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RESPONSE OF TWO CULTIVARS OF OKRA *ABELMOSCHUS ESCULENTUS* (L.) MOENCH TO SPRAYING WITH AMINO ACIDS ON SOME GROWTH AND YIELD PARAMETERS

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Abstract

The experiment was carried out in a private field in the Najaf Governorate, Kufa District for the 2019 growing season to study the response of two okra *Abelmoschus esculentus* (L.) Moench cultivars, Hussainawiya the local and Clemson from Turkeya newly adopted cultivar, to foliar spray with amino acids (AA) at 0, 2 or 4 ml.L^{-1} and to evaluate the effect of AA on plant vegetative growth and yield. The plants were sprayed twice during the growing season, at 45 and 60 days post planting. The experiment was developed as a split-plot with three replicates based on Randomized Complete Blocks Design (R.C.B.D.). Okra cultivars were placed in the main-plots and the AA concentrations were in the sub-plots. Plant growth parameters and yield characters including plant height, stem diameter, number of leaf.plant^{-1}, leaf content of total chlorophyll, number of pod.plant^{-1}, pod weight and total yield were compared among treatments and cultivars according to the least significant difference (L.S.D.) at $P \leq 0.05$.Results showed that the local cultivar Hussainawiya in general was better than cultivar Clemson in all the evaluated growth and yield parameters. Although the local cultivar resulted in higher values of growth and yield parameters, Clemson Turkey was more affected by AA treatment concentration than local Hussainawia. All the studied parameters of Clemson okra, except stem diameter and total chlorophyll, had much higher percent increase due to AA than Hussainawia. AA at 2 and 4 ml.L^{-1} increased yield over the untreated control plants of both cultivars by 10.79% and 26.56% for the local Hussainawia and 27.2% and 46.6% for the Turkish Clemson.
***Keywords*:** Cultivars, Amino Acids, Okra.

Introduction

Okra (*Abelmoschus esculentus* L. Moench) in the Malvaceae family, is an important summer vegetable crop in Iraq. Central Africa, Ethiopia, Eritrea, Sudan and Egypt are considered to be okra origins from which okra moved to the Mediterranean aria, Arab and India and lately became more common vegetable in USA, Canada, Australia and many other countries (Matloub *et al*., 1989). Okra pods are quit nutritional containing phosphorus, calcium, carbohydrates, proteins and vitamin C (Genome and Al-Halabi, 2005). It can be eaten fresh as a salad or cooked either steamed or stewed and can be canned as well. Okra extract (Gel) from stems and roots is used in industry to purify sugarcane juice or in the soap production. Boiling okra flowers is believed to have medicinal effects as analgesics and moisturizers for by suria syndrome (Chakravarty, 1970). In order to meet the need for increasing domestic consumption, it is necessary to investigate effective methods to increase the production of this crop, especially through the introduction of high-yielding varieties. It was found in a study by Al-Jubouri (2006) that there are significant differences between two okra cultivars, Husainawia and an Indian cultivar where the local Husainawia had higher values of all the vegetative growth traits than the Indian one. Al-Moussaoui (2013) compared two okra cultivars Hussainawia and Btera for their yield characters and showed that Hussainawia plants gave higher averages in number of pods/plant and pod weight than the Btera plants.

Amino acids have an important role in may biological processes, whether they exist in a free from or as a component of proteins, so their importance lies in all stages of plant growth and development as well as making plants more resistant to withstanding some environmental stresses (Hayat *et al*., 2007).

Therefore, this experiment was conducted to demonstrate the effect of amino acids spraying with the best concentration of two okra cultivars, one of which is local cultivated in Najaf and the other is Clemson from Turkey cultivated for the first time in the region and comparing their response to foliar spray with amino acids in terms of plant growth parameters and yield characters.

Materials and Methods

The experiment was conducted during the summer growing season of 2019 in a private field in the province of Najaf, Kufa District in. Ten soil samples were randomly taken from the field soil before planting, mixed thoroughly and one representative 250 g sample was taken for chemical and physical analysis in the laboratory of soil chemistry at the Faculty of Agriculture, University of Kufa (Table 1).

Table 1 : Physical and chemical characteristics of the experiment greenhouse soil

pH	E.C. dS.m^{-1}	% Organic Matter	Clay	Silt	Sand	Soil texture
			g.Kg^{-1}			
7.20	7.5	1.2	230	190	580	Sandy loam

The soil of the field was prepared (tilled, softened and settled) and divided into three 10 x 50 m lines with 75 cm apart from each other. At rate of 200Kg.ha^{-1} (Al-Obaidi, 1980), fertilizer NPK (5:18:18) was added and buried by banding in a slit along with each planting line. Drip lines were applied on both sides of each planting line. Okra seeds were water soaked for 24h and 3-4 seeds were planted in holes 30 cm apart. Seedlings then were thinned to one plant in each hole. All the crop services and practices were performed as followed in the growing area (Matloub *et al*., 1989). The experiment was split-plot on Randomized Complete Blocks Design (R.C.B.D.) with three replicates. The main-plot was two okra cultivars (local cultivar Hussainawia and Clemson from Turkey) while the sub-plot was AA at three concentration levels (0, 2 and 4 ml.L^{-1}). Plants were sprayed with SA according to each treatment at 40 and 55 day post planting. Each experimental unit was 1.13m^2 with 9 plants each.

Measurements and statistical analysis

At the end of the experiment (15/8/2019), vegetative growth parameters including plant height (cm), stem diameter (cm), number of leaf.plant^{-1}, leaf content of total chlorophyll (mg. 100g^{-1} F.W.) which was measured in the fully expanded fifth true leaf under the apical leaf the taken six randomly selected plants using acetone extraction method and spectrophotometer at wave length frequency of 645 and 663 calculated according to (Goodwin, 1976) based on the following equation:

Total Chlorophyll =

$$= 20.2 \times D\,(645) + 8.02 \times D\,(663) \times \frac{V}{W \times 1000} \times 100$$

While, yield characters included number of pod.plant^{-1}, pod weight and total yield tons.ha^{-1}. Data were statistically analyzed and analysis of variance was performed using the GenStat (12th Edition) statistical computing system. Differences among means were compared based on the Least Significant Test (L.S.D.) at a 0.05 probability level.

Results and Discussion

Results showed that plant vegetative growth indicators were affected by plant cultivar and treatment (Table 2). In case of plant cultivar, the local Hussainawia, regardless of treatment, had always higher values for growth parameters than the Turkey Clemson in all the treatments including the control. Relative to AA treatments, the highest concentration of foliar application resulted in the highest values of all the measured growth parameters for both okra cultivars (Table 1). The highest values were always recorded in the 4 ml.L^{-1} of AA regardless okra cultivar. Interaction of cultivar and amino acids spray concentration indicate significant effects on vegetative growth rate, plant height, stem diameter, number of leaves and leaf content of total chlorophyll, which significantly differed from the control plants of both tested cultivars. Similarly to vegetative growth indicators, the results showed that interaction okra cultivar and spraying with AA had also significant effect on yield characters. Interaction of Hussainawia and 4 ml.L^{-1} AA resulted in the highest number of pods.plant^{-1} (49.82), pod weight (4.22 g) and total yield (3.05 tons.ha^{-1}) compared to 35.14, 3.57 and 2.41 from untreated control plants, while same AA treatment with Clemson resulted in 34.26 pod.plant^{-1}, 4 g and 2.80 tons.ha^{-1} compared it corresponding control that resulted in 21.11, 2.95 and 1.91, respectively. However, Clemson Turkey was more affected by AA treatment concentration than local Hussainawia. All the studied parameters of Clemson okra, except stem diameter and total chlorophyll, had much higher percent increase due to AA than Hussainawia (Fig. 1). Over the control, number of pods.plant^{-1}, pod weight and total yield at 4 ml.L^{-1} AA were increased in Clemson by 63%, 35% and 46% (Fig. 2) compared lower increase that of 41%, 18% and 26% in local Hussainawia, respectively (Fig. 1). Our findings showed that different okra cultivar performed differently.

Table 2 : Effect of foliar spray with amino acids AA on growth parameters and yield characters of two okra *Abelmoschus esculentus* (L.) Moench cultivars

Growth and yield parameters	Local cultivar Hussainawia				Clemson from Turkey				L.S.D. (*P≤0.05*) Cultivars
	AA concentration levels			Average	AA concentration levels			Average	
	Control	2 ml.L^{-1}	4 ml.L^{-1}		Control	2 ml.L^{-1}	4 ml.L^{-1}		
Plant height (cm)	92.12	95.32	100.19	95.87	82.37	86.85	91.59	86.93	2.50
Stem diameter (cm)	19.28	20.95	22.79	21.00	16.11	17.27	18.43	17.27	0.39
No. of leaf.plant^{-1}	22.25	25.47	28.88	25.53	19.16	23.54	26.41	23.03	2.11
Total chlorophyll	29.18	32.49	36.26	32.64	24.51	26.68	28.26	26.48	1.02
No. pods.plant^{-1}	35.14	44.71	49.82	43.22	21.11	28.55	34.26	27.97	3.35
Pod weight (g)	3.75	3.88	4.22	3.89	2.95	3.61	4.00	3.52	0.42
Total yield tons.ha^{-1}	2.41	2.67	3.05	2.71	1.91	2.43	2.80	2.38	0.11
Average	29.13571	32.21286	35.03		24.01714	26.99	29.39286		
L.S.D. (*P≤0.05*) AA Concentration	Plant height=3.12, Stem dia. = 0.53, No. leaf.plant^{-1}= 2.41, Total chlorophyll= 1.10, No. pod.plant^{-1}= 3.67, Pod weight= 0.20 and total yield= 0.16								
L.S.D. (*P≤0.05*) Interaction	Plant height=3.44, Stem dia. = 0.71, No. leaf.plant^{-1}= 2.79, Total chlorophyll= 1.22, No. pod.plant^{-1}= 3.81, Pod weight= 0.23 and total yield= 0.19								

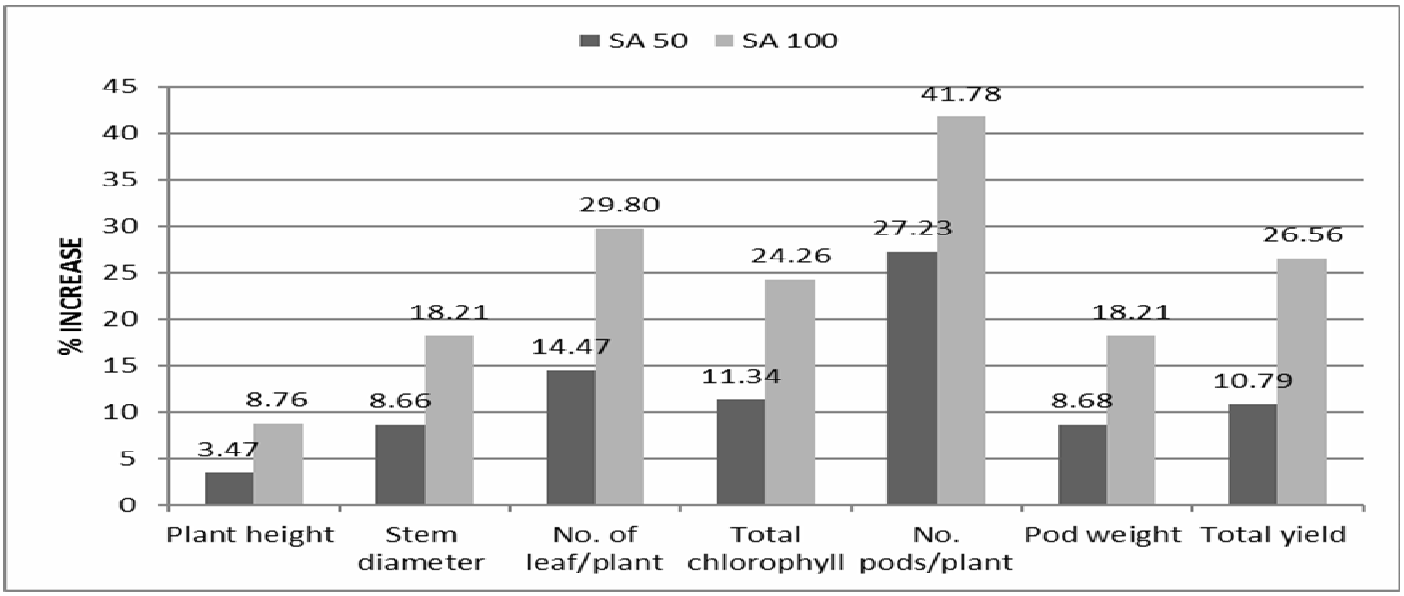

Fig. 1 : Effect of amino acids spray on growth parameters and yield characters measured by percent increase over the control in local okra Hassainawia

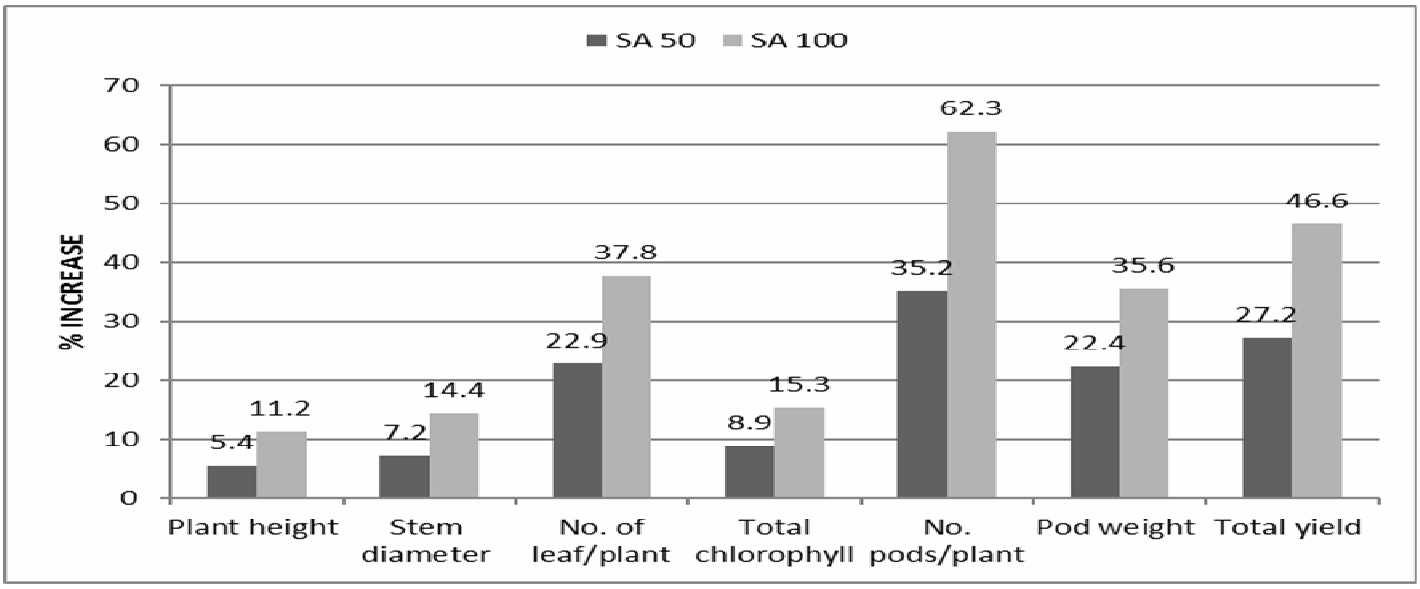

Fig. 2 : Effect of amino acids spray on growth parameters and yield characters measured by percent increase over the control in okra cultivar Clemson from Turkey

This may be due to genetic differences between the two cultivars (Al-Moussaoui, 2013) beside the higher level of adaptation of the local cultivar to the environmental conditions of the region compared to the Turkish cultivar agreeing with findings of previous study (Al-Jubouri, 2006). This study also showed that plant growth indicators were increased due to AA treatments. This is mostly attributed to amino acids roles in increasing plant content of auxins and cytokines which are responsible of increasing cell division of cells in the root apical meristem (Hayat *et al*., 2007). Such increase in root growth will be reflected positively on plant height and number of leaves and thus carbohydrates synthesis resulting in stem diameter increase agreeing with findings by Jaafar *et al*. (2013) in their study on eggplants. It was also found in this study that yield characters and components were increased in both cultivars due to AA treatments. AA compounds were reported to have positive effects and roles in increasing the photosynthesis products and resulting in a surplus in plant content of sugars that available to promote plant floral growth. This will lead to total increase in number of flowers and thus fruits per plant (Hayat *et al*., 2007). Moreover, abundance in plant content of carbohydrates will defiantly increase their storage in plant pods (fruits) resulting in heavier pod weights (Jabbarzadeh *et al*., 2009) which in turn will be reflected in total yield increase (Abdullah, 2010).

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