Effect of adding levels of organic fertilizer and chelated iron on growth and productivity of plant

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Abstract

A field experiment was conducted in the Department of Horticulture - College of Agricultural Engineering Sciences - University of Baghdad during the winter season 2020-2021, with the aim of studying the effect of adding levels of organic fertilizer and chelated iron on the growth and yield of cabbage (Hybrid Clubmaster),The experiment included two factors, the first factor was organic fertilizers and included 6 treatments, which is the addition of 1/2 the fertilizer recommendation NPK, 1, the full fertilizer recommendation NPK and the ground addition of organic fertilizer at the level of 200, 300, 400 and 500 kg. ha^{-1} and its symbol is 1/2 Chm, Chm O200, O300, O400, O500 respectively The second factor is the ground addition of chelated iron Fe-EDDHA (6%) at three levels 0, 3 and 6 kg. ha^{-1} and symbolized by F0, F1 and F2 sequentially, where three batches were added a week after cultivation, 15 days after the first batch, and after 30 days From the first batch.All fertilizers are added in the manner of spraying around the plant. The full NPK fertilizer recommendation included 150 kg $N.ha^{-1}$, 120 kg $P2O5.ha^{-1}$ and 120 kg $K2O.ha^{-1}$ A factorial experiment was conducted according to the randomized complete block design, R.C.B.D. With three replications, the averages of the treatments were compared using the least significant difference test (L.S.D). At the 5% probability level, The results showed the O500F2 treatment excelled in most vegetative growth indicators and yield, and the ChmF2 treatment gave the highest leaf area of (200) cm. interaction treatment O500F1 gave the highest average head diameter of (19.30) cm, and interaction treatment ChmF1 gave the highest head height of (29.89 cm,The interaction treatment ChmF0 and O300F0 gave the highest ratio of head height to diameter (1.60) cm.

Introduction

Cabbage: *Brassica oleracea var.capitata* L.is an important winter leaf vegetable crop in Iraq, belonging to the cruciferous family. It grows well in relatively cold and humid weather. It is grown in order to obtain the heads resulting from the wrapping of the leaves around the enlarged terminal bud. Studies of healthy food have confirmed that it is a cleanser of the digestive canal and liver, a de-fatter to dissolve fat in the body, a remover of cholesterol, and a balance of sugar and pressure and it contains the distinctive anthocyanin dye, and this dye contains active compounds such as flavonoids, phenols, glycosides, and antioxidants, and the ability to inhibit pathogenic bacteria (AL-Rawahy et al., 2004, Abdel Hassan, 2019, and Al-Tamimi, 2020).Organic fertilizers are an important factor in increasing vegetative growth, increasing production, and improving its quality. Therefore, adding it is critical to raising the vitality of these soils, as it plays an important role in improving the physical, chemical and fertility properties and is a storehouse of nutrients necessary for plant growth.It also works to increase the availability of nutrients in the soil through its high content of organic acids that reduce the degree of soil reaction and the dissolution of some insoluble compounds (Al-Nada, 2019). Plants need micro-elements in small quantities, but they play an important role in regulating metabolic processes and their impact on the growth of plant yield. One of the most important of these micro-elements is iron, which is a nutrient needed by all living organisms and is important for the growth and

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development of all plants and cannot be replaced by another element .It is a vital component of many plant enzymes (Ali, 2012). The research aimed to study the effect of manufactured organic fertilizer and chelated iron on the growth and yield of fermentation

Materials and methods

A field experiment was conducted during the winter season 2021-2020 at Research Station A of the College of Agricultural Engineering Sciences - University of Baghdad (Al-Jadiriyah Complex) For the cultivation of the cabbage Clubmaster hybrid, which is characterized by high productivity and regulated maturity, suitable for cultivation in the autumn season and early summer cultivation, the head is white, of high quality, and well-integrated under the conditions of open cultivationTo study the effect of adding levels of organic fertilizer and chelated iron on the growth and yield of the plant, the experiment included two factors, the first factor was organic fertilizer and it included 6 treatments, it is the addition of 1/2 the fertilizer recommendation NPK, the complete fertilizer recommendation NPK and the ground application of organic fertilizer at the level of 200, 300, and 400 and 500 kg.ha^{-1}, symbolized by 1/2 Chm, Chm, O200, O300, O400, and O500, respectively.The second factor is the ground addition of chelated iron Fe-EDDHA (6%) (commercial) at three levels 0, 3 and 6 kg. ha^{-1} and its symbols are F0, F1 and F2 respectively. Three batches were added a week after planting, 15 days after the first batch, and 30 days after the first batch. All fertilizers are added in the manner of feeding around the plant. The full NPK fertilizer recommendation included 150 kg N.ha^{-1}, 120 kg P2O5.ha^{-1} and 120 kg K2O.ha^{-1},Iron was added in three batches a week after planting, 15 days after the first batch, and 30 days after the first batch. All fertilizers are added by the method of feeding around the plant, Fe-EDDHA = ethylenediamine di(o-hydroxyphenyl) acetic acid with 6 percent Fe (Fe3+). Phosphate fertilizer was added all at once when cultivation,As for the nitrogen and potassium fertilizers, it was added in two batches, the first two weeks after transferring the seedlings, and the second one month after the first batch. The addition was made by making an incision under the plant at a distance of 15 cm, bearing in mind that the recommendation of the manufacturer of organic fertilizer is 20-40 kg per 1000 m^2. cultivation seedlings on 10/1/2020 on planting lines between a line and another 75 cm and between one plant and another 40 cm, and the service operations were conducted with the crop from weeding, hoeing, control, and irrigation according to, the experiment was designed according to Randomized Complete Block Design (RCBD), Completely Random Block Design (C.R.B.D) by 18 treatments and three replications resulting from the two factors of the study are (3 * 3 6 *) represented by the levels of organic fertilization and chelated iron, so the total number of experimental units in the experiment is 54 experimental units Data were analyzed using Genstst program, and arithmetic means were compared using L.S.D test at 5% probability level. Organic Fertilizer Ingredients(Total Organic Material 40%, Total Free Aminoacid 5%, Total Seaweed %, Humic Acid 30%, Fulvic Acid 10%)

The study indicators included

1. Indicators of vegetative growth, plant height, cm, chlorophyll content of the leaves, mg.100 g, fresh weight (Goodwin, 1976). Number of head leaves,(leaf.head $^{-1}$, , leaf area cm plant $^{-1}$, according to(Watson and Watson, 1953)

2. Yield indicators: head diameter cm, head height cm, head height ratio to diameter, yield per plant kg.

Results and discussion

It is noted that the organic fertilizer O500 treatment significantly increased head height, chlorophyll content of leaves, and the number of outer leaves, respectively, 42.28 cm, 238.89 mg, 100 g $^{-1}$fresh weight, and 16,479 leaves. Plant $^{-1}$ Whereas the Chm treatment gave the highest leaf area amounting to 177.92

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compared to the rest of the treatments Table 1, and it is noted from the table also that the treatment of the interaction with organic fertilization and chelated iron O500F2 gave the highest values for head height and leaf content of chlorophyll, respectively 43.92 cm , 246.67 mg, 100 g $^{-1}$fresh weight compared to other treatments Whereas, the O200F2 interaction treatment gave the highest number of head leaves, which amounted to 16.667 heads.

Table 1. Effect of levels of organic fertilizer and chelated iron and the interaction between them on some indicators of vegetative growth of cabbage plant

Treatment	plant height (cm)	leaves content of chlorophyll	Number of head leaves (leaf. head^{-1})	Leaf area (dm^2. plant^{-1})
1/2 Chm	**36.44**	**182.95**	**15.331**	**136.80**
Chm	**39.86**	**208.89**	**15.514**	**177.92**
O200	**39.11**	**209.35**	**15.701**	**158.54**
O300	**39.02**	**213.43**	**15.813**	**156.27**
O400	**39.84**	**226.11**	**15.926**	**163.21**
O500	**42.28**	**238.89**	**16.479**	**175.29**
L.S.D	**1.598**	**14.555**	**0.6211**	**7.790**
Fe 0	**38.27**	**200.33**	**15.478**	**151.13**
Fe1	**39.78**	**210.98**	**15.758**	**160.20**
Fe2	**40.23**	**228.50**	**16.147**	**172.6**
L.S.D	**1.130**	**10.292**	**0.4392**	**5.508**
1/2 ChmF0	**36.13**	**170.00**	**15.330**	**132.69**
1/2 ChmF1	**36.87**	**183.84**	**15.000**	**134.39**
1/2 ChmF2	**36.33**	**195.00**	**15.663**	**143.33**
ChmF0	**38.83**	**203.33**	**15.660**	**157.19**
ChmF1	**39.67**	**206.67**	**15.443**	**176.56**
ChmF2	**41.07**	**216.67**	**15440**	**200.00**
O200F0	**38.20**	**173.33**	**14.997**	**148.81**
O200F1	**39.80**	**207.05**	**15.440**	**150.14**
O200F2	**39.33**	**247.68**	**16.667**	**176.67**

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O300F0	**38.33**	**211.97**	**14.997**	**157.00**
O300F1	**39.40**	**205.00**	**15.777**	**153.33**
O300F2	**39.33**	**223.33**	**16.667**	**158.48**
O400F0	**37.80**	**206.67**	**15.443**	**157.00**
O400F1	**40.33**	**230.00**	**16.333**	**165.00**
O400F2	**41.40**	**241.67**	**16.000**	**167.63**
O500F0	**40.33**	**236.67**	**16.440**	**154.09**
O500F1	**42.60**	**233.33**	**16.553**	**181.79**
O500F2	**43.92**	**246.67**	**16.443**	**190.00**
LSD	**2.768**	**25.209**	**N.S**	**13.493**

Table 2 Effect of levels of organic fertilizer and chelated iron and the interaction between them on yield indicators of cabbage plant

Treatment	head diameter (cm)	head height (cm)	Ratio of head height to diameter	plant yield (kg)
1/2 Chm	**17.86**	**27.00**	**1.52**	**1.777**
Chm	**18.71**	**28.92**	**1.51**	**2.103**
O200	**18.02**	**27.81**	**1.54**	**1.983**
O300	**18.44**	**27.77**	**1.55**	**2.123**
O400	**18.74**	**28.37**	**1.51**	**2.193**
O500	**19.13**	**29.29**	**1.53**	**2.733**
L.S.D	**0.498**	**2.692**	**0.074**	**0.1750**
Fe 0	**18.16**	**27.74**	**1.50**	**2.008**
Fe1	**18.46**	**28.52**	**1.55**	**2.159**
Fe2	**18.82**	**28.33**	**1.53**	**2.290**
L.S.D	**N.S**	**1.099**	**0.053**	**0.1237**
1/2 ChmF0	**17.06**	**24.00**	**1.41**	**1.679**

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1/2 ChmF1	**17.83**	**28.44**	**1.59**	**1.787**
1/2 ChmF2	**18.68**	**28.55**	**1.53**	**1.867**
ChmF0	**18.37**	**29.33**	**1.60**	**1.864**
ChmF1	**18.79**	**29.89**	**1.59**	**2.013**
ChmF2	**18.96**	**27.55**	**1.45**	**2.432**
O200F0	**18.40**	**28.11**	**1.53**	**1.867**
O200F1	**17.34**	**27.22**	**1.57**	**1.973**
O200F2	**18.33**	**28.11**	**1.53**	**2.110**
O300F0	**18.05**	**28.89**	**1.60**	**2.037**
O300F1	**18.68**	**27.55**	**1.47**	**2.167**
O300F2	**18.58**	**26.88**	**1.45**	**2.167**
O400F0	**18.22**	**27.11**	**1.50**	**2.100**
O400F1	**18.82**	**28.55**	**1.52**	**2.213**
O400F2	**19.18**	**29.44**	**1.53**	**2.267**
O500F0	**18.89**	**29.00**	**1.54**	**2.500**
O500F1	**19.30**	**29.44**	**1.52**	**2.800**
O500F2	**19.18**	**29.44**	**1.54**	**2.900**
LSD	**1.220**	**1.554**	**0.129**	**0.3031**

It is noticed in Table 2 that the organic fertilizer O500 treatment significantly increased the head diameter, the head height, and the yield of one plant, respectively 19.13 cm, 29.29 cm, 2.733 kg. Plant $^{-1}$, while the treatment O300 and F1 gave the highest head-to-diameter average of 1.55 cm compared to With the rest of the treatments, It is also noted from the table that the interaction treatment with organic fertilization and chelated iron O500F2 gave the highest value for the yield of one plant, which amounted to 2.9 kg. Plant^{-1} compared to the rest of the treatments, while the interaction treatment ChmF1 gave the highest head height of 29.89 cm,The interaction treatment O500F1 gave the highest value for the head diameter, which amounted to 19.13 cm. The two interaction treatments, ChmF0 and O300F0, gave the highest value for the height of the head to the diameter, which amounted to 1.6.

Discussion

It is noticed in the light of the research results a clear reflection of the studied indicators on the vegetative growth and yield traits. This is due to the treatment of adding organic fertilizer and chelated iron O500F kg.ha significantly excelled in increasing the concentration of nutrients in the leaves as a result of the role of organic fertilizers in improving the physical, chemical, and biological properties of the soil as a result of

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soil moisture retention and increased aeration, which provides ideal conditions for the growth of the root system.Increasing the activity of microorganisms and their numbers, which increases the availability of nutrients and increases their absorption from the plant as well as due to the elements contained in the fertilizer that are ready and easily absorbed by the plant, which led to an increase in the concentration of nutrients in the leaves (Abdel Razzak et al. 2008, Prasad 2009 Hasan 2012 and ,, Haque 2015)These elements are important in plant metabolism and growth as a result of their entry into most of the vital processes within the plant and then increasing the process of carbon metabolism and food manufacturing in the leaves. This is due to the increase in the percentage of nitrogen and the concentration of iron in the leaves and the functional role of these elements in building chlorophyll, as nitrogen and phosphorous enter the composition of nucleic acids such as DNA and RNA, which are necessary for the process of cell division (Taiz and Zeiger, 2006),or, it may be attributed to its great role in increasing nitrogen levels in and increasing the availability of Fe, Zn and S elements, which leads to an increase in the concentration of chlorophyll in the leaves, encouraging growth and increasing the size of cells, and as a result, increasing the size of the vegetative group and leaf area .These results are in agreement with Al-Lami (2021), Sadiq et al. (2016), and Al-Zaidi 2006. As for potassium, it has a role in activating more than 80 enzymes, such as synthetases, oxidoreductases, dehydrogenases, transferases, and kinases, and these are important for basic plant activities such as energy formation, starch formation, nitrogen metabolism, and protein and respiration in the plant,Potassium also stabilizes the cytoplasm's pH, regulates the osmotic pressure of the cell, and regulates the cell's water content because it is responsible for opening and closing the stomata in the leaves of the plant. It also contributes to accelerating the transfer of materials manufactured in the leaves to their storage places in the heads because of its important role in the transfer processes across cell membranes, which leads to the expansion of cells and increases their size (Al-Sahaf, 1989 and this were reflected in the strength of the vegetative growth of these plants. These results are consistent with what Globe found) 2014), Mulusew and Nagappan (2013) and Mashhadani (2014).

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