Effect of pinching and foliar spraying with boron on vegetative growth and photosynthetic pigments of Cowpea plants cultivated in southern Iraq (*Vigna unguiculata* L.Walp)

Omar A. Ibrahim * and Abdulla A. Abdulla**
University of Basrah- College of Agriculture- Department of Horticulture and Landscape Design
uobasrah.edu.iq; Abdulla.abdulaziz@ uobasrah.edu.iq @omar.ibrahem

Abstract

The study was conducted at the Agricultural Research Station of the College of Agriculture, University of Basrah, in Karmat Ali area during the summer season of 2023 to study the effect of pinching at two different stages and foliar spraying with different concentrations of boron (0, 100, 200) mg L-1 and their interaction on vegetative growth and leaf content of total chlorophyll and carotene pigments for Cowpea plants. The results showed that the plants pinched at the stage of 5-6 true leaves were significantly excelled in the number of leaves, leaf area, and fresh and dry weights of the plant, while the plant length decreased when pinched at the stage of 3-4 true leaves. Pinching did not significantly affect the number of branches and the content of chlorophyll and carotene in the leaves. Foliar spraying with boron at both concentrations of 200 and 100 mg L-1 led to a significantly excelled in plant length and leaf area, while the concentration of 200 mg L-1 was significantly excelled in the fresh and dry weights of the plant. The interaction between the two study factors showed a significant effect on all studied traits.

Keywords: Cowpea, pinching, boron, vegetative growth, photosynthesis pigments.

Introduction

Cowpea Vigna unguiculata L. is a summer vegetable crop belonging to Fabaceae family. Its soft green pods or dry seeds are eaten with high nutritional value. Every 100 g of it contains 11 g of water, 61 g of carbohydrates, 22.5 g of protein, 1.4 g of fat, in addition to some minerals such as iron, calcium, phosphorus, and vitamins B3, B2, B1 and C (14). It also fixes atmospheric nitrogen through bacterial nodules, which increases soil fertility (15). The area planted with Cowpea in Iraq for the year 2020 is estimated at about 29,000 dunums with a total productivity of 46,200 tons and a productivity rate of 1,593 tons.dunum-1 (10). The decrease in production per unit area may be due to the failure to follow modern scientific techniques and methods and the failure to carry out some important, inexpensive and appropriate agricultural operations to increase the yield, including the pinching process as an important way to obtain a large vegetative growth of the plant. (4) noted that

pinching of local Cowpea plants above the third true leaf caused a significant decrease in plant height and a significant increase in the number of branches, leaf area and dry weight of the vegetative group compared to non-pinched plants for both spring and autumn seasons of the experiment. (16) obtained when pinching fenugreek plants Trigonella foenum-graecum after 25 or 35 days of planting in addition to the treatment of not pinching the top, the pinching treatments were significantly excelled in increasing the number of branches,

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fresh and dry weight of the plant and the chlorophyll content of the leaves, while it caused a significant decrease in plant height. (13) indicated that when pinching cowpea plants early after two weeks of elongation or late after four weeks of elongation, late pinching was significantly excelled in plant height, number of branches and leaves, fresh and dry weight of leaves compared to early pinching for both seasons of the experiment. (6) explained that pinching of broad bean plants Vicai faba caused a significant increase in the number of branches and leaf area, while it did not significantly affect plant height and leaf chlorophyll content. Foliar nutrition with boron is important in plant growth and increasing productivity, although the plant needs it in small quantities, but it has important physiological roles, including cell division and facilitating the movement and transfer of photosynthesis products from the leaves to the active areas in the plant (9). It also leads to reducing the water balance in plant cells and increasing the plant's efficiency in absorbing potassium (1). As an activator in the process of carbohydrate metabolism and protein assimilation (17) (11) noted that when spraying pea plants Pisum sativum with different concentrations of boron (0, 5, 10, 15) mg L-1, the concentration of 10 mg L-1 significantly excelled the plant length, number of branches and leaves, fresh weight of the plant, and leaf content of chlorophyll (Spad) for both seasons of the experiment compared to control treatment. (3) obtained that when spraying Cowpea plants with different concentrations of boron (0, 50, 100, 200) mg B L-1 in the form of boric acid (17% boron), the spray concentrations significantly excelled the number of leaves, leaf area, and dry weight of the vegetative group for both seasons of the experiment, spring and autumn, compared to control treatment. (7) indicated that spraying plants Faba bean with boron element at a concentration of 75 mg L-1 led to a significant increase in plant height, number of branches and leaves, leaf area of the plant, leaf content of chlorophyll (Spad) and percentage of dry matter in the leaves. Due to the lack of studies on the effect of pinching and foliar spraying with boron element on the growth of cowpea plant under the conditions of Basrah city, this study was conducted .

Materials and methods

The field experiment was conducted at the Agricultural Research Station of the College of Agriculture - University of Basrah, Karmat Ali site, on 1/5/2023. The planting was done after preparing and preparing the land. The experiment was conducted according experiments using a completely randomized block design. (R.C.B.D.). The experiment included two factors, the first factor included pinching at the stage of (0, 3-4, 5-6) true leaves and the second factor was foliar spraying with different concentrations of boron (0, 100, 200) mg L-1, so that the number of treatments became 9 factorial treatments, which are the interaction between three concentrations of pinching and three concentrations of spraying with boron and with three replicates, so the number of experimental units is 27 experimental units. The treatments began three weeks after planting and for three times and for a period of two weeks between one spray and another. The experimental measurements included the

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vegetative growth traits which included plant height, number of leaves, leaf area dm2 which were estimated according to the method described by (18), number of branches per plant, fresh and dry weight of the plant, , total chlorophyll pigment in green leaves mg 100 g1 fresh weight was estimated according to the method described by (12) and carotene mg 100 g-1 fresh weight, according to (19). `The averages of the results were analyzed statistically using the statistical program Genstat and the Least Significant Differences Test (L.S.D) was used to compare the averages at the probability level of 0.05, (5.(

Table (1): Some chemical and physical properties of the study soil

Traits		**Values**	**Units**
PH		**7.7**	
Electrical conductivity ECE		**5.22**	$Ds.m^{-1}$
	Available phosphorus	**38.3**	$g.kg^{-1}$
Total nitrogen		**23.0**	$g.kg^{-1}$
	Available potassium	**101.20**	$mg.kg^{-1}$
Calcium	dissolved positive ions	**16.5**	$mmol.L^{-1}$
Magnesium		**11**	
Sodium		**21.3**	
Bicarbonates		**13.6**	
Sulfates		**18.5**	
Chlorides		**28.0**	
Sand	**Soil separators**	**593**	$mg.kg^{-1}$
Silt		**271.5**	
Clay		**135.5**	
Texture		**Sandy loam**	

Results and discussion

It is clear from Table (2) that the process of without pinching had a significant effect on plant length, number of leaves and leaf area, as pinching at the stage of 3-4 true leaves caused a significant decrease in plant length compared to the treatment without pinching and pinching at the stage of 5-6 true leaves with a decrease rate of (29.44, 28.17)%, respectively, while pinching at the stage of 5-6 true leaves caused a significant increase in the number of leaves and leaf area compared to control treatment and at the stage of 3-4 true leaves with an increase rate of (14.33, 29.68)% and (24.03, 43.30)%, respectively, and the pinching treatments did not show a significant effect on the number of branches. The decrease in plant length as a result of early pinching of plants at the stage of 3-4 true leaves led to the stem stopping longitudinal growth, and this result is consistent with (4;16; 13) The increase in the number of leaves and leaf area at the pinching stage of 5-6 true leaves may be due to the formation of more nodes on the main stem and the renewal of novelty to encourage vegetative growth. This may be due to some changes in the balanced ratios between internal growth hormones responsible for growth activity and abundance, or the reason may be that the growing tip of the plant is primarily responsible for extending the period of youth and strong growth in the leaves and delaying their aging with an

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increase in the rate of photosynthesis (2). This result is consistent with (4; 13; 6).It appears from the same table that foliar spraying with boron caused a significant increase in plant length and leaf area, as both concentrations of 100 and 200 mg L-1 excelled their increase by an increase rate of (34.14, 33.98)% and (44.63, 56.32)%, respectively, compared to control treatment. Spraying with boron did not show a significant effect on the number of branches and leaves. The significantly excelled of the boron element in increasing plant length and

leaf area may be due to the effective role of boron in its effect on physiological processes in the plant, such as the absorption of nutrients, their movement and transfer to parts of the plant, and the regulation of the vital activities of enzymes, which gives a greater opportunity for plant growth and the transfer of materials manufactured for the products of photosynthesis to the effective growth areas, which will contribute to increasing cell division and elongation (8). These results were consistent with what was obtained by both researchers (11;7). The interaction between the two study factors also showed a significant effect on all the traits under study, as the plants pruned at the 5-6 true leaf stage and sprayed with boron at a concentration of 200 mg L-1 gave the highest values in plant length, number of branches, number of leaves and leaf area, reaching (206.7 cm, 6.0 plant-1, 47.0 plant-1and 68.68 dm2), respectively, while the plants at the 5-6 true leaf stage and not sprayed gave the lowest length, reaching 102.7 cm, while the plants pruned at the 3-4 true leaf stage and sprayed with boron at a concentration of 100 mg L-1 gave the lowest number of branches, reaching 2.0 branches, and the plants not pruned and sprayed with boron at a concentration of 200 mg L-1 gave the lowest number of leaves and leaf area, reaching (18.7 leaves and leaf area 21.3 dm2) respectively .

Table (2). The effect of the process pinching and spraying with boron and the interaction between them on the vegetative growth indicators of Cowpea plant.

Treatments			**Plant height (cm)**	**Number of branches**	**Number of leaves**	**Leaf area (dm^2)**
without pinching	**Average effect without pinching**		174.9	3.89	28.3	33.83
Pinching 3-4 node			123.4	3.00	32.1	29.28
Pinching 5-6 node			171.8	3.78	36.7	41.96
LSD 0.05			**30.0**	**N.S**	**4.5**	**5.15**
0	**Average effect of boron element $mg.L^{-1}$**		127.7	3.56	31.1	26.08
100			171.3	3.33	32.8	37.72
200			171.1	3.78	33.2	40.77
LSD 0.05			**30.0**	**N.S**	**N.S**	**5.13**
0	**without pinching**	**Interaction between**	141.3	4.00	28.7	26.83
100			198.3	5.33	37.7	53.36
200			185.0	2.33	18.7	21.30
0	**pinching**		139.0	4.00	38.7	31.37

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100	**3-4 node**	**pinching and boron spraying**	109.7	2.00	23.7	24.16
200			121.7	3.00	34.0	32.31
0	**pinching 5-6 node**		102.7	2.67	26.0	20.04
100			206.0	2.67	37.0	35.66
200			206.7	6.00	47.0	68.68
LSD 0.05			**52.0**	**1.65**	**19.7**	**8.89**

Table (3) shows that the process without pinching had a significant effect on the fresh and dry weight of the plant, as both treatments, pinching at the stage of 3-4 and 5-6 true leaves, caused a significant increase for both traits, with an increase rate of (28.31, 26.16)% and (28.83, 25.82)%, respectively, compared to non-pinched plants .

The pinching process did not significantly affect the content of chlorophyll and carotene in the leaves. The significantly excelled of the pinching process in the fresh and dry weights may be due to the abundance of vegetative growth of the pinched plants (Table 2). These results are consistent with (4; 16; 13 (

The same table shows that foliar spraying with boron had a significant effect on the fresh and dry weights of the plant. The high concentration of 200 mg L-1 caused a significant increase in both traits compared to the control treatment and the concentration of 100 mg L-1, with an increase rate of (75.71, 45.94)% in the fresh weight of the plant and (70.75, 23.50)% in the dry weight, while spraying did not have a significant effect on the chlorophyll and carotene pigments .

The significantly excelled of spraying with the appropriate concentration of boron 200 mg L-1 in increasing the fresh and dry weights of the plant may be due to its role in encouraging vegetative growth (Table 2). This result is consistent with (11; 3; 7 .(

The interaction between the two study factors also showed a significant effect on all the traits under study, as the plants pruned at the stage of 5-6 true leaves and sprayed with boron at a concentration of 200 mg L-1 gave the highest fresh and dry weights, reaching (71.97, 429.7) g, respectively .

The unpruned plants and those sprayed with boron at a concentration of 100 mg L-1 gave the highest total chlorophyll content, reaching 9.81 mg 100 g-1 fresh weight, while the plants pruned at the stage of 5-6 true leaves and unsprayed plants had the highest carotene content in the leaves, reaching 0.1779 mg 100 g-1 fresh weight, while the pinched plants at the 5-6 true leaves stage and sprayed with boron at a concentration of 100 mg L-1 gave the lowest fresh and dry weight of the plant, reaching 28.27, 120.7 g, respectively, and the non-pinched and unsprayed plants gave the lowest content of chlorophyll and carotene pigments, reaching (0.1336, 7.28) mg 100 g-1 fresh weight, respectively.

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Table (3). The effect of the process of pinching and spraying with boron and their interaction on fresh and dry weight and concentration of chlorophyll and carotene

Treatments			Fresh weight of plant (g)	Dry weight of plant (g)	Total chlorophyll in leaves mg $100g^{-1}$	Carotene in leaves mg $100g^{-1}$
without pinching	**Average effect without pinching**		180.8	33.50	8.67	0.1588
pinching 3-4 node			228.1	42.15	8.30	0.1543
pinching 5-6 node			232.0	43.66	9.15	0.1689
LSD 0.05			**33.6**	**3.10**	**N.S**	**N.S**
0	**Average effect of boron element mg.L^{-1}**		194.8	40.33	8.50	0.1578
100			161.8	29.17	8.93	0.1681
200			284.3	49.81	8.69	0.1561
LSD 0.05			**33.6**	**3.10**	**N.S**	**N.S**
0	**without pinching**	**Interaction between pinching and boron spraying**	181.7	37.93	7.28	0.1336
100			203.7	30.98	9.81	0.1697
200			157.0	31.59	8.92	0.1731
0	**pinching 3-4 node**		257.0	52.75	8.51	0.1620
100			161.0	28.28	8.64	0.1670
200			266.3	45.86	7.76	0.1338
0	**pinching 5-6 node**		145.7	30.75	9.71	0.1779
100			120.7	28.27	8.34	0.1675
200			429.7	71.97	9.39	0.1614
LSD 0.05			**58.2**	**5.37**	**1.47**	**0.0225**

Conclusions and recommendations

We conclude from this study that in order to encourage the vegetative growth of Cowpea plants grown in Basrah city, it is necessary to carry out the process of without pinching at the 5-6 true leaves stage and spray them with boron at a concentration of 200 mg L-1 .

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