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Role of Humic Acid and Amino Acids in Increasing Growth and Productivity of Mungbean Varieties Grown under Newly Reclaimed Soil

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Abstract: Two field experiments were conducted for evaluation the response of three mungbean varieties (Turkish, Uzbekistan and Local) to four foliar spraying (Water, Humic acid, Amino acids and mix of humic and amino acids) were used to observe the growth and productivity of mungbean. Turkish variety produced the highest plant height (52.4 cm) in the first season, no. of pods plant^{-1} (64.94 and 60.54), plant yield (16.22 and 14.28 g), seed yield (1083.3 and 948.2 kg ha^{-1}) and protein yield (241.16 and 213.42 kg ha^{-1}) in both seasons. Foliar application of mix increased plant height, no. of seeds pod^{-1} and protein were52.6 cm, 9.60 and 23.96%, respectively, in the second season. No. of branches plant^{-1} (10.4 and 10.4) no. of pods plant^{-1} (67.4 and 56.2), plant yield (17.7 and 14.04 g), seed yield (kg ha^{-1} (1187.1 and 935.3 kg ha^{-1}) and protein yield (272.54 and 205.01 kg ha^{-1}) in both seasons. The highest values of growth and productivity were obtained when the interaction between Turkish variety and foliar spraying with the mix.

***Keywords*:** Foliar Spraying, Seed yield, Protein percentage

Mung bean (*Vigna radiate* L. Wilczek) is a summer pulse crop with short life spane70-90 days (Abdul Qados 2010), and it can be grown in light soils having marginal fertility and low moisture content (Jan et al 2000). It plays an important role in improving the soil fertility by fixing atmospheric nitrogen into available form with the help of rhizobial species present in the nodes of its roots apart from its role in human diet (Bhuiyan et al 2008). In arid and semi-arid areas, about 20 to 30 million ha of irrigated land are currently seriously damaged by salinity (FAO 2000). Under the environmental conditions of saline soils cultivation of salt tolerant cultivar and alleviation of saline stress are very important for mungbean production. Rahman et al (2016) reported the differences among mungbean genotypes were tested in three salinity levels. There are usually three main methods of applying micronutrients to crops: soil fertilization, foliar sprays and seed treatment. Foliar application of micro-nutrients are effective (humic acid) is a vital constituent and an intimate part of soil organic structure and contains 4% to 6% nitrogen, 51 to 57%,carbon and 0.2% to 1% phosphorus and other micronutrients (Waqas et al 2014). On the other hand, humic acid is an organically charged bio-stimulant that significantly affects plant growth and crop yield (Nardi et al 2004). The increased growth and yield are also observed in mungbean due to humic acid application, including (Waqas et al 2014, Kalyoncu et al 2017). El-Ghamry et al (2009) indicated that, foliar application of humic acid up to 2000 ppm as significantly increased plant growth represented as plant height and no. of branches of faba bean as compared with untreated control plants. Amino acids are participatory in the compilation of other organic compounds, such as alkaloids, amines, enzymes, vitamins and protein (Ibrahim et al 2010). Concerning to the advantageous belongings foliar spraying of amino acids, many investigator have observed that, the valuable effects of amino acids to improved growth and yield for all crops. Spraying mungbean varieties with amino acid (arginine) could alleviate the harmful effect of salinity at all studied parameters (Abdul Qados 2010). Tryptophan at 50 mg l^{-1} was significantly superior number of tillers, number of spikes, weight of 1000 grains and grain yield in the two seasons, respectively (Baqir and Al-Naqeeb 2019).The aim of this study was to evaluate the effect of spraying with the humic acid and amino acids to improvement of growth and productivity of mungbean varieties, grown under the conditions of newly reclaimed soil.

MATERIAL AND METHODS

Field experiments were conducted at al-Mijar al-kabeer district, Missan, Iraq, during the autumn season of 2015-2017 in split plot in RCBD design with three replicates. Experiment included thirty six experimental unit comprising three mungbean varieties and four foliar spraying. The main plots included the following mungbean varieties *i.e.* Turkish, Uzbekistanand Local. The sub-plots were devoted for four foliar spraying treatments *i.e.* water (control treatment), humicacid @ 5 ml Actosol liter^{-1} water, amino @ 5 ml Amino-

Catliter^{-1} waterand the mixture of Actosol and Amino-Catat with rates 2.5 + 2.5 mlliter^{-1} water in each spraying thrice after 30, 45 and 60 days from sowing.

Cultural practices: Prior to the start of experiment, soil samples were taken from the experiment sites and analyzed for their physical and chemical properties (Piper 1950, Black 1965). The experimental field was well prepared through two ploughings, compaction, then divided into the experimental units, each unit divided into plots for each one was 3 × 4.5m and occupying an area of 15.75 m^2. Each plot divided into four rows, the distance between rows was50 cm. Seeds were sown in rows spaced at 20 cm.Urea 40 kg ha^{-1} (46% N), calcium super phosphate 43 kg ha^{-1}(15.5% P) and potassium sulphate43 kg ha^{-1} (48% K) were applied during soil preparation (after ploughing and division). Seed of mungbean varieties were sown during the last week of July in both seasons (Altai 2014). At harvesting, ten plants were randomly selected from each plot and following traits were studied; plant height, no. of branches, no. of pod plants^{-1}, no. of seeds pod^{-1}, 100 seed weight (g) and plant yield. Seed yield was calculated by harvesting whole plants in each plot and air dried, then threshed and the seeds at 15% moisture were weighted in kg ha^{-1}. The concentrations of nitrogen in seeds were determined by micro-Kjeldahl and wet digestion in a 2:1 nitric-perchloric acid mixture followed by turbidity measurement, respectively. The crude protein content in seeds was estimated by applying the factor N x 6.25 to the seed nitrogen content and was expressed as a percentage of the dried seeds (Bremner and Keeney 1966, Page et al 1982). Protein yield was calculated on the basis of protein percentage and seed yield.

RESULTS AND DISCUSSION

The Turkish and Uzbekistan varieties had a significant effect on plant height without significant differences between

Table 1. Physical and chemical soil analyses of the experimental sites in 1st and 2nd seasons

Soil analyses	Sand (%)	Silt (%)	Clay (%)	Soil texture class	pH	E.C. (dS m^{-1})	Organic matter (%)	Available (ppm)		
								N	P	K
2015/2016	40.70	34.20	30.10	Clay loam	8.00	5.41	4.10	17.20	8.11	140
2016/2017	41.12	33.60	31.28	Clay loam	7.43	6.62	3.42	15.65	7.75	141

Soil Water Analysis Institute, Mansoura Lab., Agricultural Research Center, Egypt

Table 2. Analysis of variation for the studied traits in 1st season

S.O.V	df.	Plant height (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Plant yield (g)	Seed yield (kg ha^{-1})	Protein (%)	Protein yield (kg ha^{-1})
Block	2	2.35	0.5260	113.912	0.0653	0.02436	5.9761	27440.	0.775	1.317
Varieties	2	200.98**	4.2296^{ns}	2891.944**	0.8095**	0.12528*	151.0583**	714527.**	0.314^{ns}	3.517**
Error	4	10.46	1.6159	1315.630	0.0966	0.02821	1.0228	4523.	3.092	7.583
Spraying	3	8.14^{ns}	6.9680**	109.583**	0.1267^{ns}	0.04433^{ns}	111.5748**	519279**	10.632^{ns}	3.360**
Variety* spraying	6	148.30**	2.3871**	109.583**	0.0863^{ns}	0.03249^{ns}	9.3585**	42343.**	5.921^{ns}	1.997 **
Error	18	14.53	0.5955	5.388	0.1593	0.03295	0.7876	3589.	4.672	4.914
Total	35									

**Significant at 0.01 level, *Significant at 0.05 level and ns: Non significant

Table3. Analysis of variation for the studied traits in 2nd season

S.O.V	df.	Plant height (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Plant yield (g)	Seed yield (kg ha^{-1})	Protein (%)	Protein yield (kg ha^{-1})
Block	2	39.04	3.2072	91.721	0.18594	0.00063	5.4688	25325.	2.545	1.547
Varieties	2	72.28^{ns}	0.6960^{ns}	2099.288**	1.76680*	0.21070ns	77.5159**	357432.**	1.197^{ns}	2.009**
Error	4	15.84	0.3739	11.091	0.19354	0.03911	1.2499	5574.	6.629	6.229
Spraying	3	100.96*	9.6219**	323.651**	0.21045*	0.02226ns	25.0446**	117525.**	26.573**	1.236**
Variety*spraying	6	44.82^{ns}	0.9582**	281.554**	0.12423^{ns}	0.01400ns	14.0648**	66714.**	1.431^{ns}	3.258**
Error	18	28.67	0.3286	4.716	0.06683	0.03258	0.6331	2886.	2.432	2.952
Total	35									

**Significant at 0.01 level, *Significant at 0.05 level and ns: Non significant

them in the first season with rate of 52.4 and 49.4 cm respectively, while the Local variety had a rate of 44.3cm (Table 2, 3 & 4). Similar results were found by Miah et al (2009) and Altai (2014). Highest plant heights (52.6 & 49.6 cm) were obtained as a result of foliar spraying with mixture and amino acid, without significant differences between them in the second season, compared to the water treatment 44.5 cm.The beneficial effects of humic acid on plant growth depend on the sources and concentration (Nardi et al 2002). As well as molecular fraction weight. Lower molecules size fractions easily reaches the plasma lemma of plant cell, deterring a positive effect on plant growth as well as a later effect at the level of plasma membrane, such as nutrient uptake specially nitrate. The effect of intermediary metabolism is less understood, but it seems that humic substances may influence assimilation of major and minor elements, enzyme activation (Nardi et al 2002, Ulukan 2008). The source of amino acids may be playing an important role in plant metabolism and protein assimilation which necessary for cell formation and consequently increase fresh and dry mater. Moreover, similar effect and findings about humic acids and amino acids were reported by El-Ghamry et al (2009), Ghaith and Galal (2014).The use of mix of humic and amino acid increased the no. of branches plant^{-1} in both seasons with rate of (10.4) followed by amino acid (9.7 & 9.8) without significant differences between them in the first season compared to the water (8.5 & 7.9) in both seasons, respectively (Table 2, 3 and 4). It is known that the humic acid is a source of micro and macronutrients (Waqas et al 2014). These nutrients are quickly absorbed by the plant when humic acid is sprayed as a foliar spray. Macro nutrients like N, P and K are associated with the different plant processes viz., cell enlargement, translocation of solutes, formation of carbohydrates etc. It is associated with increasing plant height and the no. of branches in the present study. Our results are supported by El-Ghamry et al (2009),who have reported that HA increase no. of branches. Results presented in Table 2, 3 and 4 clearly indicated thatthe highest no. of pods plant^{-1} recorded in the Turkish variety (64.9 & 60.5), whereas the local variety had the lowest no. of pods/plant which was (35.5 & 34.3) in the two seasons, respectively. These results might be related to genetic factors and genetic makeup of the varieties. Similar results were observed by Ahmad et al (2004) and Altai (2014). Likewise, the highest rate of this trait was observed in the mixture 67.4 and 56.2 compared to the water which was 39.2 and 41.6 in both seasons, respectively. Spraying by the mix increased the no of pod plant^{-1}, may be due to the high content of macro, micro nutrients and plant growth regulars. This enhanced the flowering stages and then increased the no. of podplant^{-1}.The no of seedspod^{-1} in the local and Uzbekistan varieties were significantly different and superior which reached up to (9.6 and 9.7) for the local variety and (9.6) for the Uzbekistan variety considering the Turkish variety which was (9.2 and 9.0) in both seasons, respectively. Similar results were found by Bhuiyan et al (2008). However, the type of foliar spry made no significant effect in the second season, otherwise, the mix had the highest rate of no. of seed pods^{-1} in the second season was (9.6) followed by humic acid (9.4).(Table 2, 3 and 4).The results in Table 2, 3 and 4 indicate that the 100 seeds weight was not influenced by the difference of varieties by foliar spry of the study in both seasons. The Turkish variety significantly surpassed other studied varieties in plant yield (16.2 and 14.2 g) and seed yield (1083.3 and 948.2 kg ha^{-1}) in both seasons, respectively. This variety followed by Uzbekistan variety, which recorded plant yield (14.8and 13.0 g), and seed yield (1083.3 and 948.2 kg ha^{-1}) in both seasons, respectively. Lastly, local variety registered the lowest values of plant yield (9.5and 9.3 g) and seed yield (623.2 kg ha^{-1} and 617.2 kg ha^{-1}) in both seasons, respectively. The reason for the superiority of the Turkish variety to the superiority of the original in the no. of pods plant^{-1}, no. of seeds pod^{-1} and 100 seed weight (Table 2, 3 and 4), this increase led to an increase in the plant yield and seed yield, this result agreed what happened (Altai 2014).So that, the highest plant yield and seed yield observed from the mixture treatment (17.7 and 14.04 g) for the plant yield and for the seed yield (1187.1 and 935.3 kgha^{-1}) in both seasons, respectively. Whereas, the lowest values of plant and seed yield were resulted from the spraying with water, and perhaps due to the mix in accelerating the transfer of photosynthesis products from source to downstream, which led to an increase in the downstream size by increasing the no. of pods plant^{-1} and increasing the no. of seeds pod^{-1}.The results in Table 2, 3 and 4 indicate that the mix treatment had the highest rate of the protein percentage (23.9%) in the second season compared to control (19.9%). The mean comparison showed that the maximum protein yield was recorded in the Turkish variety followed by Uzbekistan variety which recorded (241.1 and 213.4 kg ha^{-1}) for Turkish variety and (219.6 and 192.7 kg ha^{-1}) for Uzbekistan variety, respectively. The minimum yield was in local variety (138.5 and 134.5 kg ha^{-1}). The mix treatment increased protein yield (272.5 and 205.0 kg ha^{-1}), followed by amino acid (223.9 and 214.3 kg ha^{-1})as compared to the water which recorded (133.7 and 133.3 kg ha^{-1}) in both season, respectively. The reason for increasing protein yield may be due to the mix treatment in the spray solution of seed yield and protein percentage (Table 2, 3 and 4). The interaction between types of mug bean variety and foliar spray had a significant effect on plant

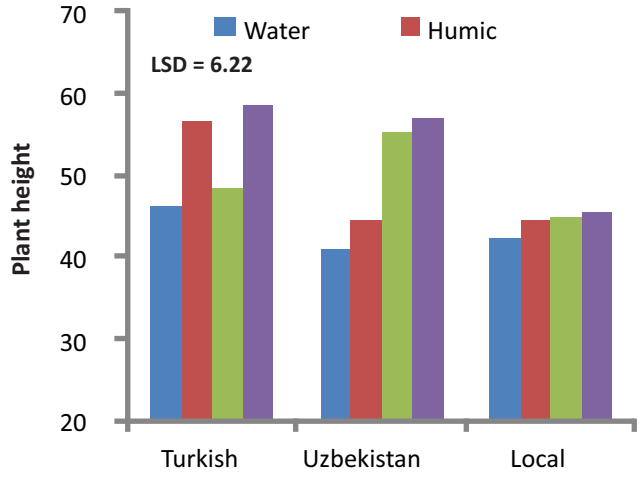

Fig. 1. Plant height as affected by the interaction between varieties and spraying during 1st seasons

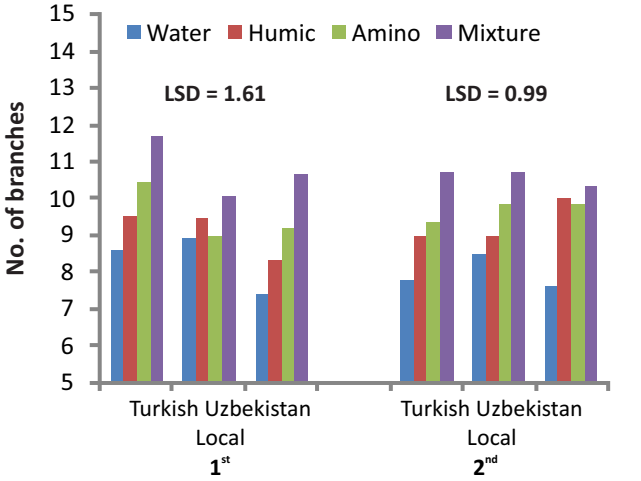

Fig. 2. Number of branches as affected by the interaction between varieties and spraying during 1st and 2nd seasons

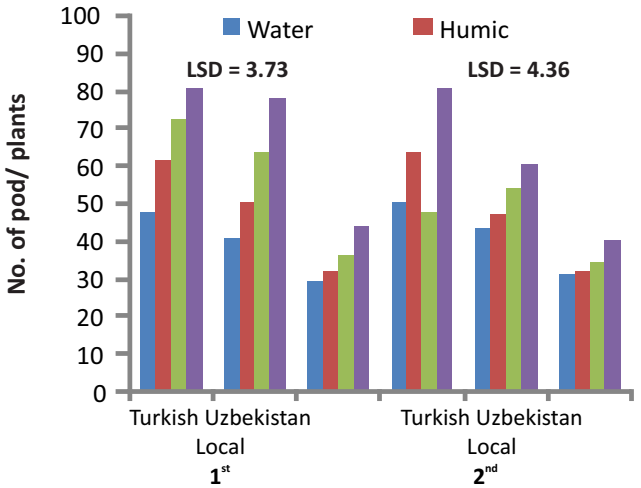

Fig. 3. Number of pod plant^{-1} as affected by the interaction between varieties and spraying during 1st and 2nd seasons

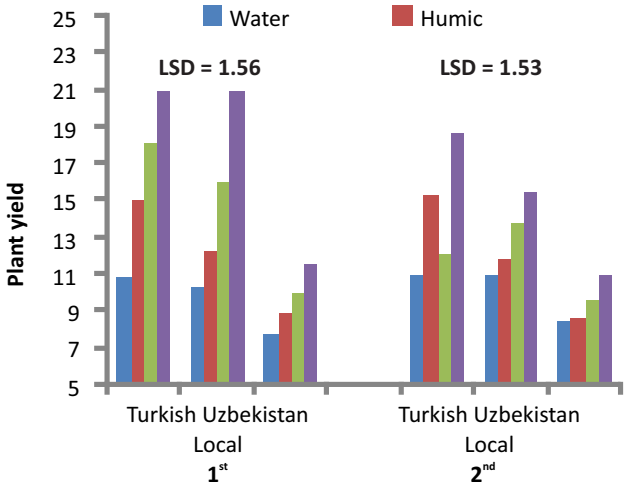

Fig. 4. Plant yield as affected by the interaction between varieties and spraying during 1st and 2nd seasons

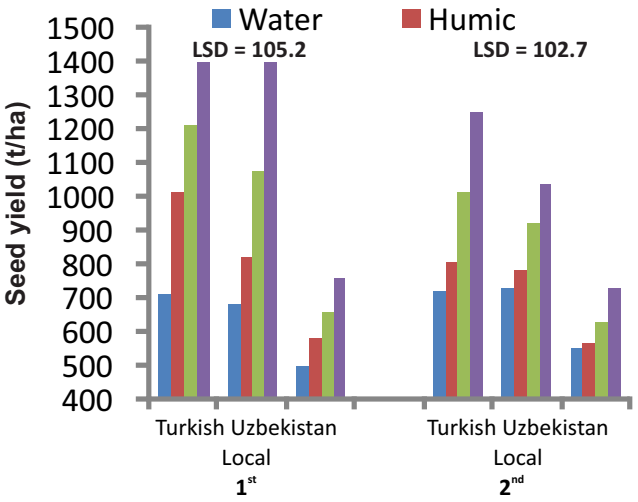

Fig. 5. Seed yield (kg ha^{-1}) as affected by the interaction between varieties and spraying during 1st and 2nd seasons

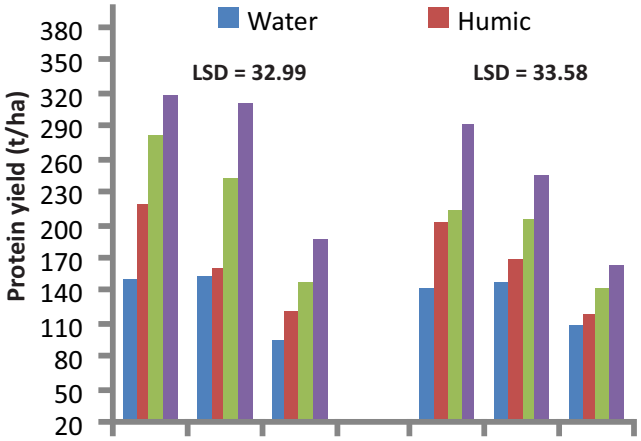

Fig. 6. Protein yield (kg ha^{-1}) as affected by the interaction between varieties and spraying during 1st and 2nd seasons

Table 4. Means for studied traits in mung bean under treatment in 1st and 2nd seasons

Varieties	Spraying	Plant height (cm)		No. of branches $plant^{-1}$		No. of pods $plant^{-1}$		No. of seeds pod^{-1}		100 seed weight (g)		Plant yield (g)		Seed yield (kg ha^{-1})		Protein %		Protein yield	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Turkish		52.4a	50.7	10	9.1	64.9a	60.5a	9.2b	9.0b	3.7	3.6	16.2a	14.2a	1083.3a	948.2a	22.2	22.3	241.16a	213.42a
Uzbekistan		49.4a	49.6	9.3	9.2	58.7b	51.1b	9.6a	9.6a	3.6	3.6	14.8b	13.0a	994.2b	867.4a	21.9	22	219.66a	192.77a
Local		44.3b	46	8.8	9.6	35.5c	34.4c	9.6a	9.7a	3.8	3.8	9.5c	9.3b	623.2c	617.2b	21.9	21.7	138.50b	134.52b
	Water	47.4	44.5b	8.5b	7.9c	39.2d	41.6c	9.3	9.3b	3.6	3.6	9.5d	10.0d	627.2d	665.6d	21.1	19.9c	133.74d	133.35c
	Humic acid	48.6	48.3ab	8.7b	9.4b	48.1c	47.6b	9.5	9.4ab	3.6	3.7	12.0c	11.9c	803.6c	786.9c	21	21.4b	168.81c	168.23b
	Amino acids	49.6	49.6a	9.8a	9.7b	57.4b	49.3b	9.5	9.3ab	3.7	3.7	14.7b	12.8b	983.2b	855.9b	22.7	22.8ab	223.99b	214.35a
	Mixture	49.3	52.6a	10.4a	10.4a	67.4a	56.2a	9.5	9.6a	3.8	3.7	17.7a	14.0a	1187.1a	935.3a	23.2	23.9a	272.54a	205.01a
$LSD_{5\%V}$		3.6	ns	ns	ns	2	3.7	0.3	0.4	NS	NS	1.1	1.2	76.2	84.6	NS	NS	31.21	28.28
$LSD_{5\%F}$		ns	5.3	0.7	0.5	2.2	2.1	ns	0.2	NS	NS	0.8	0.7	59.3	53.2	NS	1.5	21.95	17.01
$LSD_{5\%V*F}$		6.2	ns	1.61	0.9	3.7	4.3	ns	ns	NS	NS	1.5	1.5	105.2	102.7	NS	NS	32.99	33.58

Values followed by the same letters are not significantly different at 5% level

height in the first season, no. of branches, no. of pod/plant, plant, seed and protein yields in both seasons (Table 2 and 3). Data graphically illustrated in Figures 1, 2, 3, 4, 5 and 6 show that the highest values of plant height (58.5 cm) in the first season, no. of branches (11.6 & 10.7), no. of pod $plant^{-1}$ (80.2), plant yield (20.9 and 18.7 g), seed yield (1400.1 and 1255.2 kg ha^{-1}) protein yield (319.6 and 292.5 kg ha^{-1}) in both season, respectively were obtained when foliar spraying Turkish variety with the mix treatment.

REFERENCES

Abdul Qados AMS 2010. Effect of arginine on growth, nutrient composition, yield and nutritional value of mungbean plants grown under salinity stress. *Nature and Science* **8**(7): 30-42.

Ahmad R, Mahmood I, Kamal J and Bukhari SAH 2004. Growth and yield response of three mungbean (*Vigna radiate* L.) varieties to varying seeding rates. *International Journal of Agriculture and Biology* **6**(3): 538-540.

Altai DSK 2014. Effect of planting dates on growth, yield and quality of two mungbean (*Vigna radiate* L.) varieties. *Journal of Thi-qar Science* **5**(1): 32-37.

Baqir HA and Al-Naqeeb MAS 2019. Effect of some amino acids on tillering and yield of three bread wheat cultivars. *Iraqi Journal of Agricultural Sciences* **50**(Special Issue): 20-30.

Bhuiyan MAH, Mian MH and Islam MS 2008. Studies on the effects of bradyrhizobium inoculation on yield and yield attributes of Mungbean. *Bangladesh Journal of Agricultural Research* **33**(3): 449-457.

Black CA 1965. Methods of Soil Analysis. Part 2.*American Society of Agricultural and Biological* [NC] Publisher, Madison.

Bremner JM and Keeney DR 1966. Determination and isotope ratio analysis of different forms of nitrogen in soil: 3 Exchangeable ammonium, nitrite by extraction distillation methods. *Soil Science Society of America Proceedings* **30**: 577-582.

El-Ghamry AM, Abd El-Hai KM and Ghoneem KM 2009. Amino and humicacids promote growth, yield and disease resistance of faba bean cultivated in clayey soil. *Australian Journal of Basic and Applied Sciences* **3**(2): 731-739.

FAO 2000. Extent and causes of salt-affected soils in participating countries. Global network on integrated soil management for sustainable use of salt-affected soils. FAO-AGL website.

Ghaith RH and Galal RM 2014. Response of pea plant (*Pisum sativum* L.) Growth and yield for spraying of amino acid and boron. *Egyptian Journal of Applied Sciences* **29**(3): 154-173.

Ibrahim ME, Bekheta MA, El-Moursi A and Gafar NA 2010. Improvement of growth and seed yield quality of *Vicia faba* L. plants as affected by application of some bio regulators. *Australian Journal of Basic and Applied Sciences* **1**(4): 657-666.

Jan A, Kaleem SA, Taj FH and Khan H 2000. Response of mungbean cultivars to different seeding densities at dry land conditions. *Pakistan Journal of Biological Sciences* **3**(12): 2030-2032

Kalyoncu O, Sener A and Esin B 2017. The effects of humic acid on growth and ion uptake of mung bean (*Vigna radiata* L. Wilczek) grown under salt stress. *African Journal of Agricultural Research* **12**(49): 3447-3460.

Miah MAK, Anwar MP, Begum M, Juraimi AS and Islam MA 2009. Influence of sowing date on growth and yield of summer mungbean varieties. *Journal of Agriculture, Forestry and the Social Sciences* **5**: 73-76

Nardi S, Pizzeghello D and Pandalai SG 2004. Rhizosphere: A communication between plant and soil. *Recent Research Developments in Crop Science* **1**(2): 349-360.

Nardi S, Pizzeghello D, Muscolo A and Vianello A 2002. Physiological

effects of humic substances in plant growth. *Soil Biology and Biochemistry* **34**(11): 1527-1536.

Page AL, Miller RH and Keeney DR 1982. Methods of soil analysis . Part 1 and 2, 2nd ed. *Soil Science Society of America Journal*. No. 9.

Piper CS 1950. *Soil and Plant Analysis*. Int Sci Publisher Inc. New York.

Rahman M, Habib A, Sikdar S, Shamsuzzoha I and Islam S 2016. Evaluation of mungbean genotypes for salt tolerance at seedling stage and alleviation of saline stress by gypsum. *Fundamental and Applied Agriculture* **1**(1): 39-43.

Ulukan H 2008. Humic acid application into field crops cultivation. Kahraman Maras Sutra Imen University. *Journal of Science* **11**(2): 119-128.

Walter GR and Nawacki E 1978. Alkaloid biolog and metabolism in plants. Planum Press, New York, pp.152.

Waqas M, Ahmad B, Arif M, Munsif F, Khan AL, Amin M, Kang SM, Kim YH, Lee IJ 2014. Evaluation of humic acid application methods for yield and yield components of mungbean. *American Journal of Plant Sciences* **5**: 2269-2276.

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