.11 a
	Ultra-Kalp 40	23.73 g	30.52 bc	48.11 cd	10.20 c	54.20 b

The average with the same letter for each column is non-significant according to Duncan's multiple range test at the probability level of 0.05.

Table (4) shows that monoculture significantly excelled on the intercropping in the percentage of wrapped heads, total weight of the head, marketing weight of the head, marketing yield of heads, and total yield of the head by giving an average amounted to (96.29%, 424.39 g, 314.80 g, 16.788 tons.ha^{-1}, and 22.634 tons.ha^{-1}) respectively. As for the adding treatment seaweed extracts and urea, it is noticed from the table that the highest percentage of the wrapped head was 94.44% in the adding treatment of seaweed extracts (Phyllgreen mira), with a significant difference compared to the rest of the treatments. while the adding treatment of urea fertilizer has significantly excelled in the total weight of the head, the marketing weight of the head, the marketing yield of the heads, and the total yield of the head by giving it an average amounted to (474.90 g, 366.64 g, 19.554 tons.ha^{-1}, and 25.327 tons.ha^{-1}), respectively, and they differed significantly with all treatments.

Table 4: Effect of cultivation pattern and seaweed extracts on traits of quantitative yield for lettuce.

Cultivation pattern	the percentage of wrapped heads	total weight of the head	Marketing weight of the head	marketing yield of heads	the total yield of the head
Intercropping	72.52 b	221.20 b	185.21 b	9.878 b	11.797 b
Monoculture	96.29 a	424.39 a	314.80 a	16.788 a	22.634 a
Seaweed extract (6 ml. L^{-1}):					
Urea (Control)	85.18 bc	474.90 a	366.64 a	19.554 a	25.327 a
Acadian	77.78 c	327.50 b	256.60 b	13.685 b	17.466 b
Alga zone	77.78 c	314.83 b	239.50 bc	12.773 bc	16.791 b
Phyllgreen mira	94.44 a	261.77 c	192.70 d	10.277 d	13.961 c
Ultra-Kalp 40	83.33 bc	256.72 c	207.78 cd	11.081 cd	13.692 c

The average with the same letter for each column is non-significant according to Duncan's multiple range test at the probability level of 0.05.

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As for the interaction between the cultivation patterns and the addition of seaweed extracts and urea, it is noted from the results of Table (5) that the two adding treatments of seaweed extracts (Alga zone and Phyllgreen mira) gave the highest percentage of the wrapped head of 100% and did not differ significantly with the adding treatments of Acadian and Ultra-Kelp extracts and urea in monoculture and with the addition of Phyllgreen mira seaweed extract in intercropping, While it differed significantly with the rest of the treatments, the lowest percentage of the wrapped head was when adding seaweed extract (Alga zone) in intercropping which amounted to 55.56%. While the addition of urea fertilizer was significantly excelled on the rest of the treatments in traits of the total weight of the head, marketing weight of the head, marketing yield of heads, and total heads of heads which amounted to (686.22 g, 494.44 g, 26.370 tons.ha^{-1}, and 36.600 tons.ha^{-1}), respectively. The lowest values for these traits were found in the adding treatment of the seaweed extract (Phyllgreen mira) in intercropping.

Table 5: Effect of interaction between cultivation pattern and seaweed extracts on traits of quantitative yield for lettuce.

Cultivation pattern	Seaweed extracts (6 ml.L^{-1})	the percentage of wrapped heads	total weight of the head	Marketing weight of the head	marketing yield of heads	the total yield of the head
Intercropping	Urea (Control)	74.07 cd	263.55 ef	238.83 d	12.738 d	14.056 ef
	Acadian	62.96 de	218.10 fg	173.11 ef	9.233 ef	11.631 fg
	Alga zone	55.56 e	271.67 ef	220.78 de	11.775 de	14.490 ef
	Phyllgreen mira	88.90 ab	158.76 g	129.84 f	6.925 f	8.467 g
	Ultra-Kalp 40	70.37 d	203.22 fg	168.55 ef	8.990 ef	10.840 fg
Monoculture	Urea (Control)	96.30 a	686.22 a	494.44 a	26.370 a	36.600 a
	Acadian	92.60 ab	436.90 b	340.07 b	18.137 b	23.300 b
	Alga zone	100.00 a	358.00 cd	258.22 cd	13.772 cd	19.093 cd
	Phyllgreen mira	100.00 a	364.78 cd	255.56 cd	13.630 cd	19.455 cd
	Ultra-Kalp 40	96.30 a	310.22 ed	247.00 cd	13.173 cd	16.545 de

The average with the same letter for each column is non-significant according to Duncan's multiple range test at the probability level of 0.05.

Table (2) the superiority of monoculture on the intercropping in the perimeter of the head, the number of leaves per plant, the length and weight of the stem may be due to the high agricultural density in intercropping and the lack of agricultural (plant) density in monoculture, which allowed a wide growth area and the process of absorbing nutrients from the soil as well. Exposing plants to sunlight in monoculture and not shading plants compared to intercropping, which led to an increase in the efficiency of the photosynthesis process, and this was reflected in preparing plants with an appropriate amount of nutrients necessary to increase growth and also increase the manufacture of carbohydrates and materials necessary for the growth in the photosynthesis process, thus increase and improve plant growth (Moorby, 1978). This pattern of cultivation (monolithic) has excelled in the yield traits represented in the percentage of wrapped heads, the total and

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marketing weight of the head, and the total and marketing yield of the heads as shown in Table (4). Its superiority in the traits of vegetative growth as shown in Table (2) may be due to the increase in yield components. The results of Table 2 showed that the addition of urea fertilizer (46% N) was significantly excelled on all the traits of vegetative growth, perhaps due to this fertilizer containing the nitrogen component necessary for the growth of this crop because it is one of the foliar crops that need large quantities of this element during the growing season (Wanted et al., 1989). the ease and availability of this element for absorption by plants, which does not require a large period for decomposition and absorption (Cooke, 1972). Perhaps it is due to the positive role of the nitrogen component in this fertilizer, which is included in the synthesis of proteins, nucleic acids, RNA, DNA, and other biomaterials, and chlorophyll, which helps in increasing the speed of cell division and increasing their number, thus increasing vegetative growth (Yagodin, 1984). Likewise, nitrogen fertilization encourages growth by interfering with the building of auxins, which have an effective role in activating the process of cell division and elongation (Mohammed and Rayes, 1982). The treatment of urea fertilizer has excelled in the yield traits as shown in Table (4) is due to the superiority of this treatment in the traits of vegetative growth as shown in Table (2), which reflected the increase in the yield components. The superiority of the interaction treatment of adding urea fertilizer in monoculture on all the traits of vegetative growth and the yield components as shown in Table (3 and 5) is due to the superiority of the individual factors (urea fertilizer and monoculture) and the cumulative effect of these factors, as previously mentioned.

We conclude from the study:

Despite the significant superiority for the monoculture pattern, it is possible to resort to intercropping to exploit the land with two crops in the same season to economize in all agricultural operations, and also seaweed extracts can be used to fertilize lettuce plants because they are safer for the environment and human health compared to chemical fertilizers.

REFERENCES

Al-Habar, Mohammed Talal Abdulsalam and Hussien Jawad Moharm Al-Bayati. 2017. EFFECT OF SOIL IRRIGATION WITH TWO TYPES OF SEAPLANT EXTRACT AND HUMIC ACID ON GROWTH, QUANTITY AND QUALITY OF YIELD IN LETTUCE (Lactuca sativa L.). Al-Rafidain Agriculture Journal, 45 (2): 81--87.

Al-Khaikani, Sura Abdul Kareem Mohammed, 2019. Effect of intercropping, organic matter, and chemical fertilizer on growth and yield of two cultivars of cabbage. Master Thesis, College of Agriculture, Al-Qasim Green University, Iraq.

Al-Rawi, Khashi Mahmood and Abdulaziz Khalaf Allah. 2000. Design and Analysis of Agricultural Experiments. Dar Al-Kutub Foundation for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research, Iraq.

Sebahi, Jalil, Hassoon Shalash, and Muwaffaq Fawzy 1991. A guide to the use of chemical fertilizers. Bulletin of the Iraqi Ministry of Agriculture / Iraq.

Al-Allaf, Mohammed Salem Ahmed. 2009. Effect of Soil Mulching and Spraying with Licorice Extract and Algamix on Growth and Production of Lettuce (Lactuca sativa L. cv.' Paris Island'). Master Thesis, College of Agriculture and Forestry, University of Mosul, Iraq. 93 pages.

Mohammed, Abdul Azim Kadhim and Abdul Hadi Al Rayes. 1982. Phleggy of the plant. The second part. House of Books for Printing and Publishing, Ministry of Higher Education and Scientific Research, Iraq.

Matlub, Adnan Nasser, Izz Al-Din Sultan Muhammad, and Karim Saleh Abdul. 1989. Vegetable Production, Part One, Dar Al Kutub for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research, Iraq.

 ISSN 2072-3875

Cooke, G.W**. 1972.** Fertilizing for moimum yield. Crosby lock wood and son ltd. London.

Bavec, M.; Brozovic, B.; Mlaker, S.G.; Robacer, M.; Jakop, M.; and Bavec , F. 2009. Yield and nutrient uptake of white cabbage affected by differerent intercrop. *Orginal Scientific Paper*, 7(9):66-70.

Garcia- Cervigon , A.I; Gazol ,A; Sanz, V; Camarero , J.J.; and Olano , J.M. 2013. Intraspecific competition replaces interspecific facilitation as abiotic Stress decreases: The shifting nature of plant – plant interactions. *Perspectives in plant Ecology, Evolution and systematics* 15(4): 226-236

Kirchenmann , F. L. 2007 . Potential for a new generation of biodiversity in agrroeco systems of the future. *Agronomy Journal*, 99(2): 373-376.

Mazaheri , D; A.Madani and M.Oveysi. 2006 . Assessing the land equivalent ratio (LER) of two corn (*Zea may* L.) varieties intercropping at various nitrogen Levelsin karaj, Iran .journal of Central, European Agriculture, 7(2):359-364.

Moorby, J. 1978. The physiology of growth and tuber yield in the potato crop. The Scientifics Basis for information (London).

O'Dell,C. 2003. Natural plant hormones are biostimulants helping plants develop higher plant antioxidant activity for multiple benefits .Virginia vegetable , small fruit and specialty crops .November –December 2003 2(6):1-3.

Raseduzzaman, M; Halder, F; Das, A. 2013. Final report 2012: Sustainable Integrat Farming System. Welthungerhilfi Kolkata, west Bengal, India.

Ryder. E.J. 1999 . Lettuce Endive and Chichory. CABI Publishing U.K. pp: 208.

Stirk, W.A.; G.D. Arthur; A.F. Lourens; O. Novak; M. Strnad and J. Vanstanden. 2013. Research center for plant growth and development. University of Natal Pietermaritzburg, Bagxol, Scottville 3209, South Africa.

Sullivan, P. 2003. Intercropping production practices htt:// altar. Ncot. Org/ attar an pub/ pdf.

Travena, R. G.2003. Seaweed fertilizer for hormones are biostimulants helping plants develop higher plant antioxidant activity for multiple benefits. Virginia Vegetable, Small Fruits and Specially Crops. November-December, 2 (6): 412-418.

Yagodin, B.A**. 1984.** Agriculture Chemistry (1^{ed}). Mir Publishers, Moscow. USSR.

 ISSN 2072-3875