

Effect of Garlic and Acadian extracts application on growth and yield of summer squash (*Cucurbita pepo* L.)

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(Received 10 November, 2019; accepted 15 December, 2019)

ABSTRACT

To improve growth characteristics and promote the productivity of summer squash plants an experiment was carried out at a field of Horticulture and Landscape Department/ College of Agriculture and Forestry/ Mosul University during spring growing season 2018 to study the physiological effect of Acadian and Garlic extracts at a concentration of 4 ml.L⁻¹ in addition to the control treatment (distilled water) with three application methods to add the two extracts mentioned. These are: the method of addition to soil, foliar spraying method and combination of the previous two methods (add to soil + foliar spray). This method of adding extracts has been repeated in the three stages of plants growth, the Acadian extract causes a significant increase in plant height, number of leaves, leaves area, number and length of fruits per plant in addition to plant yield and total yield as compared to control plants while Garlic extract showed a significant increase in most growth and yield characteristics studied as compared to the control treatment such. The addition of Acadian and Garlic extracts by combination method (add to soil+ foliar spray) causes a significant increase in the total chlorophyll content in the leaves as compared to the soil and foliar application methods.

Key words : Garlic extract, Acadian extract, Foliar nutrition, Summer squash

Introduction

Summer squash (*Cucurbita pepo* L.) belongs to cucurbitaceae family it is considered as the most economically important vegetable crops and it is widely spread in all over the world with high nutritional value (Hassan, 2003). Besides the medical importance of squash fruits because they are diuretic and laxative of the intestines and repellent excess fluid in the body it is of low calories, making it suitable for those who wish to diet (Khadim and Hussein, 2015). Because of the economic, nutritional and medical importance of this crop, it is necessary to look for the ways which will lead to increase its

productivity (AL-Taey and Saadoon, 2012). Several methods were used to increase production and improve the quality of the product, including spraying plants with some plant growth regulators, microelements or different fertilizers, controlling the photoperiod and temperatures by controlling planting dates or changing planting distances (AL-Obaidi, 2012; ALTaey and Majid, 2018). While some researchers have tried to find alternatives to chemicals that may have potential negative effects on the environment and public health (AL-Taey *et al.*, 2019), the trend nowadays is to use and popularize the concept of clean agriculture because of its importance both in maintaining or controlling the absence of

any adverse side effects to health or reduce the high cost of some materials used. In the treatment of some vegetable crops (AL- obaidi, 2012; ALTaey *et al.*, 2017). Horticultural crops of various kinds, which are not treated with chemicals or mineral fertilizers, are gaining international popularity. Due to the increasing demand for it, the research tended to reduce environmental pollution by using natural plant extracts as substitutes for chemical compounds. The researchers found that there are many plants, including herbs, which if the extract preparation from them and applied on whole plants or part of them or on the soil may lead to reduce the incidence of some bacterial, fungal and viral diseases and control weeds then increasing the yield (Muhammed *et al.*, 2009; Jahan *et al.*, 2012). The aim of this study is to find out how to improve the growth and yield of summer squash plants through the use of plant extracts in different ways of application and find cheap natural alternatives harmless to the environment and public health and find the best plant extract and the best way to add the extracts.

Materials and Methods

The experiment was carried out at a field of Horticulture and Landscape Department/ College of Agriculture and Forestry/ Mosul University during spring growing season 2018 in sandy soils. The experiment study included the physiological effect of two factors first was two plant extracts: A- (Acadian extract) derived from seaweed (*Ascophyllum nodosum* L.), which contains nitrogen, phosphorus, potassium and ash at 45-55%. It also contains 20% organic material, Alginic acid 10%, Manitol and Amino acid at 4% each and 6.5% moisture produced by Canadian Acadian seaplans company. B- (extract of Garlic cloves), which was prepared by taking 100 g of garlic cloves after peeling and placed with 100 mL of distilled water and mixed with (Blender) and the resulting solution was filtered with two pieces of boring cloth so we have a fully effective solution (100%) (Hayat *et al.*, 2018). The above extracts were used at a concentration of 4 mL⁻¹ in addition to the comparative treatment (distilled water) (control plant). As for the second factor, it included three application methods: soil addition method, foliar spraying method and combining of the two previous methods (add to soil + foliar spraying). The method was repeated during three stages of growth:

the first was after the 3-5 real leaves appear on the plant and the second stage after two weeks of the first addition while third stage was at the beginning of flowering plants in the vegetative growth and yield of summer squash variety ISMALIA (F1) a product of the Dutch company Enzazaden. Seeds germination 97%. Therefore, this global experiment included 9 treatments carried out in the field using RCBD design, each treatment repeated three times. The land was divided into experimental units, which included a ridges of 4.2 m length and 1 m width per experimental unit. The seeds were planted on 15/3/2018 at a distance of 40 cm from one seed to another and in the upper half of the ridges and two seeds per hole and after full germination was the process of thinning to one plant in each hole. Drip irrigation system was used. The number of plants was 6 plants/experimental unit (18 plants per treatment). Agricultural operations were carried out naturally and according to the recommendations used in the cultivation of summer squash to produce commercial fruits with attention to the process of irrigation and according to the need of the plant. Statistical analysis was conducted using SAS, 2017. Analysis of variance and Duncan's multiple range test at 0.05 were applied for all research data (AL-Rawi and Khlaf Allah, 2000).

Studied characters

A- Indicators of vegetative growth

1. Total chlorophyll content in the leaves, plant height (cm. plant⁻¹). The number of leaves (leaves. Plant⁻¹), Percentage of dry matter in the leaves, leaves area (cm² plant⁻¹)

B - Indicators of the yield

1. Average number of fruits (fruit plant⁻¹), Average fruit length (cm. fruit⁻¹) The average fruit weight (g fruit⁻¹), Fruit yield per plant (g Plant⁻¹), Total fruit yield (tons. Ha⁻¹).

Results and Discussion

A. Vegetative growth Indicators

Table 1 shows the effect of Acadian and Garlic extracts and their methods of addition and interaction between them on vegetative growth characteristics. The results presented in the table indicate that both Acadian and Garlic extracts resulted in a positive

increase in the percentage of total leaves chlorophyll content as compared to control plants. While both of these extracts resulted in a significant increase in plant height and number of leaves/plant as compared to the control treatment. No significant differences were observed between the two extracts in these traits. While the use of Garlic extract gave the highest value in the percentage of dry matter in the leaves at 16.066 and thus significantly differed with both Acadian and comparative treatments. As for the area of leaves per plant, the use of Acadian has led to a significant increase in this characteristic compared to the control treatment only at percentage increase of 35.94%. As for the effect of the application methods, the results of the this table show that the combination method (add to soil + foliar spraying) significantly exceeded the other methods of addition in the percentage of leaves content of total chlorophyll. While the number of leaves / plant significantly increased when using the foliar spraying method compared to soil application method only. There are no significant differences between the three-application methods on other studied vegetative growth traits. As for the effect of interaction between the extracts under study and

the application methods, the results indicate that the treatment of Acadian extract with the combination method (add to soil + foliar spraying) recorded the highest values in the percentage of leaves content of total chlorophyll reached (33.940) and differed significantly with the same treatment when using the soil application method and control treatment with soil and foliar application. As for the height of the plant, the results indicated that most of the two interaction factors were significantly overpass as compared to control with soil treatment and the highest value recorded in this characteristic (82.500 cm) was by using Acadian extract with foliar spraying method, thus this treatment significantly differed as compared to most other treatment. The effect of interaction between the extracts and the methods of addition in the effect on the number of leaves / plant behavior almost similar to the height of the plant in general the highest number of leaves in this interaction (21.663 leaves). The interaction between Garlic extract and all the application methods caused a significant increase in the percentage of dry matter in the leaves. So, the interaction of this interaction differed significantly only with the control treatment with all methods of its addition. The

Table 1. Effect of application methods of Garlic, Acadian extracts and interaction between them on the vegetative growth of summer squash.

Type of extract	Application methods	Chlorophyll (%)	Plant height (cm)	Leaves s number	Leaves s dry matter (%)	Leaves area (cm ²)
Control	Add to soil	28.150 b	62.737 e	16.493 d	12.933 b	2265.7 ab
	Foliar spray	28.730 b	69.987 cd	18.830 bc	15.20 ab	2076.5 b
	Add to soil+ Foliar spray	30.020 ab	65.830 de	16.830 d	14.693 ab	2511.3 ab
Acadian	Add to soil	29.010 b	67.160 de	17.660 cd	15.143 ab	2654.6 ab
	Foliar spray	29.857 ab	82.500 a	21.663 a	14.46 ab	3509.1 a
	Add to soil+ Foliar spray	33.940 a	79.553 ab	19.830 b	14.17 ab	3153.2 ab
Garlic	Add to soil	29.810 ab	79.000 ab	20.160 ab	16.44 a	2540.9 ab
	Foliar spray	29.667 ab	67.413 de	17.163 d	15.653 a	2770.1 ab
	Add to soil+ Foliar spray	31.363 ab	74.883 bc	20.163 ab	16.103 a	2705.6 ab
Mean effect of extract	Control	28.967 a	66.184 b	17.3844 b	14.276 b	2284.5 b
	Acadian	30.936 a	76.404 a	19.7178 a	14.591 b	3105.6 a
	Garlic	30.280 a	73.766 a	19.1622 a	16.066 a	2672.2 ab
Mean effect of Application methods	Add to soil	28.990 b	69.632 b	18.1044 b	14.839 a	2487.0 a
	Foliar spray	29.418 b	73.300 a	19.2189 a	15.104 a	2785.2 a
	Add to soil + Foliar spray	31.774 a	73.422 a	18.9411 ab	14.989 a	2790.0 a

Means followed by the same letter or letters within column are not significantly different according Duncan test at ($P < 0.05$)

interaction between Garlic extract and foliar spraying method showed the highest value in leaves area character reached ($3509.1 \text{ cm}^2 \cdot \text{plant}^{-1}$) and significantly differed as compared to control treatment only with foliar spraying.

The positive increase which is realized when using both Acadian and Garlic extracts in percentage of total chlorophyll content, significant increase in plant height and number of leaves will take place when using the same extracts. The percentage of dry matter was significantly increased in leaves when using Garlic extract and leaves area when using Acadian extract as compared to control treatment. It may be due to the fact that these extracts contain many major and minor nutrients and some trace elements, which increased the efficiency of photosynthesis in addition to containing plant extracts on auxins, gibberellins and amino acids, which leads to increased division and elongation of cells and their role in balancing the vital processes inside the plants. Shakir and AL-Rawi (2017) mentioned that Garlic extract has an amino acid content of Asparagin, Monosaccharide, Iron, Aluminum, Calcium, Magnesium, Cobalt, Zinc, Phosphorus and Sodium that play an important role in processing leaves with nutrients and hormones. Garlic extract has similar behavior to growth regulator (GA_3), which finally leads to improve vegetative growth characteristics. Significant differences in some vegetative traits may be explained by the addition method used in the study. The results showed that the application of combination method (add to soil + foliar spraying) significantly exceeded both foliar spraying method and soil addition method in percentage of total leaves content of chlorophyll. While the combination method and foliar spraying method were superior to soil addition in plant height, as well as significantly overpass of foliar spraying method was observed over soil addition method in number of leaves. This may be due to the integration of these two methods (add to soil + foliar spray) in increasing the plant water content and this may lead to continued growth and increase the efficiency of photosynthesis process and give more opportunity to increase the concentration of photosynthetic pigments, thus reflecting a significant increase in the percentage of the total chlorophyll in leaves and plant height. The significant increase in the application of foliar spraying as compared to soil application in both the plant height and the number of leaves may be explained by the efficient

and effective foliar feeding of the plant in order to speed up nutrient absorption of plant parts equally and reduce the use of large quantities of fertilizers (Brayan, 1999), and the most problems of fertilizers are due to the inadequate pH, where the 5.5 - 6.5 is more suitable for the readiness of most nutrients to grow vegetable crops, especially in Iraqi soils, which have a high content of salt and mud, which makes the nutrients low readiness for absorption by the plant (Mohammed, 2013). Therefore, the method of foliar spraying may have reduced the pH of the leaves to the appropriate level and thus created the optimum conditions for the absorption of nutrients needed by the plant, which was reflected in significant increases in plant height and number of leaves.

B. Yield indicators

The results of Table 2 shows the superiority of plants treated with Acadian and Garlic extracts significantly in each number of fruits per plant, yield per plant and total yield per unit area as compared to control treatment. Both extracts did not differ significantly between them in these characters and the highest significant values were ($9.50 \text{ fruit} \cdot \text{Plant}^{-1}$, $1.893 \text{ kg} \cdot \text{Plant}^{-1}$ and $47.324 \text{ ton} \cdot \text{Ha}^{-1}$) for each character respectively founded when using Acadian extract which significantly differed as compared to control plants only. While the plants treated with Acadian extract were significantly superior to the other treatments in the length of the fruit reached (17 cm). The highest value in the number of fruits (8.96 fruit). It was found significantly when using the method of combination (add to soil + foliar spray) which significantly differed only with the method of addition to soil, while significantly superiority of foliar spray method in fruit length as compared to the method of combination (add to soil + foliar spray) only, there was no significant effects in the average of fruits weight between all application methods. The plants treated with foliar spraying and combination method (add to soil + foliar spray) showed a significant increase in both plant yield and total yield per unit area as compared to soil application method. From the observation of the results of the interaction between the two study factors, it was discovered that the interaction treatment between the Acadian extract and the leaves spraying method and the interaction treatment between the Garlic extract and the combination method recorded the highest values in the average number of fruits of the plant (11.42 and 10.44 fruit) respectively

for each interaction both treatments did not differ significantly, while they differed significantly with most treatments of this interaction. As for the length of fruit, the results indicate that many of the interaction treatments between the extracts used and the different application methods were significantly superior as the comparison treatment in all the methods of application and the highest value recorded in this characteristic (17.42 cm) was when used Acadian extract with foliar spraying method thus this treatment significantly differed as compared to the interaction treatment between comparison plants with all methods of its application and interaction treatment between Garlic extract with foliar spray and combination methods (add to soil + foliar spraying). While the treatment of interaction between the comparison plants and the combination method recorded the highest significant value in the average weight of fruit reached ($0.258 \text{ kg.fruit}^{-1}$), which significantly differed with all treatments of this interaction except the interaction treatment between the extract of Acadian and the method of addition to soil. The interactions treatment between comparative plants by foliar spraying and combination method (add to soil + foliar spraying), and bilateral interactions between Acadian and garlic extracts with all the application methods cause significantly increases in both plant yield and total yield for unit area as compared with the treatment of binary interference between the comparison plants and the method of soil addition and the highest values obtained in these two characters were ($2.159 \text{ kg, plant}^{-1}$ and $53.972 \text{ ton. ha}^{-1}$), respectively, for each character when Acadian extract was interaction with foliar spraying method. As a result, this treatment is different with the same treatment by using the addition method of soil, the treatment of bilateral interference between Garlic extract, foliar spraying method and with comparison plants with all methods of its application.

The significant effect of Acadian and Garlic extracts in most of yield characters as compared to the comparative treatment may be explained by the hormonal regulation caused by these extracts, which pushes the plant towards the set of flowers and finally increasing the number of set fruits and production (Shafeek *et al.*, 2015). Plant extracts rich with nutrients that pushed plants to a strong growth in the vegetative as it is shown in Table 1, which led to the increase of the manufactured nutrients in the leaves during the process of photosynthesis and

transferred to the active growth areas in the plant. This will encourage the production of more flowers and increase the set ratio, thus reflecting the yield indicators. Al-Obaidi (2012) explained that plant extracts contain amino acids or salicylic acid, which play an important role in a plant hormone where it stimulates plant growth. It increases the absorption of nutrients and reduces them from the manufacturing to production areas and increases the photosynthesis process which ultimately stimulates the vegetative growth (Table 1) and the fruit of plants represented by increasing the number of fruits and the yield of one plant and the product per unit area. Plant extracts also contain calcium, which plays a major role in the formation of cell walls, especially the middle lamella (David, 2007). Also Garlic extract was characterized by its high content of gibberellin, which acts as a stimulation factor for flowering, as well as the extract of Acadian on the auxins which works to stimulate flowers. This is consistent with the increase of most of the yield indicators studied. The significantly overpass of combination method (add to soil + foliar spraying) in all the characteristics of the yield as compared to the method of addition to the soil except for the length of fruit and the weight of the fruit may be due to the fact that the air feeding in the leaves produced Carbohydrates and many other organic compounds. It is also accompanied by root nutrition which supplies the plant with mineral elements and both are the essence of plant life (Moalla *et al.*, 2015). The significant increase in the length of fruit / plant when using soil addition method as compared to the method of combination may be explained to the significant decrease in the number of fruits / plant caused by the soil application method. Perhaps this will cause a reduction in the number of fruits due to the lack of competition for fruit on manufactured food in the leaves and thus there is a significant increase in the length of fruits. The results of Table 2 showed that the spraying method was significantly overpass in both plant yield and total yield for unit area as compared with the soil application method, leaves nutritional superiority to root nutrition may be due to soil conditions, especially with regard to the pH. (Fernandez *et al.*, 2013). The Acadian and Garlic extracts resulted in a significant increase in both plant height and number of leaves. More effect varied between the extracts under study for the percentage of dry material in the leaves and the leaves area. Plants treated with Garlic extract showed the

Table 2. Effect of application methods of Garlic, Acadian extracts and interaction between them on the yield characters of summer squash.

Type of extract	Application methods	Fruits number (fruit.plant ⁻¹)	Fruit tall (cm)	Fruit weight (Kg. fruit ⁻¹)	Plant yield (Kg. plant ⁻¹)	Total yield (ton.ha ⁻¹)
Control	Add to soil	6.0833 c	15.460 c	0.18097 c	1.1022 d	27.556 d
	Foliar spray	8.1667 bc	15.7333 c	0.21897 bc	1.7639 b	44.097 b
	Add to soil + Foliar spray	6.8333 c	15.2667 c	0.25772 a	1.7322 bc	43.306 bc
Acadian	Add to soil	7.5000 c	17.36 a	0.22778 ab	1.6933 bc	42.333 bc
	Foliar spray	11.4167 a	17.42 a	0.18874 bc	2.1589 a	53.972 a
	Add to soil+ Foliar spray	9.6111 ab	16.22 a-c	0.18997 bc	1.8267 ab	45.667 ab
Garlic	Add to soil	9.7500 ab	17.110 ab	0.19645 bc	1.9217 ab	48.042 ab
	Foliar spray	6.9167 c	15.2200 c	0.20716 bc	1.4194 c	35.486 c
	Add to soil+ Foliar spray	10.4444 a	16.060 bc	0.18810 bc	1.9406 ab	47.521 ab
Mean effect of extract	Control	7.0278 b	15.4867 b	0.21922 a	1.53278 b	38.319 b
	Acadian	9.5093 a	17.000 a	0.20217 a	1.89296 a	47.324 a
	Garlic	9.0370 a	16.1300 b	0.19724 a	1.76056 a	44.014 a
Mean effect of Application methods	Add to soil	7.7778 b	16.643 a	0.20174 a	1.57241 b	39.310 b
	Foliar spray	8.8333 ab	16.1244 ab	0.20496 a	1.78074 a	44.519 a
	Add to soil+ Foliar spray	8.9630 a	15.8489 b	0.21193 a	1.83315 a	45.829 a

Means followed by the same letter or letters within column are not significantly different according Duncan test at (P<0.05)

most prominent effect on the percentage of dry material as compared to Acadian and control treatments. Whereas the treatment of Acadian extract had an effect in the leaves area compared to the control plants, indicating the feasibility of using both extracts in commercial production fields for summersquash. From this study, it can also concluded that the treatment of plants with both extracts when using both spraying method and combination method will cause positive increases in some characters and significant in other characters related to vegetative growth and yield. It is possible to rely upon these methods in the summer squash fields as compared to the soil application method.

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