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EFFECT OF GROUND ADDITION OF HUMIC ACID AND FOLIAR SPRAYING OF EXTRACT ORGANIC FYLLOTON, MINERAL FERTILIZER AGROLEAF POWER ON GROWTH AND YIELD OF CABBAGE

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Abstract

This study was carried out at vegetables field of Horticulture and landscape department, College of Agriculture and Forestry, Mosul University, Iraq., during growth season 2018-2019 in order to study the effect of Humic acid addition to the soil in concentrations 2, 4g.l^{-1} and spray the organic extract Fylloton in concentrations 3, 6 ml.l^{-1} and Agroleaf power mineral fertilizer workshops in concentrations of 5, 10 g.l^{-1} and comparative treatment (no additives) on growth and yield of Cabbage hybrid plants (V. Blue Jays). The three fertilizers were added in three stages 15, 45 and 75 days after seedling. The study included seven treatments carried out in the field according to the Randomized Complete Block Design R.C.B.D. with three replicates. The results can be summarized as follows: The spraying process was performed by Fylloton fertilizer at a concentration at 3 gm.l^{-1} resulted in significant superiority on the comparative treatment in the character of early maturity by 12 days in addition to significant superiority compared to other fertilizer treatments. In comparison, the length, diameter and cohesion head characters were significantly superior with comparative treatment where reached (16.00 cm, 15.63 cm and 1.220) respectively. The same treatment and concentration above also achieved a significant superiority in yield characteristics (average weight of marketable head 1688.67g, early marketing yield 35.400 ton.hec^{-1}, total marketing yield 46.43 ton.hec $^{-1}$, total yield 67.21 ton.hec^{-1}) Which significantly outperformed all other treatments. The treatment of ground addition of humic acid at a concentration of 4 g.L^{-1} gave a significant superiority compared to the comparative treatment in the characteristics of height of the plant amounted to 22.23 cm and early maturity by 7 days and early marketing yield 22.278 ton.hec^{-1} and total marketing yield is 36.02 ton.hec^{-1} and total yield is 53.72 ton.hec^{-1}. Also, the treatment of foliar spraying with mineral fertilizer with a concentration of 5 g.l^{-1} gave a significant superiority over the comparison treatment in the yield characteristics (1326.33(g), 26.942 ton.hec^{-1}, 36.47 ton.hec^{-1}, 53.90 ton.hec^{-1}) respectively. It is clear from all the results that all fertilizers used exceeded the comparative treatment in most of the studied traits and treatment Fylloton concentration of 3g. L^{-1} showed a significant superiority over all other treatments and for most studied traits.

Key words: Cabbage, Humic acid, Fylloton, Agroleaf power.

Introduction

Many important winter vegetable crops are grown in Iraq , Some of these crops belong to the Cruciferae family, including the cabbage crop *Brassica Olearacea* var. Capitata is widespread . As is known, the part eaten is the head, which mainly contains leaves wrapped around each other which are consumed fresh or in the work of pickles (Matlub, 1989) Because it contains many nutrients including 3-5.4% carbohydrates, 1-2% proteins, 0.2% fats and mineral elements such as calcium, phosphorus, potassium, magnesium, iron, vitamins such as vitamin A, C and thiamine, Cabbage has medical benefits such as stomach ulcers, lowering blood sugar and protecting against cancer (Euras *et al.,* 2011; Tatlay and Fahey, 2011). Cabbage is grown in many countries of the world and the China, India, Russia, Japan and South Korea rank first in production (FAO, 2016), the cultivated area in Iraq is estimated according to the latest statistics for this crop 1500 hectares in 2014 with an average productivity of 12.667 ton.hec^{-1} (Arab Organization for Agricultural Development, 2014) when comparing the productivity

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of Iraq with the rest of the world we find it significantly low and the reason is due to the continuity of most farmers following traditional agricultural methods and the lack of awareness of farmers about modern agricultural systems and techniques and not to use improved varieties with high and early production and other reasons. Several studies have indicated that the growth of cabbage plants has been affected by several factors, including genetic and environmental factors, as well as the role of agricultural service operations, including fertilizer additions, types and dates (Abdo and Khalil, 1968) , This has led many research centers and international companies to study these factors and ways of producing new types and composts used to increase the production of vegetable crops per unit area to provide an incentive for them to provide optimum concentrations of major and micro nutrients (Al-Saidi and Abdul Kader, 2000) . Mohanty and Nema (1970) found a premature cabbage yield of 16 to 12 days as well as an increase in the total yield when using a 1% urea starting solution. Abdel-Razik (1996) showed that the total vegetative spraying of Paris White lettuce crop with nutrient solution (containing 5% nitrogen and microelements) caused a significant increase in the soft and dry weight characteristics of the plant and the total yield ratio compared to control plants . Abdul Hadi *et al.,* (2009) reported that spraying plants of kohlrabi with mineral solution (yongren) in concentrations of 1.5 and 2.5 cm^3. l^{-1} gave a significant superiority over the comparison plants in the number of leaves of the plant and the width of the leaf (cm). Eidan (2014) found that spraying tomato plants with mineral solution Agro leaf at concentrations of 25 and 30 ppm resulted in a significant superiority in the characteristics of vegetative growth in general compared with the control treatment. The concentration of 30 ppm gave the highest moral values, especially in plant height , number of leaves.$plant^{-1}$, leaf area of the plant and the fresh and dry weight for the plant . Abdul Rahman and Ramadan (2015) explained in a study that included the use of types of mineral and organic fertilizers on the cabbage crop outweigh the treatment of adding humic acid in the character of the leafy area of the plant. The trend has increased in recent years by many companies specialized in agricultural production and researchers to use organic fertilizers of animal or plant origin as a fertilizer source for the purpose of reducing the pollution of the environment and agricultural soils with chemicals and the production of safe agricultural crops for humans and animals and compensation for organic matter lost from the soil as a result of intensive agriculture, One of these organic materials is the use of humic acid as it is a commercial product that also contains many elements that improve soil fertility, It increases the readiness of the elements, which is reflected in the increased growth and yield of the plant (Lee and Bartlette, 1976). The trend towards the use of organic fertilizers in vegetable fields to reduce the use of chemical fertilizers or substitute them, including humic acid, which is one of the compounds of humic material resulting from the decomposition of organic matter (Al-Naimi, 1999), and the role of humic in improving plant growth by improving soil construction and increasing the efficiency of the roots to absorb water and nutrients dissolved in the soil to the plant as well as increases the ability of the soil to retain water and nutrients. Furthermore, it has an important role in stimulating the activity of microorganisms (Phelpstek, 2002). Al-Sawaf and Omer (2017) found when the addition of humic acid at concentrations of 2.5 and 5 $cm^3.L^{-1}$ to cabbage plants had a role in the effect on plant growth where the concentration of 5 $cm^3.L^{-1}$ gave the highest significant values in the characteristics of the number of external leaves , the percentage of total chlorophyll, leaf area, wet weight of external and internal leaves and dry matter ratio of the leaves interior . Abbas and Hammad (2017) showed that when the cabbage plants were sprayed with humic acid at concentrations of 0, 100 and 200 $ml.L^{-1}$ significantly superior treatment of 200 $ml.L^{-1}$ in the percentages of chlorophyll and the duration required for the maturation of 50% of the heads and head diameter. The extracts of marine plants have recently been used as an organic fertilizer , They are natural extracts of marine plants and algae and are now widely used in the fields of foliar fertilizer industry as a source of natural growth regulators such as Oxines, Gibberellins (GA3, GA7) and Cytokines (Brad and Weil, 2000, Ergun, etc., 2001). Marine extracts contain vitamins and enzymes that stimulate and accelerate vegetative and root growth of the plant (Jensen, 2004). Merhi and Al-Allaf (2012) indicated that the addition of marine extract Algamix at a concentration of (1, 2 and 3) $gm.L^{-1}$ significantly affected the growth and yield of lettuce plant, the concentration of 3 $gm.L^{-1}$ recorded the best significant values in the number of leaves, plant length, head circumference, leaf area, average head weight and marketing yield characterizes. Al-Maliki (2013) noted that the addition of marine extract Biozyme TF at a concentration of 0.75 $ml.L^{-1}$ to cabbage plants led to a significant increase in the growth and yield characteristics and recorded the treatment of the addition of the extract three times the highest moral values in the characteristics (height of the plant and the number of leaves of the plant, leafy area, total plant weight, marketing head weight and head

diameter, total yield) as measured by comparison treatment. Satekge *et al.,* (2016) found that the treatment of mixing of microelement solution spray with marine extract Kelpak on cabbage plants recorded the highest significant values in growth traits obtained under greenhouse conditions compared with single and comparative treatments.

Materials and Methods

This experiment was conducted to study the effect of fertilization with organic fertilizer Humic Acid added to the soil and sprayed organic extract Fylloton and mineral fertilizer Agroleaf power in the growth and production of cabbage hybrid (Blue Jays), was prepared amid the cultivation of seeds from a mixture of river soil and peat moss and decomposed animal manure by 1:1:2 the mixture was placed in the trays of agriculture and hybrid seeds were planted inside the wooden sunshade on (10/9/2018) in the vegetable field of the horticulture and landscape department/ college of agriculture and forestry / university of Mosul during the agricultural season (2018-2019) , Random samples of field soil were taken before planting at a depth of 0-30 cm for the purpose of analysis and estimation of some physical and chemical characteristics (Table 1).

The research site was prepared from tillage, softening and dividing it into meadows. The drip irrigation system was extended and the field lines were dotted and the lines were covered with black polyethylene. drilling the lid in the upper third of the line at a distance of 40 cm from one hole to another. After the arrival of the seedlings hybrid cabbage (Blue Jays) to the stage of the formation of the real leaf fourth-sixth was transferred from the wooden sunshade and seedlings in the pre-prepared in the groves of the field experiment on 11/10/2018 with the process of drip irrigation. The experiment involved the following fertilizer treatments:

1- Comparison (without any composting).

2- Addition of the organic compound Humic acid to the soil at a concentration of 2 gm.L^{-1} and 4 gm.L^{-1}.

3- Spray the organic extract Fylloton on cabbage plants at a concentration of 3 g.L^{-1} and 6 g.L^{-1}.

4- Spray the mineral fertilizer solution Agroleaf power on the cabbage plants at a concentration of 5 g.L^{-1} and 10 g.L^{-1}.

Humic acid was added to soil and sprayed Fylloton extract and Agroleaf power mineral solution on cabbage plants in three batches: The first after 15 days of transplantation and the second one month after the first and the third one month after the second, the Tween-20 diffuser was added at a rate of 0.1% with sprayed fertilizer solutions on the plant to reduce the surface tension of the water molecules and sprayed until fully wet, specifications of organic and mineral fertilizers used in the experiment in Table 2.

Table 1: Number of Chemical and Physical Properties of Soil Field Experiment in the Research Season*.

Chemical and physical soil qualities of the experiment field in the growing season 2018/2019 depth (0-30cm)	Characteristics and unit of measurement
7.89	Degree of soil reaction PH
0.569	Electrical Conductivity EC DS.M^{-1}
13.29	Organic matter g.kg^{-1}
available concentration of nutrients	
27.7	Available nitrogen mg.kg^{-1}
18.34	Available phosphor mg.kg^{-1}
153.1	Available potassium mg.kg^{-1}
0.78	Sodium mg.L^{-1}
1.45	Calcium mg.L^{-1}
3.15	Magnesium mg.L^{-1}
3	Chlorine mg.L^{-1}
246.5	Total Carbonate g.kg^{-1}
Volumetric distribution of soil contents	
681.2	Sand g.kg^{-1}
196	g.kg^{-1} Silt
122.8	g.kg^{-1} Clay
Sandy Loamy	Soil texture

*Analysis was conducted in the Central Laboratory of the Faculty of Agriculture and Forestry, University of Mosul.

The experiment was carried out according to the Randomized Complete Block Design (RCBD) with three replicates. Thus, the area allocated for the experiment was divided into three equal segments by seven experimental units for each replicate , The area of the experimental unit was 2.24 m^2. The experimental unit represented one line of 2.8 m long and 0.8 m wide , each line contains seven plants and the distance between one plant and another is 40 cm. Agricultural service operations were carried out from the beginning of the seedlings to the last stage of head harvest on 6/3/2019, as in the cabbage fields (Matlub *et al.,* 1989). The results were statistically analyzed for the qualities that will be mentioned later according to the design used by S.A.S (1996). The mean traits were compared using the Duncan

Table 2: Organic fertilizer components used in the experiment.

WSG85 POWHUMUS						
Potassium K2O	**Potassium humate**	**Atomization**	**Humic acid**	**Humidity**		
12%	85%	99.8%	85%	14%		
Production	Other materials	Iron Fe	Nitrogen N	Dry Matter		
company						
Humintech.com	15%	1%	0.8%	86%		
Germany						
Mineral fertilizer (Agroleaf power)						
Mn 0.07%(EDTA)	Fe 0.14%(EDTA)	K2O 11%	P2O5 11%	Nitrogen Total 31%		
Com. Scotts Poland	Zn0.070%(EDTA)	Mo 0.001%(EDTA)	Cu 0.070%(EDTA)	B 0.03%(EDTA)		
/Warszawa						
Extract mixture of yeast and marine algae (Fylloton)						
Type of extract	Fungi type	Components of the extract				
		Elements	Growth	amino	Organic	Organic
			regulators	acids	nitrogen	carbon
Produced by the	*Ascophyllum*	It is a concentrated	Contains a high	Very rich in		
Italian company	*nodosum*	source of major	amount of growth	different	7.62%	32%
Com. Biolchim		and minor nutrients	regulators oxins	types of		
			and cytokines	amino acids%37.5		

polynomial test at a 0.05% probability level (Al-Rawi and Khalaf Allah, 2000). To evaluate the growth and yield of cabbage hybrid plants (Blue Jays), the following characteristics were estimated:

-Average height of plant (cm), number of external leaves of the head (leaf.plant^{-1}), leaf area (cm^2), percentage of dry matter (%), percentage of total chlorophyll (%), stem diameter (cm), length and diameter of head (cm) and head cohesion :Four plants were randomly taken from each experimental unit and measurements were taken.

- Average number of days required for head maturation (day): Calculated the number of days from seedling to maturity and harvesting cabbage heads.

- Average marketable head weight (g): It was calculated from the weight of all experimental unit plants.

- Early marketing yield , total marketing yield for heads without external leaves and total yield (tons.ha^{-1}): They were calculated from the total area of the experimental unit only and the total yield was calculated according to the following equation:

Total yield = Experimental Unit Yield / Experimental Unit Area m^2 × 10000.

Table 3: Effect of fertilization treatments on plant height, number of external leaves and leaf area of cabbage crop.

characteristics Treatments	Plant height (cm)	Number of external leafs	Leaf Area (cm2)
Control	19.20 b	21.00 a	302.92 a
Humic acid (2) g.L^{-1}	21.70 ab	22.26 a	321.35 a
Humic acid (4) g.L^{-1}	22.23 a	21.86 a	316.30 a
Fylloton (3) ml.L^{-1}	21.53 ab	21.50 a	378.61 a
Fylloton (6) ml.L^{-1}	20.90 ab	22.63 a	364.48 a
Agroleaf power (5) g.L^{-1}	21.76 ab	20.76 a	338.89 a
Agroleaf power (10) g.L^{-1}	21.00 ab	22.06 a	331.47 a

Averages that share the same alphabetical character for each trait do not differ significantly according to the Dunkin test below the probability level of 5%.

Result and Discussion

The results of Table 3 indicate that the plants treated with fertilizers used in the experiment all significantly superior to comparison plants in the character of plant height and did not differ significantly between them , The highest value of the plant height was in the treatment of the addition of humic acid at a concentration of 4 g.L^{-1} which was 22.23 cm. This is due to the role of humic acid in increasing the physiological activity of the plant and its reflection in increasing the growth and plant content of nutrients and increase cytokinein and internal oxygen as well as activates enzymes and energy compounds within plants, which activates the internal cytokinein and increases cell division (Chen and Avaid, 1999 and Anonymous, 2005). The results showed that there were no significant differences between all treatments, although Fylloton treatment with high concentration gave the highest value in the number of leaves only at 22.63 leave.plant^{-1}. While the treatment of Fylloton at a

Table 4: Effect of fertilization treatments on dry matter quality, total chlorophyll ratio and stem diameter of cabbage crop.

characteristics Treatments	Dry matter (%)	Total chlorophyll ratio	stem diameter (cm)
Control	9.400 a	59.10 a	2.466 a
Humic acid (2) g.L^{-1}	9.540 a	63.36 a	2.450 a
Humic acid (4) g.L^{-1}	9.830 a	56.10 a	2.513 a
Fylloton (3) ml.L^{-1}	10.216 a	63.46 a	2.443 a
Fylloton (6) ml.L^{-1}	10.603 a	60.10 a	2.610 a
Agroleaf power (5) g.L^{-1}	11.196 a	56.83 a	2.520 a
Agroleaf power (10) g.L^{-1}	10.696 a	64.60 a	2.476 a

Averages that share the same alphabetical character for each trait do not differ significantly according to the Dunkin test below the probability level of 5%.

concentration of 3 ml. L^{-1} gave the highest value in the character of leafy area which amounted to 378.61 cm^2. The results of Table 4 indicate that there was no significant differences between all treatments among them in the characteristics of dry matter (%) and the ratio of total chlorophyll and stem diameter (cm), although the treatment of plants with Agroleaf power at 5g gave the highest value of dry matter was 11.196%. The same treatment with high concentration of 10 g.L^{-1} gave the highest value in the total chlorophyll ratio of 64.60%, while the treatment of plants with Fylloton with high concentration 6 ml.L^{-1} was the highest stem diameter of 2.610 cm compared to the rest of the treatments.

The results of Table 5 indicate that the treatment of Fylloton concentration of 3 ml.L^{-1} recorded the highest values in the characteristics of early maturity (123 days), head length (16.00 cm), head diameter (15.63 cm) and head cohesion (1.220) which significantly exceeded treatment of the control in the four characteristics , While it was significantly superior to other fertilizer treatments in early maturity and significantly superior to the treatment of spraying Fylloton concentration of 6 ml.L^{-1} only in the character of head length and did not differ significantly with the rest of the other treatments except the comparative treatment in diameter and head cohesion , Thereafter Humic acid treatment significantly exceeded the concentration of 4 gm.L^{-1} on the treatment of control only in the early maturity character. The treatment of Fylloton exceeded at concentration of 3 ml.L^{-1} by about 12 days than the comparative treatment in early maturity, a significant advantage for farmers economically and an increase in the outcome in case of delaying the harvest, This is due to the role of this marine extract as a source of natural growth regulators such as Auxins, Gibberellins (GA3, GA7) and Cytokines (Brad, Weil, 2000, Ergun *et al.,* 2001), as well as Its containment at the vitamins and enzymes that stimulate and accelerate the vegetative and radical growth of the plant (Jensen, 2004).

The results of Table 6 indicate that the spray treatment with marine extract Fylloton at concentration of 3 ml.l^{-1} was significantly higher on all other treatments, including comparative treatment in the mean weight of the average head weight for marketing, early marketing yield, total marketing yield and total yield where the values reached (1688.67g), (35.400, 46.43, 67.21 t.ha^{-1}), respectively, compared with the control treatment with the lowest values (1158.00 g), (13.789, 31.84, 48.79 t.ha^{-1}) respectively. The treatment of Agroleaf power at 5 gm^{-1} was significantly superior to the comparative treatment only in the above four traits and on treatment of Humic acid at 4 gm^{-1} in total marketing yield trait and did not differ significantly with other treatments. From the above results, Fylloton marine spray treatment, especially at concentration of 3 mL^{-1}, shows the greatest role in increasing the early and total marketing yield and the total yield of cabbage, as well as increasing the average head weight resulting from increasing leaf area and early maturation compared to other treatments. It follows its importance in the same role. It may be due to the content of this bio-fertilizer of the nutrients used in the rich nutrients and growth regulators that contribute to increasing cell division and building and activate the vital activities of the plant, which leads to increased vegetative growth and thus increase in production, This may be due to the rapid absorption of nutrients by the plant and thus its impact.

Table 5: Effect of fertilization treatments on early maturity, head length, head diameter and head cohesion of Cabbage crop.

characteristics Treatments	Early maturity (day)	Head length (cm)	Head diameter (cm)	head cohesion
Control	135 c	14.20 b	13.90 b	1.763 b
Humic acid (2) g.L^{-1}	131 bc	14.66 ab	14.63 ab	1.636 ab
Humic acid (4) g.L^{-1}	128 b	15.36 ab	15.01 ab	1.663 ab
Fylloton (3) ml.L^{-1}	123 a	16.00 a	15.63 a	1.220 a
Fylloton (6) ml.L^{-1}	131 bc	14.56 b	14.16 ab	1.530 ab
Agroleaf power (5) g.L^{-1}	130 bc	15.33 ab	14.95 ab	1.220 a
Agroleaf power (10) g.L^{-1}	131 bc	15.60 ab	14.31 ab	1.496 ab

Averages that share the same alphabetical character for each trait do not differ significantly according to the Dunkin test below the probability level of 5%.

On the development of vegetative total plant . On the other

Table 6: Effect of fertilization treatments on average weight of marketable head, early marketing yield, total marketing yield and total yield of Cabbage crop.

characteristics Treatments	Average marketable head weight (g)	Early marketing yield $t.h^{-1}$	Total marketing yield $t.h^{-1}$	Total yield $t.h^{-1}$
Control	1158.00 c	13.789 c	31.84 d	48.79 c
Humic acid (2) $g.L^{-1}$	1218.33 bc	16.775 bc	33.50 bc	49.65 c
Humic acid (4) $g.L^{-1}$	1310.00 bc	22.278 b	36.02 c	53.72 b
Fylloton (3) $ml.L^{-1}$	1688.67 a	35.400 a	46.43 a	67.21 a
Fylloton (6) $ml.L^{-1}$	1226.33 bc	16.138 bc	33.72 bc	50.31 bc
Agroleaf power (5) $g.L^{-1}$	1326.33 b	26.942 b	36.47 b	53.90 b
Agroleaf power (10) $g.L^{-1}$	1209.67 bc	15.183 bc	33.26 bc	49.84 c

Averages that share the same alphabetical character for each trait do not differ significantly according to the Dunkin test below the probability level of 5%.

hand, the quality of the nutrients used in the paper represents the necessary nutrients for growth such as nitrogen, phosphorus, calcium, etc. It is one of the most important requirements for plant development and growth and its impact on productivity and head quality (Saunders, 2001; Torres *et al.,* 2004).

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