Effect of foliar spraying with ascorbic acid and potassium fertilizer on the growth and Chemical Content of Green peas Plants (Pisum sativum L(.

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Abstract

The experiment was carried during the winter agricultural season 2022-2023 at the Agricultural Research Station affiliated to the College of Agriculture - University of Basra at the Karmat Ali site. To studying the effect of foliar feeding with different concentrations of ascorbic acid (0, 50, 100) mg L-1 and liquid potassium fertilizer with concentrations (0, 1.5, 3) ml L-1 and the interaction between them on the growth and quality of the pea plant yield. The results showed that spraying with ascorbic acid at a concentration of 50 mg L-1 significantly increased the number of leaves, leaf area, dry weights of the vegetative group (26 Leaves,261.8cm2,4.71gm) respectively, and significantly decreased the content of total chlorophyll and carotene in the leaves(7.93,0.138) mg100g-1weight fresh respectively. Spraying with liquid potassium fertilizer at a concentration of 1.5 ml L-1 showed a significant increase in the number of leaves, leaf area, and dry weight of the vegetative group (25.11Leaves,252.7cm2,4.82gm) respectively, while a concentration of 3 ml L-1 caused a significant increase in the content of total chlorophyll and carotene in the leaves (9.51,0.162) mg100g-1weight fresh respectively. The interaction between the two study factors showed a significant effect on most of the traits under study.

Keywords: Peas, foliar nutrition, ascorbic acid, potassium fertilizer, vegetative growth, photosynthetic pigments, percentage of total dissolved solids (T.S.S.(

Introduction

Green peas (Pisum sativum L.) are one of the important winter vegetable crops belonging to the legume family Fabaceae. Their green seeds are eaten either cooked or fried and frozen. They have a high nutritional value, as they are rich in protein, carbohydrates, and minerals including phosphorus, iron, magnesium, and vitamins including riboflavin, niacin, and thiamine (Hassan, 2002.(

It also has an important role in the agricultural cycle, as it contributes to fixing biological nitrogen and improving soil fertility (Davies et al., 1985). The cultivated area of it in Iraq for the year 2023 was estimated at about 12,000 dunums, with a total productivity of 18,000 tons and a productivity rate of 1,500 tons dunum-1 (Central Statistical Organization, 2024). One of the important means that contribute to increasing productivity is reducing the environmental and biological stresses to which plants are exposed by using antioxidants, including ascorbic acid (vitamin C) ; its chemical formula is C6 H8 O6. In addition, it works as an enzyme cofactor in the enzymatic reactions of carbohydrate and protein metabolism and is involved in the processes of respiration and photosynthesis (Robinson, 1973), and in stimulating cell division and elongation (Smirnoff and Wheeler, 2000.(

It plays an important role in controlling the flowering date and the onset of senescence (Barth et al., 2006) and works to increase the tolerance of plants to excessive salinity due to

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its role in protecting against reactive oxygen species that are formed during photosynthesis and respiration processes (Zhang, 2013). El-Saady and Rakha (2018) obtained that when pea plants were sprayed with different concentrations of ascorbic acid (0,100, 200, 400) mg L-1 twice, the first after 22 days and the second after 43 days from planting, the concentration of 400 mg L-1 caused a significant increase in plant length, fresh weight of the plant, number of leaves, leaf area, percentage of dry matter in leaves, leaf content of chlorophyll b, a and carotene, and percentage of total soluble solids in seeds TSS for both seasons of the experiment compared to the control treatment. Esmat et al (2018) reported that spraying pea plants grown under salt stress conditions with ascorbic acid at a concentration of 250 mg L-1 three times, the first after 20 days from planting and the other with an interval of 10 days, caused a significant increase in stem length, leaf area, fresh and dry weight of the vegetative group, and leaf content of chlorophyll b, a pigment. Carotene compared to the control treatment and for both seasons of the experiment. El-Sawy et al (2019) noted that spraying pea plants grown under sandy soil conditions with different concentrations of ascorbic acid (0,100, 150, 200) mg L-1 twice, the first after 30 days of planting and the second after 15 days of the first, gave a concentration of 200 mg L-1 a significant increase in plant length, number of leaves, fresh weight of the stem and leaves, dry weight of leaves, and leaf content of chlorophyll pigment spad compared to the control treatment and for both seasons of the experiment.

Ahmed and Taha (2023) indicated that spraying pea plants grown under high temperature conditions with ascorbic acid at a concentration of 5 mg L-1 once caused a significant increase in plant length, leaf area, fresh and dry weights of the plant, leaf content of chlorophyll pigment Spad and carotene, and the percentage of total sugars in the seeds compared to the control treatment for both seasons of the experiment. Foliar feeding of major nutrients is an important means of increasing plant productivity, especially when their addition to the soil is subject to sedimentation, fixation or competition (Abu Dahi and Al-Younes, 1988), including potassium, which has important physiological roles in the plant, such as photosynthesis, respiration and the transfer of carbohydrates from their manufacturing sites to the rest of the plant parts, due to its ability to activate many enzymes within the plant (krauss, 1993), reduce nitrates and form amino acids and proteins (Brito and Kronszcker 2008), and control the water content in plant cells due to its effective role in the process of opening and closing stomata and regulating osmotic potential (Fournier et al., 2005). Shaheen et al (2009) indicated that spraying pea plants with potassium sulphate fertilizer at a concentration of 1.5 ml L-1 twice or three times with an interval of ten days between each spray caused a significant increase in the fresh and dry weights of the plant and the percentage of total dissolved solids for both seasons and in the length of the plant and the number of leaves and branches for the second season only compared to spraying twice. Abdel Naby et al (2016) noted that when spraying pea plants with potassium salicylate fertilizer at a concentration of 2 ml L-1, it caused a significant increase in the length of the plant and the fresh and dry weights of the plant and the number of leaves and leaf area and the content of chlorophyll pigment Spad in the leaves for both seasons of the experiment compared to the control treatment. Ismail et al

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(2017) obtained that when spraying pea plants grown under salt stress conditions with three sources of potassium and three concentrations of each, which are potassium sulphate (1,2,4) g L-1 and potassium silicate (1,2,4) ml L-1 and potassium humate (1,2,4) ml L-1 in addition to the comparison treatment, potassium silicate fertilizer at a concentration of 4 ml L-1 gave a significant increase in plant length, number of leaves, fresh and dry weights of the plant, and leaf content of chlorophyll pigment Spad for both seasons of the experiment compared to the comparison treatment. Shafeek et al (2018) showed that spraying pea plants with potassium fertilizer Potassium thiousulfate at different concentrations (0,1,2) L feddan-1 led to a concentration of 2 L/feddan-1, a significant superiority in plant length, number of leaves, fresh and dry weights of the plant compared to the comparison treatment for both seasons of the experiment.

Ahmed and Taha (2023) indicated that spraying pea plants grown under high temperature conditions with potassium citrate at a concentration of 5 mg L-1 caused a significant increase in plant length, leaf area, fresh and dry weights of the plant, leaf content of chlorophyll pigment Spad, percentage of total sugars in seeds for both seasons of the experiment, and leaf content of carotene pigment in the first season only compared to the control treatment.

Due to the lack of studies under the saline conditions of Basra city on the effect of foliar spraying with ascorbic acid and liquid potassium fertilizer on the growth and quality of peas, this study was conducted.

Materials and Methods

The experiment was carried out in the fields of the Agricultural Research Station belonging to the College of Agriculture, University of Basra, in the Karmat Ali area during the agricultural season 2022-2023 in a sandy mixture soil (Table 1). The land was plowed perpendicularly, smoothed, leveled and fertilized with animal manure and decomposed cow waste at a rate of 40 tons per hectare-1 and divided into three holes with a length of 27 m and a distance of 80 cm between them. Syrian pea seeds were planted on 11/2/2022 using 3 seeds per hole and with a distance of 25 cm between one hole and another. After germination was complete, they were thinned to one plant(Hassan, 2002). Each hole was considered a single sector, and 9 foliar fertilization treatments were distributed randomly. The length of the experimental unit was 3 m, containing 12 plants. The experiment included two factors. The first factor included spraying with three concentrations of ascorbic acid, which are (0, 50, 100) mg L-1 (El-Sawy et al 2019), and the second factor was spraying with three concentrations of liquid potassium, which are (0, 1.5,3) ml L-1 (Shaheen et al 2009) so that the number of treatments becomes 9 factorial treatments, which are the interaction between three concentrations of foliar spray with ascorbic acid and three concentrations of liquid potassium, with three replicates, so the number of experimental units becomes 27 experimental units.

The spraying was done three times, the first one a month after full germination and with a two-week interval between each spray, with the addition of Tween 20 as a spreading agent. The following vegetative growth indicators were studied end the season: plant height (cm), number of leaves, fresh and dry weight of the vegetative mass (g), leaf area

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(dm2) according to the method described by (Weston and Weston, 1953). The total chlorophyll pigment in the green leaves was estimated according to the method described by (Goodwin, 1976) and the carotene pigment according to (Zaehrlnger et al, 1974). The percentage of total soluble solids in the seeds was also measured by placing them in a hand press, and then several drops of the juice were taken and placed in a Hand refractormeter. The means were compared according to the Least Significant Differences Test (L.S.D) at the probability level of 0.05 using the Genstatic statistical analysis system .
) Al-Rawi and Khalaf Allah, 2000.(

Table (1) some physical and chemical properties of field soil

Attribute		Value	Unit
Ph		7.7	
ECE		5.22	ds m-^{1}
Available Phosphorus		38.8	mg kg-^{1}
Total Nitrogen		0.23	g kg-^{1}
Ready Potassium		101.20	mg kg-^{1}
solube positive ions	Calcium	16.5	millimoles l-^{1}
	Magnesium	11	
	Sodium	21.3	
	Bicarbonates	13.6	
	Sulfates	18.5	
	Chlorides	28.0	
Soil separators	Sand	593	g kg^{-1}
	Silt	271.5	
	Clay	135.5	
Soil texture		sandy loam	

Results and Discussion

It is clear from Table (2) that the spraying treatments with ascorbic acid had a significant effect on the studied vegetative growth indicators except for plant length, as plants sprayed with ascorbic acid 50 mg L-1 were significantly superior in increasing the number of leaves and leaf area compared to the comparison treatment and spraying with a concentration of 100 mg L-1, with an increase rate of (13.04, 16.43) % for each of them and (7.03, 47.10) %, respectively. In turn, the concentration of 100 mg L-1 was significantly superior in the leaf area of the plant compared to the comparison treatment, with an increase rate of 37.72%. As for the fresh weight of the vegetative group, the spraying treatment with a concentration of 100 mg L-1 was significantly superior compared to the comparison treatment, with an increase rate of 12.86%, and neither treatment differed significantly compared to the spraying treatment with a concentration of 50 mg L-1. While the spraying treatment with a concentration of 50 mg L-1 was superior in increasing the dry weight of the vegetative group of the plant compared to the spraying treatment with a concentration of 100 mg L-1,

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with an increase rate of 12.94%, and neither treatment differed significantly from the comparison treatment.

The moral superiority of spraying with the appropriate concentration of ascorbic acid in the studied vegetative growth indicators may be attributed to its important physiological roles in stimulating active growth, as it enters as an enzyme companion in the enzymatic reactions of carbohydrate and protein metabolism and has an important role in the processes of photosynthesis and respiration (Robinson, 1973) and in stimulating cell division and elongation (Smirnoff and wheeler, 2000). These results are consistent with what was obtained by (El-saady and Rakha 2018, Esmat et al 2018, El-sawy et al 2019, Ahmed and Taha 2023 .(

Table (2). The effect of foliar spraying with ascorbic acid, liquid potassium fertilizer and their interaction on some vegetative growth indicators of pea plants

Treatments			Plant Height (cm)	Leaves Number (Leaf Plant^{-1})	Leaves area (cm^2)	Fresh weight of vegetative group (g)	Dry weight of vegetative group (g)
Average effect of ascorbic acid mg L^{-1}		0	43.8	22.33	177.6	27.99	4.40
		50	40.2	26.00	261.8	28.93	4.71
		100	40.9	23.00	244.6	31.59	4.17
LSD 0.05			N.S	1.97	14.4	3.06	0.43
Potassium Fertilizer Effect Extract ml L^{-1}		0	41.0	21.00	206.9	27.87	4.16
		1.5	42.7	25.11	252.7	30.22	2.82
		3.0	41.2	25.22	224.3	30.43	4.30
LSD 0.05			N.S	1.97	14.4	N.S	0.43
Effect of interaction between ascorbic acid and potassium fertilizer	0	0	50.5	21.00	114.0	22.99	4.69
		1.5	39.6	20.00	142.7	30.12	5.06
		3.0	41.3	26.00	276.0	30.86	3.44
	50	0	36.6	22.00	277.7	32.28	4.06
		1.5	45.0	30.00	327.0	28.57	5.98
		3.0	38.9	26.00	180.7	25.95	4.09
	100	0	35.9	20.00	229.0	28.34	3.73
		1.5	43.5	25.33	288.3	31.97	3.41
		3.0	43.2	23.67	216.3	34.47	5.38
LSD 0.05			N.S	3.41	25.0	5.31	0.75

The same table shows that spraying with potassium fertilizer had a significant effect on the leaf area and dry weight of the vegetative group, as the spray concentration of 1.5 ml L-1 was significantly superior compared to the comparison treatment and spraying with a concentration of 3 ml L-1 by an increase rate of (12.66, 22.13) % for each of them and (12.09, 15.65) %, respectively. In turn, the concentration of 3 ml L-1 was significantly superior in increasing the leaf area compared to the comparison treatment and by an increase rate of 8.40%. As for the total number of leaves, both spray concentrations of 1.5 and 3 ml L-1 were significantly superior compared to the comparison treatment and by an increase rate of (20.09, 19.57)%, respectively, and the two concentrations did not differ significantly between them.

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The spray concentrations did not show a significant effect on plant length and fresh weight of the plant's vegetative mass. The significant superiority in some vegetative growth indicators when spraying with potassium fertilizer may be due to the role of the active element potassium in many vital processes resulting from its active and stimulating effect on a large number of enzymes, including photosynthesis enzymes associated with the energy transfer process, in addition to its role in regulating osmotic potential, which helps improve and increase plant growth (Fournier et al., 2005). These results are consistent with what was obtained by (Abdel Naby et al., 2016, Ismail et al., 2017, Shafeek et al., 2018, Ahmed and Taha, 2023.(

The interaction between the two factors showed a significant effect on the vegetative growth indicators except for plant length. The plants sprayed with ascorbic acid 50 mg L-1 and potassium fertilizer at a concentration of 1.5 ml L-1 gave the highest values for the number of leaves, leaf area and dry weight of the vegetative group, which reached (30.0 leaves, 327.0 cm2, 5.98 g), respectively. The plants sprayed with ascorbic acid at a concentration of 100 mg L-1 and potassium fertilizer at a concentration of 3 ml L-1 gave the highest fresh weight of the vegetative group, which reached 34.47 g. The lowest values for the number of leaves, leaf area and fresh weight of the vegetative group were in the plants not sprayed with ascorbic acid and potassium fertilizer, which reached (21.0 leaves, 114.0 cm2, 22.99 g), respectively, while the lowest dry weight of the vegetative group was in the sprayed plants. With ascorbic acid at a concentration of 100 mg L-1 and with potassium fertilizer at a concentration of 1.5 ml L-1, it reached 3.41 g.

Table (3) shows that the two concentrations of ascorbic acid spraying 100.50 mg L-1 caused a significant decrease in the leaf content of total chlorophyll and carotene pigments, with a decrease rate of (16.40, 18.16) % for each and (19.42, 21.14) % for each compared to the control treatment, respectively, while the ascorbic acid spraying treatments did not have a significant effect on the percentage of total soluble solid materials in the seeds. The significant decrease in photosynthetic pigments when sprayed with ascorbic acid may be attributed to the inhibition process that occurs by the acid in the process of leaking basic electrons, and the reason for this leakage is the oxidation of the cell membrane (AbdEl-Hamid, 2009), which negatively affected the content of photosynthetic pigments in the leaves. This is contrary to what was mentioned by (Oertli, 1987) that ascorbic acid preserves chloroplasts from oxidation, and this result does not agree with what was obtained by (El-saady and Rakha 2018, Esmat et al 2018, El-sawy et al 2019, Ahmed and Taha 2023.(

An increase in them occurs when spraying with ascorbic acid. The same table shows that potassium fertilizer caused a significant increase in the

content of leaves of total chlorophyll and carotene pigments, as the spraying concentration of 3 ml L-1 gave a significant increase in them compared to the control treatment and spraying with a concentration of 1.5 ml L-1, with an increase rate of (19.77, 15.13)% for each of them and (12.5, 8.72)%, respectively, while the potassium fertilizer treatments did not significantly affect the percentage of total dissolved solids in the seeds. The moral superiority when spraying with the appropriate concentration of potassium fertilizer may be attributed to its

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effective role in stimulating and activating many enzymes, including photosynthetic pigment enzymes (Krause, 1993). These results are consistent with what was obtained by (Abdel Naby et al., 2016, Ismail et al., 2017, Shafeek et al., 2018, Ahmed and Taha, 2023.(

Table (3). The effect of foliar spraying with ascorbic acid, liquid potassium fertilizer and their interaction on in some qualitative characteristics of leaves and seeds

Treatments			Total chlorophyll in leaves mg100g^{-1}	Carotene in leaves mg 100g^{-1}L	TSS in seeds(%)
Average effect of ascorbic acid mg.L^{-1}		0	9.69	0.195	4.24
		50	7.93	0.138	4.77
		100	8.10	0.141	4.34
LSD 0.05			0.98	0.007	N.S
Potassium Fertilizer Effect Extract ml.L^{-1}		0	8.26	0.149	4.58
		1.5	7.94	0.144	4.50
		3.0	9.51	0.162	4.48
LSD 0.05			0.78	0.007	N.S
Effect of interaction between ascorbic acid and potassium fertilizer	0	0	9.14	0.158	4.77
		1.5	9.64	0.175	4.37
		3.0	10.28	0.191	3.60
	50	0	8.50	0.159	4.83
		1.5	7.19	0.129	4.50
		3.0	8.10	0.127	4.97
	100	0	7.15	0.130	4.13
		1.5	7.00	0.128	4.63
		3.0	10.14	0.166	4.87
LSD 0.05	1.36	0.012	N.S		

The interaction between the two study factors showed a significant effect on the leaf content of total chlorophyll and carotene pigments only, as plants not sprayed with ascorbic acid and sprayed with potassium fertilizer at a concentration of 3 ml L-1 gave the highest values for these two pigments, reaching (0.191, 10.28) mg 100 g-1 fresh weight, respectively, while the lowest total chlorophyll content in plants sprayed with ascorbic acid at a concentration of 100 mg L-1 and with potassium fertilizer at a concentration of 1.5 ml L-1 reached 7.0 mg 100 g-1 fresh weight, while the lowest carotene content in plants sprayed with ascorbic acid at a concentration of 50 mg L-1 and with potassium fertilizer at a concentration of 3 ml L-1 reached 0.127 g fresh weight.

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Conculotions

Can conclude from this study that in order to obtain good vegetative growth of pea plants grown under the conditions of Basra city, we spray with ascorbic acid at a concentration of 50 mg L-1 and with liquid potassium fertilizer at a concentration of 1.5 ml L-1.

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