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Role of organic nutrient (Tecnokel) and application methods on some qualitative characteristics of two cauliflower hybrids (*Brassica Oleracea* var. botrytis)

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Abstract--The experiment was carried out in the vegetable field of the Department of Horticulture and Landscape / College of Agriculture and Forestry / University of Mosul, during the autumn growing season (2021). The experiment included the study of three factors, the first: two hybrids of broccoli (Raheq and Ice ball), second factor included application methods (foliar spray and add to soil) as for the third factor it included the use of the organic nutrient (Tecnokel) at four concentrations (0, 2, 4, and 6 g .L⁻¹), thus the experiment included 16 treatments (2* 2* 4). Arranged in a factorial experiment within split-plot using the Randomized Complete Block Design, the hybrids were placed in the main plots and the compatibility between the application methods and the organic nutrient concentrations in the sub-plots. Each treatment was repeated three times, the results were analyzed statistically, according to the design used and the comparison of means according to Duncan's polynomial test at the 0.05 probability level. The results can be summarized as follows: a) The significant effect of the two hybrid plants (Raheq and Ice ball) on the characteristics of the specific yield was examined. The hybrid Raheq plants outperformed with a significant decrease in the time of ripening and harvesting of 20% of the curds and with a significant increase in the circumference and thickness of the curds, while the Ice ball hybrid plants outperformed significantly in curds color; b) Foliar spraying method was superior in the circumference curds compared to the method of to the add to soil method; 3) The use of the nutrient

in all its concentrations led to significant effects on most qualitative traits of compared to the control plants.

Keywords---organic nutrient (Tecnokel), cauliflower hybrids, Brassica oleracea.

Introduction

Cauliflower *Brassica oleracea* var. betrytis belongs to the Brassicaceae family with a high nutritional value, low calories, high content of alpha, fatty acids, vitamins B, C, E, and nutrients such as P, ME, Mn Fe (Kapusta Duch et al,2019) .In Application to the high nutritional value of the plant, it has medicinal properties, as its medical benefits lie in the fact that it contains compounds that are beneficial for bowel cancer, which are compounds that are formed by chewing cauliflower and vitamin) that is useful for the eyes, bones, teeth, religion and two nights that stand in the face of The growth of breast cancer cells, a high percentage of fiber that helps build a healthy intestine, galactose, which prevents colon cancer-causing compounds, glucoraphanin, which keeps heart diseases away, and three-carbinol, which stops prostate gland cells from being cancerous, and calcium, which is important for bones and teeth (Sharma et al,2004), which increased the demand for its consumption and attracted the attention of many farmers and amateurs in recent years in mushrooms with interest and expansion in its cultivation.

Cauliflower is grown in most of the governorates of Iraq as a winter crop to obtain floral opportunities, which are merging flower buds, which is the part that is eaten before they open, and despite the importance of this crop, it is still low in the rate of production per unit area in Iraq compared to production The global average cultivated area reached 990 hectares and the production rate per unit area was 7266.94 kg. ha⁻¹ (Arab Organization for Agricultural Development,2019). Which necessitates studying the reasons and expanding the cultivation of the crop and trying to raise the productivity per unit area by using advanced agricultural methods and technologies in its production to provide the crop with good quality and high crown. Ibraeem (2007) in Mosul, in his study on two cauliflower cultivars, showed that the qualitative characteristics represented in the circumference, thickness, consistency and color of the curds were significantly superior in plants of the variety White Cloud compared to Rami variety. Kindo and Singh (2018) in India found in a study on eleven Hybrid of cauliflower that Madhuri Hybrid was significantly superior in the circumference, thickness, consistency and color of the curds as compared to rest hybrids. Broccoli plants above insignificantly in circumference and thickness Curds in comparison with the rest of the hybrids. In Bangladesh when studying two cauliflower cultivars (Snow White and White Angle) the results showed that the White Angle cultivar was significantly higher in circumference and thickness of curds compared to Snow White cultivar (Eimon et al, 2019) and Giri et al (2020) in Nepal for two consecutive seasons, when evaluating the color of eleven hybrids of cauliflower, it was found that the hybrid 16 Snowbal and followed by the hybrid Amazing gave the best significant results in the color of the curds compared to other hybrids. A significant increases in the thickness and circumference of

broccoli heads was obtained in experience of Abdel Rahman and Yassin (2019) in Tikrit when comparing several Organic fertilizers of sheep manure and poultry manure added to the ground at a rate of 2 kg per experimental unit, and humic acid at a concentration of 5 ml⁻¹ sprinkled on the shoots on broccoli plants. An experiment was carried out by Al-Salihi and Mahmoud (2020) in Kirkuk when foliar spraying with (Acadin) extract at three concentrations (0, 1.5 and 3 g.L⁻¹ they noticed the superiority of the concentration of 1.5 g L⁻¹ in the characteristic of the circumference of the curds compared to the rest of the concentrations. Hussain et al (2020) in Pakistan when studying the effect of Application three organic fertilizers FYAM, PM and SMC at a rate (3: 6: 15) ton ha⁻¹ respectively, to a significant increase in the circumference and weight of curds. It was concluded through the study of Bhowal et al (2020) in Bangladesh when using vermicompost at 1.5 tons ha⁻¹ on cauliflower plants, where they noticed the superiority of the characteristic of the circumference and thickness of the curds.

Research aims

Evaluation and behavioral study of two hybrids of cauliflower imported under the conditions of Nineveh Governorate in order to choose which is the best suitable for cultivation under the conditions of the region with the use of the organic nutrient Tecnokel with different concentrations and two ways of Application: foliar spray and add to soil in order to raise and improve the quality of production and find the best concentration of organic nutrient that cauliflower plants respond to and finding the best triple interaction between hybrids, organic nutrient concentrations and application methods .

Materials and Methods

The experiment was carried out in a vegetable field of the Department of Horticulture and Landscape /College of Agriculture and Forestry/Mosul University during the autumn growing season (2021). Two hybrid seeds of cauliflower (lee ball and Raheq) were used in the experiment. Plastic plates containing 50 eyes using peat moss as a medium for planting, after the formations reached the stage of three - four real leaves that were transplanting in the morning in the field with complete care while keeping the peat moss around the roots during transplantation and maintaining soil moisture, the statistical analysis of the results was adopted using a system (SAS, 2017) and Technological Polynomial Test, Choice Means at the Probability Level of 0.05 (Al-Rawi and Khalaf Allah, 2000). The experiment included the study of three factors:

The first factor:

Hybrid:

This factor included two hybrids of imported cauliflower, namely: -

1. The Raheq hybrid produced by the American company Vegetable Global, with a germination rate of 90% and a purity of 99%, produced on the date May 2021 from the information on the seed envelope.

2. The hybrid Ice ball variety produced by the American company Quantum, with a germination rate of 90% and a purity of 99%, produced on the date May 2020 from the information on the seed envelope.

The second factor:

Methods of application to the organic nutrient: My method of application was used.

1. Add to soil.
2. Foliar spraying.

The third factor:

The organic nutrient (Tecnokel) consisted of four concentrations:

1. 0 g.L⁻¹ comparison treatment.
2. 2 g.L⁻¹.
3. 4 g.L⁻¹.
4. 6 g.L⁻¹.

Studied traits:

1. Curds color (degree):
2. Curds compact (degree):
3. Curds thickness (cm):
4. Circumference of the curds(cm):

Results and discussion:**1- Circumference of the curds(cm):**

The results of the statistical analysis in Table (1) in the characteristic of the circumference of the curd that the hybrid Raheq plants were significantly superior compared to the hybrid Ice ball plants. As for the effect of the application method, the foliar spray method was superior compared to the method of application to the soil, while all the concentrations of the organic nutrients were superior compared to the comparison treatment. In this trait, the treatment with a concentration of 4 g.L⁻¹ of the organic nutrient gave the highest value for the circumference of the curd, which was 55.89 cm and differed significantly with the treatment with a concentration of 6 g.L⁻¹ of the organic nutrient and the comparison treatment.

The highest value was reached through the double interaction surrounding the curd in the case of the hybrid Raheq in the case of using the add to soil method, which reached 54.48 cm, and it disappeared significantly only with the method of application to the soil in the case of the hybrid Ice ball, whose plants showed the lowest value in this trait it was 52.42 cm.

The results of the binary interaction between hybrids and the organic nutrient show that the plants of the hybrid Raheq when treated with a concentration of 4

g.L⁻¹ of the organic nutrient recorded the highest value of the curd circumference of 56.73 cm and it did not differ significantly with the treatment with a concentration of (2 and 6) g.L⁻¹ of the organic nutrient of the same hybrid and with treatment with a concentration of 4 g.L⁻¹ of organic nutrient on hybrid Ice ball.

Through the results of the binary interaction between the application method and the organic nutrient, the treatment was recorded by the foliar spray method, at a concentration of 4 g.L⁻¹ of the organic nutrient had the highest value of curds circumference of 56.93 cm, significantly superior to all other interaction treatments except for the treatment with concentration 2 g.L⁻¹. for the same method.

The best triple interaction treatment for the circumference of the curd was reached in the hybrid Raheq plants by application the organic nutrient through the soil and at a concentration of 2 g.L⁻¹ of the organic nutrient amounted to 57.86 cm.

Table (1): Effect of hybrids, method of Application, organic nutrient (Tecnokel) and interaction coefficients between them in the circumference of the curds(cm)

Hybrids	Application Method	Organic Nutrient Concentrations (Tecnokel) g.L ⁻¹				Hybrids X Application Method	Average Hybrids effect
		0	2	4	6		
Raheq	Foliar spray	50.80 f-h	54.76 b-e	57.20 ab	54.76 b-e	54.38 a	54.43 a
	Add to soil	48.10 h	57.86 a	56.26 a-d	55.70 a-d	54.48 a	
Ice ball	Foliar spray	51.30 f g	56.33 a -d	56.66 a-c	53.43 d -g	54.43 a	53.42 b
	Add to soil	50.53 g h	52.00 e - g	53.43 d - g	53.73 c - f	52.42 b	
Hybrids X Organic Nutrient	Raheq	49.45 c	56.31 a	56.73 a	55.23 ab	Average Effect Method add	
	Ice ball	50.91 c	54.16 b	55.05 ab	53.58 b		
Application Method X Organic Nutrient	Foliar spray	51.05 c	55.55 ab	56.93 a	54.10 b	54.40 a	
	Add soil	49.31 c	54.93 b	54.85 b	54.71 b	53.45 b	
Average effect of Organic Nutrient		50.18 c	55.24 ab	55.89 a	54.40 b		

*The averages that share the same letter for each factor and each overlap do not differ significantly between them according to Duncan's polynomial test at the probability level (P < 0.05).

2- Thickness of the curds(cm):

Through the results of Table (2), it was concluded that there are significant differences between the two hybrids in the thickness of the curd, as the plants of the hybrid Raheq were significantly superior on this trait. While there was no significant effect between the two application methods of the thickness of the curd. It was noted that there was a significant effect of application the organic nutrient in all its concentrations, which led to a significant increase in the thickness of the curds compared to the comparison treatment and it did not differ significantly superior concentrations among them.

In the case of the dual interaction between the hybrids and the application methods, the plants of the hybrid Raheq and the methods of application the organic nutrient were significantly superior to the plants of the hybrid Ice ball and the same as my application methods. The results of the binary interaction between the hybrid and the organic nutrient also indicate the superiority of plants the hybrid Raheq and with all the concentrations of the organic nutrient on the comparison plants of the same hybrid and all the treatments of the hybrid Ice ball.

Through the results of the statistical analysis of the bilateral interaction between the application methods and the organic nutrient, the highest thickness of the curd was reached, which was 13.05 cm. in case of foliar spray method and organic nutrient at 4 g.L⁻¹ concentration. In line with the results of the singular and binary interactions, the triple interference was obtained to the highest value in the thickness of the curd for plants of hybrid Raheq by foliar spraying method with a concentration of 4 g.L⁻¹ of organic nutrient reached 14.20 cm, significantly superior compared to all interaction treatments in the case of hybrid Ice ball plants and some of the triple interactions for the same hybrid according to the method of application, while the lowest value in this triple overlap for this trait was found in the comparison plants of the hybrid Ice ball by method the application to the soil amounted to 10.90 cm.

Table (2): Effect of hybrids, method of Application, organic feeder (Tecnokel) and interaction coefficients between them on the thickness of the curds(cm)

Hybrids	Application Method	Organic Nutrient Concentrations (Tecnokel) g.L ⁻¹				Hybrids X Application Method	Average Hybrids effect
		0	2	4	6		
Raheq	Foliar spray	11.30 e	13.20 ab	14.20 a	13.16 ab	12.96 a	12.88 a
	Add to soil	11.00 e	13.56 ab	13.00 b c	13.63 ab	12.80 a	
Ice ball	Foliar spray	10.93 e	12.63 b - d	11.90 c - e	12.00 c - e	11.86 b	11.68 b
	Add to soil	10.90 e	11.93 c - e	11.33 e	11.85 d e	11.50 b	
Hybrids	Raheq	11.15	13.38	13.60	13.40	Average Effect	

X		c	a	a	a	Method add
Organic Nutrient	Ice ball	10.91 c	12.28 b	11.61 b c	11.92 b	
Application Method X	Foliar spray	11.11 c	12.91 ab	13.05 a	12.58 ab	12.41 a
Organic Nutrient	Add soil	10.95 c	12.75 ab	12.16 b	12.74 ab	12.15 a
Average effect of Organic Nutrient		11.03 b	12.83 a	12.60 a	12.66 a	

*The averages that share the same letter for each factor and each overlap do not differ significantly between them according to Duncan's polynomial test at the probability level ($P < 0.05$).

3- The compact of the curds:

The results of Table (3) on the effect of hybrids on the compact of the curd indicate that there is no the presence of any significant differences between the two hybrids. While the foliar spray method was superior significantly compared to the method of application to the soil in this trait. All concentrations the organic nutrient showed a significant increase for this trait compared to the comparison treatment.

It is clear from the results of the binary interaction between the hybrids and the method of application that there are no significant differences between all the coefficients of this interaction in the compact of the curd. As for the bilateral interaction between the hybrid and the organic nutrient, it was observed that all concentrations of organic nutrients and for both hybrids was significantly differences compared the two comparison treatments.

From observing the results of the binary interaction between the application method and the organic nutrient, the highest value of curd compact was 4.70 when using the foliar spray method at a concentration of 2 g.L⁻¹ of the organic nutrient, the treatment of this interaction was significantly superior on all treatments of the soil application method, while it was only significantly superior to the treatment of comparison of the same method of application.

The best triple interaction treatment between hybrids, application method and the organic nutrient for this trait, it was recorded in Ice ball hybrid plants by foliar spray method at a concentration of 2 g.L⁻¹ of organic nutrient amounted to 4.73, thus it was significantly superior compared to most of the treatments this interference, while the lowest value in this trait was recorded in the comparison plants by the method of foliar spray and for both hybrids, it reached 3.80.

Table (3): Effect of hybrids, method of Application, organic nutrient (Tecnokel) and interaction coefficients between them on the compact of the curd

Hybrids	Application Method	Organic Nutrient Concentrations (Tecnokel) g.L-1				Hybrids X Application Method	Average Hybrids effect
		0	2	4	6		
Raheq	Foliar spray	3.80 e	4.66 ab	4.53 a - c	4.66 ab	4.41 a	4.34 a
	Add to soil	3.93 e	4.40 b c	4.40 b c	4.33 c	4.26 a	
Ice ball	Foliar spray	3.80 e	4.73 a	4.53 a - c	4.66 a b	4.43 a	4.35 a
	Add to soil	4.00 d e	4.26 c d	4.30 c	4.53 a - c	4.27 a	
Hybrids X Organic Nutrient	Raheq	3.86 b	4.53 a	4.46 a	4.50 a	Average Effect Method add	
	Ice ball	3.90 b	4.50 a	4.41 a	4.60 a		
Application Method X Organic Nutrient	Foliar spray	3.80 c	4.70 a	4.53 ab	4.66 a	4.42 a	
	Add soil	3.96 c	4.33 b	4.35 b	4.43 b	4.27 b	
Average effect of Organic Nutrient		3.88 b	4.51 a	4.44 a	4.55 a		

*The averages that share the same letter for each factor and each overlap do not differ significantly between them according to Duncan's polynomial test at the probability level ($P < 0.05$).

4- Color of the curd:

The hybrid Ice ball plants were significantly superior in curd color compared to the hybrid Raheq plants (Table 4). While there was no significant effect of application methods in this trait, as for the effect of the organic nutrient, the organic nutrient contributed significantly in all its concentrations outperformed on the comparison treatment in curd color. The results of the binary interaction between hybrids and application methods in the characteristic of curd color to the superiority of hybrid Ice ball plants and in both ways of application compared to plants of hybrid Raheq and in the tow application method.

It was noticed from the results of the binary interaction between hybrids and the organic nutrient that the best treatment was reached in this trait in the hybrid Ice ball plants with a concentration of 2 g.L⁻¹ of the organic nutrient amounted to 4.70. Thus, the treatment of this interaction significantly outperformed compared to all other treatments except for the treatment at a concentration of 6 g.L⁻¹ of organic nutrient for the plants of the same hybrid. The results of the binary interaction between the application methods and the organic nutrient show the superiority of all the concentrations of the organic nutrient and with both

methods of application over the two comparison treatments. In the comparison treatment and in the application method reached 3.76.

Table (4): Effect of hybrids, method of Application, organic nutrient (Tecnokel) and interaction factors between them on the color of the curds

Hybrids	Application Method	Organic Nutrient Concentrations (Tecnokel) g.l-1				Hybrids X Application Method	Average Hybrids effect
		0	2	4	6		
Raheq	Foliar spray	3.66 f	4.06 d - f	4.53 a - c	4.13 c - e	4.10 b	4.09 b
	Add to soil	3.66 f	4.13 c - e	4.26 b - e	4.26 b - e	4.08 b	
Ice ball	Foliar spray	3.86 e f	4.66 ab	4.66 ab	4.66 ab	4.46 a	4.39 a
	Add to soil	3.93 e f	4.73 a	4.13 c - e	4.46 a - d	4.31 a	
Hybrids X Organic Nutrient	Raheq	3.66 f	4.10 d e	4.40 b c	4.20 c d	Average Effect Method add	
	Ice ball	3.90 e f	4.70 a	4.40 b c	4.56 ab		
Application Method X Organic Nutrient	Foliar spray	3.76 c	4.36 ab	4.60 a	4.40 ab	4.28 a	
	Add soil	3.80 c	4.43 ab	4.20 b	4.36 ab	4.20 a	
Average effect Organic Nutrient		3.78 b	4.40 a	4.40 a	4.38 a		

*The averages that share the same letter for each factor and each overlap do not differ significantly between them according to Duncan's polynomial test at the probability level ($P < 0.05$).

Perhaps the difference in the significant differences between the hybrids under study is due to the characteristics of quantitative and qualitative yield to genetic differences between the two hybrids under study quantitative and qualitative yield traits are controlled by a number of genetic genes of the hybrid. It has been observed from the results of Tables (1 and 2) that the hybrid Raheq plants were significantly superior to the hybrid Ice ball plants in both the characteristics of the circumference and thickness of the curd, which is reflected in the increase in production. These results agree with (Kindo and Singh, 2018 and Eimon 2019).

As for the significant superiority of the foliar spray method compared to the method of soil application in each of the two characteristics the circumference and compact of the curds (Tables (1 and 3) may be due to the fact that the spraying method has led to the pH of the leaves reaching a lower limit, and thus the conditions are suitable for the absorption of the nutrients that the plant needs. (Abdel Wahed, 2019), which is positively reflected in the increase of the mentioned qualities. The leaves can also absorb the nutrients sprayed, as the

absorption through the vegetative group is fast because the period is shorter between the absorption and Application process. It was through the soil (Al-Akaishi and Al-Sahhaf, 2017).

The significant effect when using the organic nutrient Tecnokel in all the characteristics of the specific yield when using all the concentrations of the organic nutrient compared to the comparison treatment mentioned quality. Our significant results agreed with what was found by (Hussain et al. 2020; Bhowal et al, 2020). (Odell, 2003) mentioned that organic nutrition with amino acids and nutrients the other works to stimulate the growth and development of the root and vegetative groups and prevent oxidation vitamins (C) and (E) that are found in chloroplasts, which increases the efficiency of the chloroplast process photosynthesis and the production of carbohydrates as well as organic nutrition works stimulating the growth of flower buds. Norrie (1996) said that spraying vegetable plants with extracts containing amino acids plays an important role in the regulation of vital processes, and they are involved in the formation of nucleotides, vitamins and growth hormones, and they are involved in the formation of the necessary enzymes, even if the enrichment of plants |with these nutrients, it will therefore be reflected on the indicators of the quantitative and qualitative yield, in application to the content of the organic nutrient under study calcium, which has a direct or indirect effect on vegetative growth in general and on production and quality indicators |in particular, in Application to the content of the nutrient solution on boron, which has a role in improving the characteristics of the specific yield due to its contribution in the processes of knot, fertilization and pollination, and the positive role of boron in facilitating the transfer of photosynthesis products from leaves to areas other plants as sugar can be easily transferred after union with boron in rich cells and is necessary for the process of mitosis the formation of the phloem and the cortex of some of the activating plant hormones (Mongol et al. 2001) also controls the speed of absorption by the plant for water also has a great relationship with the hormones that have an effect on the developing peaks and has a relationship in regulating the absorption of calcium on this, it has a major role in the formation of nucleic acids and, in turn, will increase the building of protein inside the plant (David, 2007) as well as contain this organic enricher contains EDTA, which is important in chelating the nutrients in the soil to the plant, so these will be reflected effects of the materials included in the composition of this boiler on improving the specifications of the production and quality mechanisms.

Conclusions and Recommendations:

The study showed, under the implemented circumstances, the most important conclusions and recommendations:

- 1- Ice ball hybrid plants showed clear superiority in curd color and degree of the compact of the curds despite the fact that the last trait did not reach the limit of significance compared to hybrid plants Raheq, the study recommends the possibility of adopting this hybrid for the cultivation of cauliflower in Mosul, with studies conducted to compare this hybrid with other hybrids or cultivars, especially those that are distinguished early production in order to prolong the presence of this crop in the market, taking into account the economic feasibility For hybrids or varieties used.

- 2- Variation of the moral effect when using the two methods of application to influence on some qualities, the foliar spray method was distinguished by its significant superiority in the circumference and the compact of the curds on it. This study recommends the foliar spray method in the fields of commercial production of cauliflower in the city of Mosul.
- 3- The use of the organic nutrient Tecnokel in all its concentrations led to positive results in most of the characteristics of the qualitative yield. This study using this organic nutrient in private production fields cauliflower in the governorate, with a recommendation to conduct future studies using other organic nutrients and comparing it with the organic nutrient is a limitation the study.

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