Mesopotamia Environmental Journal
ISSN 2410-2598
Mesop. environ. j. 2015, Vol.1, No.4:67-74.

Effect of some treatments on alleviating of environmental stress on growth and yield of squash (*Cucurbitta pepo* L.)

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To cite this article:

Jasim, A. H., Alryahii, I.; Abed, H. M. and Badry, A. N. Estimation Effect of some treatments on alleviating of environmental stress on growth and yield of squash (cucurbittapepo L.). *Mesop. environ. j.*, 2015, Vol. 1, No.4, pp. 67-74.

Abstract

An experiment was conducted during 2013-2014 growth seasons at the field of Agric. Coll., Babylon Univ., Iraq. , to study the effect of polyoxal (as poly hydro carboxylic applied on soil, i.e. 2 mg/l at the rate of 1L.m^{-1}) and its interaction with foliar application of humic acid, organic (N and Fe) and salicylic acid 0.5 mM at 4 and 6 leaf stages as well as control on alleviating soil salt stress on growth and yield of squash . Randomized complete block design with three replications was used. The results showed that : Adding polyoxal to the soil caused a significant increases in leaf number , leaf chlorophyll content , fruit yield and leaf content percentage of Nand P. Foliar application treatments caused a significant increase in leaves number per plants , chlorophyll content and N percentage compared to control but it had no significant effect on leaf P percentage. Humic acid had a significant effect on fruit yield.plant^{-1}. The interaction had a significant effect on the studied parameters and polyoxal with humic acid was the best.

Keywords; squash, salt stress, leaf mineral percentage, humic acid, organic fertilizers.

Introduction

Squash (Cucurbitapepo L.) is an important vegetable crops belongs to cucurbitaceae family. It is rich in niacin and medium in riboflavin and ascorbic acid. Squash plants is moderate tolerance to soil salt, and its threshold was 4.9 dS/m[1]. Salinity is an environmental factors which limit plant growth and productivity. Some researchers estimated that about 33% of world's cultivated land is affected by salinity[2]. The reclamation of salt affected soil physical, chemical and biological properties. Humic acid (HA) are the most partof the (bio) chemical degradation of plant and animal residues and from microbial synthetic activity and it constitute a significant fraction of the soil organic matter[3].[4] reported that humic acid application positively affected the parameters of plant grown in salinity condition . The HA distribution decreased soil Na, EC and pH likely due to high supplies of Ca, Mg and K. These mineral elements kept the cation-exchange sites on soil particles, minimizing adsorption of Na, so enhancing Na leaching losses during precipitation events [5].

Calcium (Ca++) act as a key nutrient which displace sodium (Na+) and other salts that are attached to soil exchange sites. This process act in "flushing" salts out of the plant root zone through the profile of the soil. "Flushing" salts opens soils and allow water and oxygen penetrate and enhance nutrient availability. Organic acids improves the availability of calcium which act as buffers pH.

Nitrogen is an important plant nutrient for crop growth and production. Nitrogen stimulates root growth and plant development as well as the uptake of the other nutrients. The concept of plant organic N nutrition relies, to a large degree, on studies of amino acids. Soil solution may contain a vast array of organic nitrogen compounds, free amino acids generally only account for a small fraction of this pool [6, 7].Iron (Fe) is an essential nutrient for plant growth. It is required for the formation of chlorophyll and it is necessary for the proper functioning of many plant enzyme systems . Under neutral or alkaline conditions, iron changes into insoluble forms and becomes unavailable for uptake and utilization by the plants . Salicylic acid application has reported to enhance plant tolerance to many abiotic stress [8]. SA alters some plants physiological functions [9,10,11,12,13]. These functions may work as a key role in enhancing plants tolerance to salt stress .

Materials and methods

Field experiment was conducted in Babylon Univ. , Agri. Coll. Field during the growing seasons 2013–2014, to study the effect of foliar application of some treatments (control, humic acid, organic N and Fe and salicylic acid)) and it`s interactions with polyoxalto alleviate the injury of soil salt stress on squash planted in sandy loam soil with pH 7.7 and salinity 10.1 dS.m-1. Squash seeds were germinated at 3/10/2013, after 25 days, seedlings were planted on lines 1.25 m apart and 40 cm between plants with drip irrigation under unheated plastic house. DAP (di-ammonium phosphate) at the rate of 200 kg/ha was added as soil dressing. Factorial experiment within (RCBD) in three replications was adopted. The experimental unit included 12 plants on 1 line (4.8 meters long).Two levels of polyoxal(as poly hydro carboxylic) was applied to the soil (i.e. 2 mg/l) at 4 and 6 leaf stages at the rate of 1L.m-1. Foliar application treatments of : control (spraying distil water),humic acid, organic (N and Fe)and salicylic acid 0.5 m M(as foliar application at 4 and 6 leaf stage). The data were recorded (as mean of 10 plants in each experimental unit) during the growing stage , which included leaf numbers, chlorophyll content, plant yield , Nitrogen and phosphorous content . The data were analyzed and the means were compared according to least significant difference (LSD0.05).

Results and discussions

The results (table 1) showed that polyoxal caused a significant increase in leaf number (74) compared to control (68.3) . Spraying humic acid and salicylic acid caused a significant increase in leaf number compared to control . Application of polyoxal to salty soil , and spraying humic acid were superior significantly in increasing leaves number.plant^{-1} . The interaction had a significant effect , in which application of polyoxal and spraying humic acid or salicylic acid were superior (78 and 76 respectively) compared to control (65). These results were in accordance with the findings of [14]on cotton plants and [15] who reported greater number of leaves in gladiolus with humic acid and putrescence which might be due to improvement of macro and micro nutrient uptake, and reduction in water evaporation from the soil . [16]reported that Humic acid raised leaf number in garlic . These results can support by those of [17,18], they reported that potassium humate had a beneficial effects on plant nutrient uptake and was important for transport the availability of micro-nutrients which were needed for optimal plant growth and development .

Table 1: effect of polyoxal and spraying of some treatments on leaves number in squash

Foliar spraying / polyoxal	Control	Humic acid	Organic N and Fe	Salicylic acid	Average of polyoxal
Without Polyoxal	**65**	**73**	**67**	**68**	**68.3**
Polyoxaladdition	**69**	**78**	**73**	**76**	**74.0**
spraying treatment mean	**67.0**	**75.5**	**70.0**	**72.0**	
$LSD_{0.05}$	**Interaction=4.28 , spraying treat.=3.03 , polyoxal=2.14**				

Table 2 showed that polyoxal caused a significant increase in chlorophyll content (49.9) compared to control (45.2) . Spraying humic acid , organic N and Fe and salicylic acid caused a significant increase in chl. content. Polyoxal application orhumic acid spraying (as individual treatment) were superior significantly compared to control and other spraying treatments. The interaction had a significant effect , and reached the maximum at humic acid interaction with polyoxal (50.8). [19] indicated that foliar spraying of humic acid on asparagus plants increasing the uptake of macro and micro nutrients which caused increasing in chlorophyll. This may due to the effect of humic aid in increasing cell membrane permeability, which promoting greater efficiency in nutrient absorption , especially nitrogen (which is direct relation with leaf chlorophyll concentration), [20]. Nitrogen is a structural element of chlorophyll and protein molecules ,and there by affects the formation of chloroplasts and accumulation of chlorophyll in them [21] . Organic Fe increased chlorophyll content. Iron is reduced to ferrous form at the root surface if necessary and transported to the leaf through the xylem in a combined form. In the leaf it is used in chlorophyll formation as well as the functioning of various iron-containing enzymes[22]. Nitrogen application affected leaf growth by increasing plant leaf area and , it influences on photosynthesis. Photosynthetic proteins represent a large proportion to total leaf N [23, 24].Foliar application of salicylic acid mitigated the reduction in chlorophyll content in salinity condition . The interaction of polyoxal with all treatments had a significant effect on chlorophyll content. This results were in agreement with the findings of earlier researchers that the reduction in leaf chlorophyll contents by salt stress were alleviated by the foliar application of SA in mung bean [25, 26] .

Table 2 : effect of polyoxal and some spraying treatments on chlorophyll leaf content (spad)

Spraying treatments / polyoxal	Control	Humic acid	Organic N and Fe	Salicylic acid spray	Average ofpolyoxal
Without polyoxal	**40.0**	**49.5**	**45.2**	**46.1**	**45.2**
polyoxal addition	**47.4**	**50.8**	**49.1**	**49.3**	**49.9**
spraying treatments mean	**43.7**	**50.2**	**47.2**	**47.7**	
$LSD_{0.05}$	**Interaction =4.08 , spraying treat. =2.88 , polyoxal=2.04**				

Table 3 showed that polyoxal caused significant increase in plant yield (3.051) compared to control (2.623) . Spraying humic acid and organic N and Fe significantly increased plant yield (3.056 and 2.909 , kg respectively) compared with control (2.559 kg). The interaction had significant effect on plant yield , and polyoxal with humic acid or organic N and Fe were superior (3.150 and 3.206 , kg respectively) compared to control (2.347 kg) . The results were agreed with[27] who reported that the addition of humic acid produced higher marigold yield ,and [28] who found that HA enhanced lettuce yield by stimulating N metabolism and photosynthetic activity , which act in increasing yield . [29] reported that ,application both of chemical fertilizer and humic substances enhance growth and yield of cowpea.

Table 3 : effect of polyoxal and some spraying treatments on squash yield ($kg.plant^{-1}$)

Spraying treatments / polyoxal	Control	humic acid	Organic N and Fe	Salicylic acid spray	Average ofpolyoxal
Without polyoxal	**2.347**	**2.961**	**2.611**	**2.578**	**2.623**
polyoxal addition	**2.770**	**3.150**	**3.206**	**3.078**	**3.051**
spraying treatments mean	**2.559**	**3.056**	**2.909**	**2.828**	
$LSD_{0.05}$	**Interaction =0.424 , spraying treat. =0.292, polyoxal=0.212**				

Table 4 showed that polyoxal had a significant effect in increasing leaf N percentage (3.35) compared to control (2.97) . Spraying humic acid , organic N and Fe and SA caused significant increase in N content(3.49, 3.81 and 2.83 respectively) compared to control (2.51). The interaction caused a significant increase in leaf N percentage ,and the interaction of polyoxal with humic acid or organic N and Fe were superior (3.84 and 4.04) compared to control (2.42) .The presence of nitrogen in excess enhance groth of the Arial plant part with abundant dark green (high chlorophyll) tissues , our data showed raising in chlorophyll content in accordance with nitrogen increasing in leaves by spraying polyoxal , organic N_2 and Fe and humic acid . [30] reported that Fe deficiency caused a decrease in shoot Nin shoots and roots . [31, 32]reported that humic acid improve nutrient uptake especially of N and P . Humic acid contain auxin- like activity , enhanced root growth which helped nutrient uptake and caused a significant increase in N content and enhanced dry matter production [33]. The effect of SA could be attributed to an increase in CO_2 assimilation and photosynthetic rate and increase plant mineral uptake under stress [34, 35].Salicylicacidincreasedcontentsofchlorophyll,totalnon-structuralcarbohydrateandtotalnitrogen, aswellas nitrate assimilation through the induction of nitrate reductase activity in isolated cucumber cotyledons [36]. The ameliorative effects of SA have been well documented in inducing salt tolerance in many crops [37, 38, 39]

Table 4 : effect of polyoxal and some spraying treatments on N content in squash leaves

Spraying treatments / polyoxal	Control	Humic acid	Organic N and Fe	Salicylic acid	Average of polyoxal
Without polyoxal	**2.42**	**3.14**	**3.57**	**2.74**	**2.97**
polyoxal addition	**2.59**	**3.84**	**4.04**	**2.91**	**3.35**
Average of spraying mean	**2.51**	**3.49**	**3.81**	**2.83**	
$LSD_{0.05}$	**Interaction=0.402 , spraying treat.= 0.248 , polyoxal=0.201**				

Table 5 showed that polyoxal had a significant effect in increasing leaf P percentage (0.420) compared to control (0.397). This was due to polyoxal rolling in reducing the adverse effect of salt stress in all growth parameters and this belongs to its structure , especially for organic matter and organic acids which act as balance of charges formed during the extensive metabolism of anions such as nitrate (NO3) and in modulating adaptation to the environment . Organic acids play important roles in nutrient soluble and restricting the passage of toxic metals across the root and attracting beneficial microorganisms. Often the excretion of organic molecules (e.g. phenolic , organic acids , and sugars) increases in response to soil stress . The CaO in polyoxal act as a key nutrient and displace Sodium (Na+) and other salts that are attached to soil exchange sites. This process is the key to "flushing" salts out of the plant root zonethrough the soil profile . "Flushing" salts resulting in opens soils and allows water and oxygen to penetrate and improving nutrient availability. Organic acids improves calcium availability which buffers pH.Foliar application treatments had no significant increase in phosphorus amount . This result in different with [40] who pointed that the application of humic acid during salinity stress increased the uptake of P , on the other hand [14, 41] reported that the percentage of the element P where slightly increased as a result of foliar application of humic acid under salinity .

Table 5 : effect of polyoxal and some spraying treatments on P content in squash leaves

Spraying treatments / polyoxal	Control	humic acid	Organic N and Fe	Salicylic acid spray	Average of polyoxal
Without polyoxal	**0.371**	**0.401**	**0.399**	**0.418**	**0.397**
polyoxal addition	**0.418**	**0.440**	**0.424**	**0.399**	**0.420**
spraying treatments mean	**0.395**	**0.421**	**0.412**	**0.409**	
$LSD_{0.05}$	**Interaction=0.0404 , spraying treat.=0.02854 , polyoxal= 0.0202**				

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