

The effect of foliar spraying with the amino acid arginine on some vegetative and yield for cowpea plant *Vigna unguiculatal* L. exposed to salt stress

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Abstract

The experiment was conducted using pots according to the completely random design method (RCBD) during the agricultural season 2022-2023 to study the effect of spraying with arginine and at concentrations (0.50.100) ml.gm.Liter-1 and irrigating with saltine NaCl and in concentrations (0.5.10.15) ds.m-1 On some vegetative and yield of cowpea plants. The results showed a significant decrease in the mean of plant height, number of leaves and leaf area and economy yield and biological yield with Harvest index .when irrigating plants with a solution NaCl, especially the concentration of 15 ds.m-1, when spraying plants with arginine, there was a significant increase in plant height, number of leaves and leaf area and economy yield and biological yield with Harvest index in concertation (100mg .L-1) ,while salinity or arginine had no significant effect on stem diameter, and the interaction between the two experimental factors had a significant effect on most of the studied traits.

Keywords: *Vinga unguicualta* L., Arginine, salt stress, foliar spraying.

INTRODUCTION

Cowpea is a leguminous crop belonging to the legume family Fabaceae, which are of important nutritional and economic importance, as they contain many essential elements, including iron, sodium, potassium and zinc. As well as containing fiber and folic acid (Heuze et al. 2015).

Cowpea cultivation spreads in most parts of the African continent and part of Asia. If it is considered a basic food crop represented by its green pods or dry seeds, or it is added as fertilizer to the soil or green fodder for animals, in addition to its role in maintaining the integrity of the sensory organs, including the nervous, digestive and circulatory systems,

regulating blood sugar and skin safety(El-Shaieny et.al.2015).

The amino acid arginine is one of the amino acids rich in nitrogen, carbon and oxygen. It is built from the amino acid ornithine in the presence of the enzyme ornithine transcarbamylase, which is one of the free amino acids and is important in providing enzymes and proteins that stimulate the vegetative and root growth of the plant (Winter et.al. 2015). This acid also reduces the effect of stress by decreasing the water stress of the cell and increasing its ability to withdraw water and nutrients from the growth medium and then increase the vegetative growth rate (Xia et.al. 2014).

Arginine has a role in improving the efficiency of the process of photosynthesis and root formation and stimulating the process of cell division because it affects the process of synthesis of hormones for growth, flowering and fruiting inside the plant by stimulating the defense mechanism of antioxidants (Conceicao et.al.2021). That salt stress a specific effect on the growth and productivity of crops by irrigating plants with saline water or as a result of the accumulation of salts from the soil for long periods as a result of natural processes (Abd El-Wahab.2006). The problem of salinity is increasing in many tropical, semi-tropical and Mediterranean regions (Crillo et.al.2016). Salts have an effect on plant growth and productivity because they increase the conditions of oxidative stress in the presence of free roots formed inside plant cells in addition to the effect of these salts on the internal level of the plant by hormones and internal growth regulators, which negatively affects the vegetative growth rate of the plant, its dry mass rate and leaf area, which leads to low economic yield and poor product quality (Taffauo et.al. 2010).

Materials and working methods

The experiment was conducted for the agricultural season 2022-2023 According to the Randomized Complete Block Design (RBCD) as an integrated experiment (4X3) and with three replications; the experiment included the following factors:

- 1- Four concentrations of solution NaCl and they are (0,5, 10,15) ds.m⁻¹ or its equivalent in mol-l which is (0,50,100,150) mol -l
- 2- Three concentrations of arginine (0,50,100) mg. Liter -l

The experiment consisted of three replicates and each replicate contained 12 pots if the number of pots in Experience 36 pots.

Cowpea seeds were sown on 15/3/2022 and at an average of three lines And that for cultivation and with four holes, the depth of one hole reached 2 cm if the potting soil was analyzed before planting in the central laboratory subordinate College of Agricultural Engineering Sciences. University of Baghdad to know some of its chemical and physical properties Table1.

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

Adjective	The value
Phosphorous	5.50ppm
Nitrogen	60 ppm
Potassium	180ppm
Electrical conductivity(EC)	2.25 ds.m ⁻¹
soil ratio	mixture – clay
PH	7.6

When the plant reaches the stage 3-4 papers dated 4/5/2022 were sprayed With the amino acid arginine by hand sprayer and in the early

morning by taking 1g of this acid and dissolve it in a small amount of distilled water, then complete the volume 1000 ml with distilled water, then the arginine concentrations were prepared according to the dilution law $C1V1 = C2V2$

As for the saline solution NaCl the plant were irrigated with it after 10 days of spraying them with the amino acid arginine, on 15/4/2022. It was prepared by preparing a stock solution of this salt at a concentration of 1 molar, from which the saline concentrations were prepared according to the law of dilution, and the perfusion process for plants continued on a regular basis.

studied traits

as explained below:

Vegetative traits : The vegetative traits of plants were measured on the date 1/6/2022 are as follows:

A- Plant Height (cm): Height was measured for three random plants and then averaged.

B- Number of leaves (leaf. plant-1): The number of leaves for three random plants was calculated and then according to the average.

C- Stem diameter (mm): The stem diameter of three random plants was calculated using Vernier device then by average.

D- Leaf area (cm²): The leaf area of three random plants was calculated according to the method mentioned by him Abu- El- Zahab et al. (1980) by taking a certain number of vegetable tablets after drying them and calculating their weight dry and then calculate the leaf area according to the following equation:

$$\text{Leaf area} = \frac{\text{dry weight of leaves} \times \text{known disk space}}{\text{dry weight of tablets}}$$

E- Economy yield (gm .plant-1)

Seed weights were recorded for three random plants and then averaged.

F- biological yield(gm. Plant -1)

The total dry weight of three random plants was recorded and then averaged..

G- Harvest index % : According to the following equation:

$$\text{Harvest index \%} = \frac{\text{Economy yield}}{\text{biological yield}} \times 100$$

statistical analysis

The studied traits were statistically analyzed according to the randomized complete block design method(RCBD) and comparing the significant differences between the arithmetic means using the least significant difference between the means and at the probability level of 0.05 (SAS.2012).

Results and discussion

Table results indicated (2) to the presence of a decrease moral The average height of the plant when treated with a solution NaCl, in particular, concentrates 15 ds.m⁻¹, which was given the lowest average for the trait amounted to 21.22 cm compared to the control, which amounted to 25.78 cm, with a percentage decrease of 17.68%, as salinity worked on affecting the energy needed for the physiological activities of the plant and inhibiting the process of cellular expansion in addition to its effect on the chemistry of the cell wall and increasing the osmosis of the soil, which negatively affects the ability of Plant uptake of nutrients needed for its growth (Yadav et al. 2020; Gandahie et al. 2009). This is in line with Al Saadi (2019). on the mung bean.

The treatment of the plant with arginine led to a significant increase in the average of this trait, especially the concentration 100 mg.L⁻¹, which gave the highest mean of the characteristic, was 22.67 cm compared to the control, which was 18.00 cm, with a percentage increase of . 25.94% The active role of arginine in Providing protection for cellular organelles from the negative effects that the plant is exposed to by the action of salt particles by increasing the internal plant content of nutrients, including nitrogen, which is necessary in building proteins and enzymes.

stimulating for vegetative growth, which leads to an increase in the number of cell divisions of the plant and thus its expansion((Wang etal. 2012. This is consistent with what Al-Hamdani and Muhammad reached (2014) on the potato plant. Also, the interaction had a significant effect on the average of this trait if the concentration was given zero ds.m⁻¹ from NaCl and 100 mg.l⁻¹ of arginine had the highest mean of 29.67cm compared to the lowest mean of 18.00cm at a concentration of 15dsm⁻¹ of NaCl and zero mg.l⁻¹ of arginine.

Table (2): Effect of foliar spraying with arginine on the average height characteristic cm plant Cowpea exposed to salt stress.

Sodium chloride average	Arginine concentrations mg.L ⁻¹			
	100	50	0	Concentrations sodium chlorideds.m ⁻¹
25.78	29.67	28.33	19.33	0
22.22	24.00	23.67	19	5
21.89	24.67	22.33	18.67	10
21.22	22.67	23.00	18	15
	25.25	24.33	18.75	average arginine
overlap =2.07		arginine =1.04	Sodium chloride =2.07	LSD (0.05)

Table(3) results indicated to exist a decrease in the mean number of leaves

when treating the plant with NaCl, especially concentration 15 ds.m⁻¹ which gave the lowest average 8.00 sheets. Plant -1 . Compared to the

control, which was 10.00 sheets. Plant -1 With a percentage decrease of 20% due to the negative effect of salinity on the photosynthesis process and the formation of the chlorophyll molecule, and thus the effect on the efficiency of the plant in absorbing the necessary nutrients

necessary for its growth and developments(The Sahockey and Al-Khafaji.2014). Also, the salt ions work on Energizing Some plant growth inhibitor stimulating for hydrolyzing enzymes for cellulosic materials quality it is found in plant cell walls, including abscisic acid and ethylene(El-sabagh etal. 2015). The table also indicated that there was a significant increase in the average of this trait when treating the plant with arginine, especially the concentration 100 mg.L⁻¹, which gave the highest mean for the trait, was

9.58 leaves. plant -1 Compared to control and extreme 8.17 sheets. Plant-1 with a stomatal

increase of 17.25%, and this is due to the role of amino acids in increasing the efficiency of the photosynthesis process and the formation of the chlorophyll molecule because it is an important source for the plant's supply of nitrogen, which reduces the negative effects of salinity on the physiological processes of the plant and increases the number of cell divisions of the plant, reflecting positively on Its vegetative characteristics, including the number of leaves (Winter etal. 2015). An interaction between the two factors of the experiment had no significant effect on the average of this trait.

Table (3): Effect of foliar spraying with arginine on the average number of leaves (plants . leaf-1) for cowpea plants exposed to salt stress.

Sodium chloride average	Arginine concentrations mg.L ⁻¹			Concentrations sodium chlorides.m ⁻¹
	100	50	0	
	10.00	9.33	8.67	
10.00	11.00	10.33	8.67	0
9.33	10.00	9.33	8.67	5
8.67	9.00	9.00	8.00	10
8.00	8.33	8.33	7.33	15
	9.58	9.25	8.17	average arginine
overlap =2.07		arginine =0.65	Sodium chloride =2.07	LSD (0.05)

Table results indicated(4) to the absence of a significant effect on the mean of the characteristic of the diameter of the stem and treat the plant with a solution NaCl and arginine, and the interaction between the two

experimental factors did not have any significant effect

Table (4): Effect of foliar spraying with arginine on average stem diameter (mm) for cowpea exposed for salt stress

Sodium chloride average	Arginine concentrations mg.L ⁻¹			
	100	50	0	Concentrations sodium chlorideds.m ⁻¹
	0	50	100	
0.378	0.400	0.400	0.333	0
0.367	0.400	0.367	0.333	5
0.333	0.333	0.300	0.367	10
0.322	0.367	0.333	0.267	15
	0.367	0.350	0.325	average arginine
overlap=NS	arginine=NS		Sodium chloride=NS	LSD (0.05)

Table 5 results indicated indicates a significant decrease in the average leaf area characteristic when treating the plant with NaCl, especially the concentration of 15 d sm-1, which gave the lowest average for the trait reached 47.01cm² compared to control and extreme 72.02 cm², with a percentage decrease of 34.72%, and this is due to an increase Activate The absorption of the necessary nutrients from the soil due to the negative conditions formed by the salt stress inside the plant, especially on the osmosis of the soil solution, in addition to the effect of salinity on the rate of cell division and the composition of cell membranes (increasing their permeability) and thus a reduction in the size of cells (Dhookie et al. 2013). Salt ions increase oxidative activity in the presence of free roots, thus affecting Chlorophyll tints and on the production of plant growth hormones Than It leads to a reduction in the elongation of cells and their numbers to become of a small leaf area (Belmecheri-cherif et al. 2019). This is

consistent with what Al-Karimawi said (2019) on the wheat plant. The table also shows a significant increase in this trait when treated with arginine, especially the concentration 100 mg. L⁻¹ which gave highest average for the adjective reached 68.09cm² compared to the control of 34.94cm², with a percentage increase of 94.87% for the positive role to Amino acids, including arginine, provide the energy needed for photosynthesis, as it is a rich source of nitrogen. As well as its role in providing protection for the cellular parts of the ion Na⁺ and Cl⁻ through discouraged absorbing them and thus activating vital processes in the plant, including cell division, increasing their numbers, and delaying their aging (Xia et al. 2014).

Also, the interference had a significant effect if the concentration was given zero ds.m⁻¹ of NaCl and 100 mg. L⁻¹ of arginine had the highest average of 85.96cm² compared to the lowest average of 28.88 cm² at a concentration

of 5 ds.m⁻¹ of NaCl and (0) mg. 1 liter of arginine.

Table (5): Foliar spray effect arginine on average leaf area characteristic (cm²) for cowpea plant exposed to salt stress.

Sodium chloride average				
	Arginine concentrations mg.L ⁻¹			Concentrations sodium chlorides.m ⁻¹
	100	50	0	
72.02	85.96	85.45	46.65	0
47.94	51.17	63.77	28.88	5
47.48	56.11	44.51	32.82	10
47.01	70.13	39.47	31.42	15
	68.09	57.80	34.94	average arginine
Overlap= 6.18		Arginine=3.09	Sodium chloride=3.57	LSD (0.05)

Table 6 results indicated a significant decrease in the average economic yield characteristic when treating the plant with NaCl, especially the concentration of 15 d sm⁻¹, which gave the lowest average for the trait reached 10.27 gm.plant⁻¹ with a percentage decrease of 10.38 % for salt effect on plant physiology characteristics and the ability for absorption of hormones because of the free root inside the plant which effect on increases the production of plant yield (wang et al., 2018 , Mohamed and al-ubaody ,202). and this is consistent with what was stated with Al-Saadi (2019) brought on the mung plant. The table also indicated that there was a significant increase in the average of this trait when

treating the plant with arginine, especially the concentration (100 mg.L⁻¹, which gave the highest mean for the trait, was 11.22) gm .plant⁻¹ with a percentage increase of 5.55 % because arginine is one of the amino acids that prepare the plant with the necessary elements for its growth, including the important nitrogen element in increasing Activating vital processes and increasing the growth of roots and their absorption of nutrients, which is reflected positively in plant growth and increasing its yield. Hassan et al. 2010; Koota ,2011; Conceicao et al. ,2021) . The interference has a significant effect on this characteristic if the concentration is given zero ds.m⁻¹ from NaCl and 100 mg.L⁻¹ of arginine

were higher than the average, reaching 12.11 9.74 (gm. plant ⁻¹) when concentration 15 (gm. plant-1), while the lowest average was ds.m-1 NaCl and 0 mg. L-1 from arginine.

Table (6): Effect of foliar spraying with arginine on average Economic yield (cm.plant-1) for cowpea exposed for salt stress

Sodium chloride average				
	Arginine concentrations mg.L ⁻¹			Concentrations sodium chlorideds.m ⁻¹
	100	50	0	
11.46	12.11	11.08	11.20	0
10.92	11.24	10.41	11.12	5
10.70	10.90	10.75	10.47	10
10.27	10.64	10.45	9.47	15
	11.22	10.67	10.63	average arginine
Overlap= 1.20		Arginine=0.60	Sodium chloride=0.69	LSD (0.05)

Table 7 results indicated a significant decrease in the average economic yield characteristic when treating the plant with NaCl, especially the concentration of 15 d sm-1, which gave the lowest average for the trait reached 19.20 gm.plant-1 with a percentage decrease of 9.09% for salt effect on plant physiology characteristics due to the oxidation environments inside the plant which effect on increases the production for anti-oxidative enzymes and un –enzyme's which lead to decreases from the vegetative and root system and therefore the plant activity for absorption of the element Absorb the nutrients needed for growth and development of plant and that has negatively effect on his biological yield

(Munns. 2002; Gumi et al., 2013; Al-harby et al., 2018). Also the treatment with arginine lead to significant increase in the average yield of these plant in particular concentrate 100 mg.L-1, which gave the highest average of 21.01 (gm.plant-1) With a percentage increase of 11.69% because arginine plays an important role in activating also the plant treatment with arginine lead to significant increase with the (100ml.L-1) reach to 56.55% with increase value in percentage 9.59% for his role in organized plant growth Synthesis of growth hormones and improvement of the photosynthesis system (Al-joboori and mohammed. 2021) Also, the interference has a significant effect reach to highest value with

58.82% if it is given concentration 0 ds.m⁻¹ of NaCl concentration and 100 mg. L⁻¹ from arginine, the highest interference of 49.79% at zero ds.m⁻¹ from NaCl and 100 mg. 1 liter of arginine, the

Table (7): Effect of foliar spraying with arginine on average biological yield (gm.plant⁻¹) for cowpea exposed for salt stress

Sodium chloride average				
	Arginine concentrations mg.L ⁻¹			
	100	50	0	Concentrations sodium chlorides.m ⁻¹
21.12	22.47	21.77	19.12	0
20.29	20.97	20.93	19.51	5
19.91	20.60	20.40	18.74	10
19.20	20.03	19.70	17.87	15
	21.01	20.70	18.81	average arginine
Overlap= 1.21		Arginine=0.60	Sodium chloride=0.69	LSD (0.05)

The results of Table (8) showed that there was a significant decrease in the Harvest index when the plant was treated with NaCl, especially the concentration 15 ds.m⁻¹, which gave the less value 53.48% for the character amounting to 1.85% for effect of salinity on the defense mechanism of plant and growth also the oxidative hormones and on the Oxidation and reduction processes and bio-metabolism and produces the power element and internal content from element . (Al-desuquy et al., 2012; singh and dwivedi, 2018; zaki and Mohamed, 2018). Also When treating the plant with arginine lead to The treatment of the plant with

arginine led to a significant increase in the concentration 100ml.l⁻¹

Reach to 56.55% with a percentage increase of 9.59% for his part in organized the plant growth and synthesis of growth hormones' and modification of photosynthesis system (Al-joboori and Mohammad, 2021). if the concentration was given zero ds.m⁻¹ from NaCl and 100 mg.l⁻¹ of arginine had the highest mean of 58.82% compared to the lowest mean of 49.75% at a concentration of 15ds.m⁻¹ of NaCl and zero mg.l⁻¹ of arginine.

Table (8): effect of foliar spraying with arginine on the average Harvest index characteristic % plant Cowpea exposed to salt stress.

Sodium chloride average	Arginine concentrations mg.L ⁻¹			Concentrations sodium chlorides.m ⁻¹
	100	50	0	
54.49	58.82	53.83	50.83	0
53.85	55.90	52.92	52.75	5
53.54	54.45	53.09	53.10	10
53.48	57.05	53.66	49.75	15
	56.55	53.37	51.60	average arginine
overlap =6.25		arginine =3.12	Sodium chloride =3.61	LSD (0.05)

Recommendations

In view of the study, we suggest the following:

- 1- Not exposing plants to high salt concentrations because it affects most of the vegetative and yeild characteristics of the plant.(concentration higher than15 ds.m-1).
- 2- The use of foliar sprays with amino acids, including arginine for it positive role and effective in improving most of the vegetative and yield characteristics of the plant, which increases the plant's defense mechanism against stressful conditions.
- 3- Using other methods of treating plants with arginine, such as soaking seeds.

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