The Impact of Foliar Spray with Ascorbic on some growth parameters and yield of maize genotypes

Lamiaa. M. Al-freeh[1] Anhar M.Alshummary[1] Sundus. A. .Alabdulla[1]

Agric. College, Basrah Univ. (1)

Abstract

Field experiment carried out at the farm of field crops department agriculture college / university of Basrah, Iraq during Autumn season 2019 to study the effect of foliar spray with different concentrations of ascorbic acid (0, 2, 4, 6, 8 g/ l) on some growth characteristics ,yield component and yield of two maize genotypes (Furat , Buhooth- 106). Treatments were arranged in according split plot design in RCBD with three replicates. The spray concentration is placed in the main plots, while the sub plots includes the genotypes . The results showed that Furat genotype was superior in most traits and gave the highest grain yield of 5.560 t/ ha. Spraying ascorbic acid at the concentration of 8 g/l produced maximum grain yield of 6.320 t/ ha which is statistically at par with 6 g/ lwith grain yield of 5.729t/ ha. Minimum grain yield was found in control treatment(4.230t/ ha). Furat genotype spraying with high concentration of ascorbic acid 6 and 8 g/ l were superior with 7.550 and 7.232 t/ ha compared to all interactions.

Key words: Maize, ascorbic acid, Genotypes, yield

Introduction

Maize (*Zea mays* L.) is a cereal crop which belongs to the family poaceae .It is an important cereal crop which ranks the third after wheat and rice in the world (Imran, 2015). It is grown widely in many countries of the world. Maize is an important cereal crop in Iraq it is widely used in both the food and by-products like corn starch, corn oil, dextrose, corn syrup, corn flakes, cosmetics, wax, alcohol (Abdullah and Karim, 2019), as well as the maize grains are rich in vitamins A, C and E, carbohydrates, proteins and essential minerals (Nuss and anumihardjo,2010) Corn.is grown in Iraq in most of Iraq's governorates, but the average yield is still smaller than that of developed agricultural countries, such as the United States 1044 t ha^{-1} Turkey 10.75 t/ ha and Canada 9.72 t/ ha (USDA, 2019).

Consequently, it has become necessary to think about new methods that increase the yield of the unit area, including the use of chemicals that are safe in the environment and have no side or negative effects in humans and animals, to drive the crop to achieve the highest possible functional and genetic capacity, such as ascorbic acid (AsA) increases the tolerance of the plant to salinity and cold Darvishan *et al*., (2013) and has a great vital role as an antioxidant In many biological systems, in the regulation of growth and differentiation. The use of growth regulators alone is not sufficient to raise the productivity of the crop unless It was accompanied by the use of a highly efficient variety in the use of nutrients and other growth factors to improve plant growth and transformation Photosynthesis products to economical

yield.. this study was conducted due to the lack of studies in the region related to the effect of AsA spray on the agricultural characteristics of maize.

Material and methods

The experiment was conducted at the research station/Agriculture College / Universi ty of Basrah, Iraq (30°57 N lat.,47°80 long). during the Autumn growing seasons 2019 to study the effect of foliar spray of ascorbic acid (AsA) on growth, yield components and yield of two maize genotypes. In this experiment the split plot design based on The randomized complete block design (RCBD) was used with three replications. The main plots consisted of five foliar AsA concentrations (0, 2, 4, 6, 8 g/l) , while the subplots included two genotypes (Furat,Buhooth-106) corresponding to V_1 and V_2.The experimental field soil was silty loam, evaluating its physical and chemical properties according to methods described in Black (1965) and Page *et al*. (1982), (Table 1). Sowing was completed on the 15th of August 2019. The experimental unit covered an area of 12 m^2 and consisted of four ridges, 70 cm across, 4 m long, 25 cm between plant and another. It produced a population density about 6.6 plants/ m^2. According to soil analysis results, nitrogen was used from urea (240 kg N/ ha), it was applied at three times including sowing, six leafy and tasseling stages (Mohsin,2007). Phosphorous fertilizer as superphosphate of 60 kg P/ ha was added through soil preparation ,but no K fertilizer was needed. Different concentration of AsA were foliar sprayed at V10 (10 leaves with collars visible) and the rest were sprayed at R1 (silking stage). The plants were sprayed at the early morning with solutions using manual sprayer and the control plants were sprayed with distilled water. Weed control and irrigation were done as necessary. five plants from each plot were randomly chosen from each of the 2nd and 3rd ridges at 22nd November to determine: plant height, number of leaves ,leaf area, Rows number/ ear, number of grains/ ear, 300 grains weight and grain yield. The data were analyzed by means of variance analysis using the Statistical Analysis System (SPSS) The average treatments were compared with the mean level of 0.05 using LSD test.

Table 1. Some initial physical and chemical characteristics of the soil

Soil properties	Value
pH	
E.C (ds m^{-1})	7.83
Organic matter (g kg^{-1})	2.30
Available N (mg kg^{-1})	31.16
Available P (mg kg^{-1})	17.30
Available K (mg kg^{-1})	116.11

Results And Discussion

plant height(cm)

The data presented in Table (2) illustrate the response of corn genotypes for ascorbic acid foliar spraying application,. The genotypes differed in plant height, where Furat (V_2) genotype gave the highest plant height of 132.63cm, while Buhooth-106 genotype (V_1) gave the lowest plant height (127.22cm). This may be because of variations in the genetic potential of these genotypes. These results are in line with results of Beiragi *et al*.,(2011) and Nwogboduhu (2016) they also reported that plant height significantly varied among different genotypes. On the other hand Foliar spray of AsA had significant effect on plant height, the highest plants were found by 8 g/ l plants (141.20cm) ,while the shortest plants were recorded by control(113.24cm). It may be due to the role of the acid in stimulating the division and growth of cells, which led to increased plant height(Dolatabadian *et al*.,2010). The interaction between factors (genotypes and AsA) showed significant effect on plant height, V_2× 6 g/ l .Ascorbic acid spraying (gave the highest of plant(144.87 cm) which is statistically at par with 4 and 8 g/ l with plant height of 143.37and 143.17cm respectively ,while, treatment (V_2×without ascorbic acid spraying(control) gave the lowest values of plant height (106.17cm).

Number of leaves/ plant

There were significant variation between genotypes on leaves number on plant (Table2).V_2 genotype was superior by giving the highest leaves number (11.67), while V_1 gave the lowest value (10.87). This was caused by genetic differences between the genotypes. The same results were also reported by Radma and Dagash (2013) ,Enujeke (2013) .AsA treatments caused a significant effect ,the level 6 g/ l gave the highest number of leaves (12.33) compared to the control treatment, which gave the lowest (10.33) (Table 2). The interaction V1×6 g/ l produced the highest number of leaves (12.67) in plant and V_1 × without AsA spraying produced the lowest number (9.33) (Table 2).

Leaf area

Both maize genotypes and ascorbic acid showed significant influences on leaf area. Highest values of leaf area was obtained from the V_2 genotype (4374.45cm^2), while the lowest was made by V1 (4275.28cm^2) . This difference was due to genetic factors which differed .Similar results were obtained by Akram *et al*.,(2013), Gomaa *et al*.,(2014) and Zaidan *et al*.,(2019). It was clear that there were significant differences in leaf area between the different concentrations of AsA. The spraying of 8 g/ l gave significantly higher leaf area

(4709.38 cm^2) compared to control (4073.69 cm^2). The probable reason may be that AsA plays multiple roles in plant growth, such as cell division, cell wall expansion, and other processes of development (Pignocchi and Foyer, 2003). Moreover, AsA protects metabolic processes against H_2O_2 and other toxic oxygen derivatives, which have affected many enzyme activities, minimizes the damage caused by oxidative processes by synergizing with other antioxidants, and stabilizes membranes(Shao et al., 2008) .The interaction between the factors caused significant effect ,spraying V_2 genotype with high concentration of AsA (8 g l^{-1}) was superior (4862.25cm^2), while V_2 with control treatment gave the lowest leaf area (3888.50cm^2).

Rows number/ear

Data revealed that genotypes had no significant effect on rows number/ ear (Table 2). Mean values of the data showed that increasing AsA concentration consistently increased rows number/ ear. Plots spraying with 8 g/ l took higher numbers of rows number/ ear (13.34 rows / ear) which is statistically at par with 6 and 4 g/ l with rows number $ear^{-1}$of 12.84 and 12.66, while control plots took lower numbers of rows number/ ear (11.67 rows / ear). The interaction between genotypes and AsA levels significantly affected rows number, in which V_2 genotype gave high rows number (14.00 rows / ear) when spraying with ascorbic concentration 6 g/ l, while V_2 genotype gave less rows number/ ear (11.33 rows / ear) when spraying with 2 g/ l of AsA.

Grains/row

Statistical analysis of the data revealed no significant differences in grains per row between maize genotypes (Table 2). Mean values of the data showed that Maximum number of grains per row was found in 8 g/l of AsA (38.67 grains / row) with no differences with 4 and 6 g/ l of 36.73 and 37.94 grains / row respectively , however lower number of grain number/ row (34.28 grains / row) was recorded by control treatment. The role of AsA is increasing the area of the vegetative system, which resulted in giving a greater number of flower inflorescences (Abbas *et al*., 2013) , it may be attributed to produced more grains per row .The interaction effects of maize genotypes and ascorbic acid showed significant influences on the number of grains per row. The highest (43.33 grains / row) and lowest (30.33 grains / row) grains per row were obtained under V_2×6 g /l and V_1×control treatment, respectively (Table 2).

300 grain weight(g)

Results showed that 300 grain weight were significantly affected by different maize varieties (Table 2). Mean values of the data indicated that higher 300 grain weight (66.76g) was found with V_2, and lower 300 grain weight (61.99g) was observed in V1. Influence AsA had significant effect on 300 grain weight of maize. Maximum weight recorded with the spraying of ascorbic at the rate of 8 g l^{-1}. Minimum 300 grain weight was recorded from control plots . Increasing grain weight can be caused by increasing photosynthesis and assimilating transportation to grains reducing of environmental stresses effects by AsA (Dolatabadian et al.,2010).There were significant differences in 300 grain weight among different treatments interactions. The highest 300 grain weight of 76.47g and the lowest of 58.47g were obtained under the treatment combinations V_2×8 /g l and V_1×control treatment, respectively (Table 2).

Grain yield (kg/ ha)

Statistical analysis showed that grain yield of maize as influenced by genotypes and AsA concentration (Table 2). Highest grain yield was found for V_2 genotype (5.560t /ha) while lowest grain yield was recorded for V_1 genotype (4.884t/ ha). This result is consistent with Olaoye *et al*.,(2009) who indicated that the difference in the genotypes in the grain yield is due to genetic factors that lead to morphological, anatomical, and physiological differences. Mean values of the data showed that spraying of AsA at the concentration of 8 g/ l produced maximum grain yield of 6.320 t /ha which is statistically at par with 6 g /l with grain yield of 5.729t/ ha. Minimum grain yield was found in control treatment(4.230t/ ha). This increase is a result of the increase in the rows number ,grain per row and 300 grain weight (Table 2).The results of interaction showed that genotypes and AsA were significantly and positively affected grain yield .V_2 genotype spraying with high concentration of AsA 6 and 8 g/ l were superior with 7.550 and 7.232 t/ ha compared to all interactions of V_1 and V_2 genotypes.

Table.2 Effect of Ascorbic acid concentration on growth ,yield components, and yield maize during 2019 autumn season.

Treatments		Plant height(cm)	Leaves number	Leaf area	Rows number	Grain per rows	300 grain weight	Grain yield
Genotypes	V1	127.22	10.87	4275.28	12.38	35.74	61.99	4.884
	V2	132.63	11. 67	4374.45	12.75	37.34	66.76	5.560
LSD (P ≤ 0.05)		**2.36**	**0.38**	**83.43**	**0.75**	**N.S**	**2.38**	**0.42**
Ascorbic acid (g/l)	0	113.24	10.33	3923.69	11.67	34.28	59.34	4.230
	2	128.67	10.83	4011.25	12.33	35.07	62.49	5.119
	4	135.12	11.17	4359.00	12.66	36.73	63.54	5.251
	6	133.32	12.33	4621.00	12.84	37.94	65.72	5.729
	8	141.20	11.67	4709.38	13.34	38.67	70.80	6.320
LSD (P ≤ 0.05)		**3.33**	**0.549**	**178.33**	**0.96**	**2.29**	**1.69**	**0.65**
V_1	0	120.30	9.33	3958.88	11.57	30.33	58.47	3.648
	2	131.77	9.67	4097.25	13.33	38.47	60. 60	5.526
	4	126.87	11.33	4282.50	11.65	39.67	63.07	5.929
	6	121.77	12.67	4481.25	11.67	32.55	62.70	4.227
	8	138.23	11.67	4556.50	13.67	37.67	65.13	5.090
V_2	0	106.17	11.33	3888.50	11.76	38.23	60. 20	4.812
	2	125.57	12.00	3925.25	11.33	31.67	64.38	4.712
	4	143.37	11.00	4435.50	13.67	33.78	64.00	4.572
	6	144.87	12.00	4760.75	14.00	43.33	68.73	7.232
	8	143.17	12.00	4862.25	13.00	39.67	76.47	7.550
LSD (P ≤ 0.05)		**5.77**	**0.95**	**302.58**	**1.84**	**3.78**	**1.27**	**1.73**

Conclusions

In this study, maize genotypes were highly responsive to spraying of ascorbic acid, , improved most of growth and productivity parameters : plant height, Leaves number ,leaf area, , Rows number, Grain per rows, weight of 300 grain, and grains yield.

Acknowledgement

The authors would like to thank Dr. Yahia Jahad Shabib the manager of research station of, for providing facilities and technical assistance.

References

Abbas, M. F; Jerry, A, N. Jerry and Faisal H. A. (2013). Effect of salicylic and ascorbic acids and method of application on flowering and green yield of broad bean (Vicia faba L.) plants. Basrah J. Agric. Sci., 27 (1): 34-43.

Abdullah, A.H. & Karim, A.A.K. (2019). Evaluation of F1S', F2S'hybrids, heterosis, and inbreeding depression of Maize (*Zea mays* L.). Tikrit J. Agric. Sci., 19(1): 1-17.

Akram , M. ; Ashraf, M. Y. Ahmad, R.; Rafiq, M.; Ahmad, I. and Iqbal ,J.(2013). Allometry and yield component of maize (Zea Mays L.) hybrids to various potassium levels under saline conditions. Arch. Biol. Sci., Belgrade, 62 (4): 1053-1061.

Beiragi MA, Khorasani SK, Shojaei SH, Dadresan M, Mostafavi K, Golbashy M (2011). A study on effects of planting dates on growth and yield of 18 corn hybrids (Zea mays L.). American Journal of Experimental Agriculture 1(3):110-120.

Black, C. A.; Evans, D.D.; White, L.L.;Ensminger, L.E. & Clark, F.E. (1965).Methods of Soil Analysis. Part 1, No. 9.Am. Soc. Agron. Madison, Wisconsin:840pp.

Darvishan,M.,Moghadam ,H and H. Zahdi (2013) .The effect of foliar application of ascorbic acid (vitamin C) on physiological and biochemical changes of corn (Zea mays L.) under irrigation with holding in different growth stages .Maydica 58.195-200.

Enujeke E. C. (2013). Effects of Variety and Spacing on Growth Characters of Hybrid MaizeAsian Journal of Agriculture and Rural Development, 3(5): 296-310.

Gomaa, M. A., Radwan, F. I., Khalil, G. A. M., Kandil, E. E. and El-Saber, M. M. (2014). Impact of humic acid application on productivity of some maize hybrids under water stress conditions. *Middle East J. Appl. Sci.* **4** : 668-73.

Imran, 2015. Effect of germination on proximate composition of two maize cultivars. J. Bio. Agri and H.Care.5:3: 123-128.

Mohsin, K.H. (2007). Response of Yellow corn to different levels of nitrogen, iron and zinc elements and their interventions under the southern region of Iraq, Ph. D. Thesis, Coll. Agric., Univ. Basra: 175pp. (In Arabic):

Nuss, E. T., and S. A. Tanumihardjo. 2010. Maize: a paramount staple crop in the context of global nutrition. Comprehensives Review in Food Science and Food Safety 5(4): 415-436.

Nwokwu Gilbert Nwogboduhu (2016). Response of Maize (Zea mays L)varieties to planting densities. IOSR Journal of Agriculture and Veterinary Science, Volume 9, Issue 10 Ver. I (Oct. 2016), PP 01-06.

Olaoye, G. ; Ajala, S.O. and Adedeji , S.A.(2009). Participatory selection of a maize (Zea mays L.) variety for the control of stem borers in a southeastern Nigeria location, Journal of Food, Agriculture & Environment 7 (2) : 508-512.

Page, A. L., Miller, R. H. and Keeney, D. R. (1982). *Methods of Soil Analysis, Part 2, 2nd edn*. ASA Inc. Madison, Wisconsin, U. S. A.

Radma, I. A. M. and Dagash, Y. M. I. (2013). Effect of Different Nitrogen and Weeding Levels on Yield of Five Maize cultivars under Irrigation. Universal Journal of Agricultural Research, 1(4): 119-125.

Shao , H. B., Chu, L. Y., Zhao, H. L. and Kang C. 2008. Primary antioxidant, free radical scavenging and redox signaling pathways in higher plant cells. Int. J.Biol. Sci., 4(1):8-14.

USDA. (2019). World agriculture production, foreign agriculture service, office of global analysis, Washington, Circular Series WAP 1-18.

Zaidan , Safaa A. ; Mohsin K.H. and Muhsin S. J. (2019). Effect of genotypes and tillage systems in some growth characteristic of maize (*Zea mays* L.) Basrah J. Agric. Sci., 32(2): 7-15.