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Effect of Potassium Spray and the Addition of Organic Matter on Some Physical Properties of Soil and Yield of Yellow Maize (Glory) Variety

Aws Mahmoud Kreet^{1*}, Sabah Mahdi Jassem¹, Deyaa Hussein Abs¹

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ABSTRACT

Field experiment was conducted for the autumn season 2022 in Khamisiyah area/Babil governorate in silty loam soil to study the effect of foliar fertilization for four levels of potassium (0, 1.5, 3.0, 4.5 g potassium per liter-1) and its source is potassium sulfate and four levels of zinc are (0, 25, 50, 75 mg zinc L-1) and its source is zinc sulfate water and their interaction in some physical properties of soil and indicators of yield and quality of yellow maize plant for Glory variety. A fully randomized block design was used for three replicates, and means were compared using a least significant difference at the 5% probability level. The observations are as follows:

Foliar potassium application (4.5 gm K/L-1) significantly increased the average weighted diameter and hydraulic conductivity of the soil after planting, the number of grains per panicle, the weight of 500 grains, the total grain yield, and the content of protein and oil in grains, significantly increase 26.9, 26.0, 37.2, 16.4, 20.5, 18.2, 96.9, 16.7 and 35.7% respectively, However, soil bulk density values were reduced by 5.8% compared to the control treatment (sprayed with water only) which gave the lowest average value. Foliar application of zinc (75 mg zinc L-1) significantly improved the mean values of the above traits by 17.4, 13.3, 29.2, 16.6, 19.7, 10.6, 64.1, 41.7 and 42.8%. The bulk density was reduced by 5.8% compared to the control treatment which showed the lowest mean value, the results also showed that the combination (4.5 gm Potassium L-1 + 75 mg Zinc L-1) was increasing the growth index and gave the highest mean value, They were 0.94 mm, 14.7 cm/min, 1.7 cobs, 19.3 rows, 425.8 grains, 138.9 g and 13.4 mcg.h-1, 10.92% and 7.52%, respectively, while the bulk density was 1.36 μgm^3 , respectively.

INTRODUCTION

Yellow maize (*Zea mays* L.) "is one of the main and important cereal crops in the world, as its grain contains a high percentage of Protein, Starch, Oils, Carbohydrates and Vitamins, and the productivity of the crop decreases, as indicated by most studies when conditions are not available for its growth, including the readiness of macro and micro nutrients (Al Sahoki, 1990)". Iraqi soils contain high levels of active calcium carbonate, thus, the degree of their interaction tends to be basic. At this degree, most nutrients are subjected to stabilization processes and thus, their readiness decreases. For the purpose of achieving nutritional balance and providing what is required for plant growth, methods and means are resorted to reduce the negative impact when feeding The plant, including spraying nutrients directly on the leaves of the plant (Al-Naimi, 1999).

Potassium is a major nutrient necessary for plant growth through its contribution to many vital activities. It contributes to improving the products of photosynthesis and the speed of their transportation from the source to the store (fruits, grains and tubers) and accelerating their conversion into starch, proteins and fats (Mengel & Krikby, 2001). It stimulates a wide range of enzymes and the formation of sugar, starch and protein in the plant. It also affects the processes of opening and closing stomata and increasing the efficiency of water use. It also

contributes to stimulating root growth and cell division (Jensen, 2003). Al-Moussawi and Abu Dahi (2012), It was concluded that applying potassium as a spray to the foliage of plants significantly increased the average leaf area, dry matter weight, grain yield, and percentage protein in corn kernels of the plants (Al-Amri, 2005). After 4 seasons of spraying K fertilizer on the leaves of maize plants, the plant height, leaf area and dry weight increased significantly, and the uptake of K and P by leaves increased. Plant (Abu Dahi, 1997), and Al-Saadi (2007) Maize yields have increased significantly. And the weight of 500 grains when using three-level nitrogen fertilizer.

Al-Bayrouti *et al.* (2008) obtained traits such as leaf area, average ear length, number of kernels per ear, number of rows per ear, weight per 1000 kernels, and total number of ears that significantly increased grain yield in maize plants.

Zinc is one of the micronutrients essential for plant growth and plays an important role in its life cycle because it controls the function of the growth hormone indole acetic acid (IAA) necessary for cell elongation and its direct effect on amino acids (Anand *et al.*, 2008). It also contributes to the cycle of acid metabolism and building carbohydrates and affects the fertilization processes and the production of vital pollen (Vallee & Falchuk, 1993). Salim and Hassan (2004) When spraying chelated zinc

¹ Al-Musayyab Technical Institute, Al-Furat Al-Awsat Technical University, Iraq

* Corresponding author's email: Awsmahmoud.kreet@atu.edu.iq

at different levels (25, 50 mg L⁻¹) on wheat plant, There were significant differences in plant height characteristics compared with the control treatment.

According to Mohsen (2007), when Zn was added at 5 kg.ha⁻¹, the plant height characteristics of maize were significantly increased compared with the un-supplemented treatment. Ali & Sharhi (2010), Plant height, leaf area, leaf chlorophyll content and nutrient uptake (Ani) were significantly increased when sorghum was supplemented with zinc at levels (0, 350, 700 mg.l⁻¹) and foliar fertilized Increase. Al-Weisi (2001) found a significant increase in yield of yellow kernels at zinc levels (8, 16 kg H⁻¹) compared to control treatments, while (Kanwal *et al.*, 2010) obtained an equally significant increase using Grain yield of yellow maize plants in response to zinc. Ghazvineh and Yousefi (2012), At (6, 18, 54 kg H⁻¹) levels, when Zn was sprayed on the leaves at a level of 5 kg.ha⁻¹, the grain yield of maize plants was also significantly higher compared to the treatment without Zn addition Increase.

The purpose of the experiment was to understand the effects of spraying different levels of potassium, zinc and their interaction on the physical properties of the soil part of the glory maize plant, as well as the grain yield and quality indicators.

MATERIALS AND METHODS

Field experiments were carried out in the Al-Khamisiyah area of the Al-Madhatiyah district south of the Babylonian province and on a private farm at two latitudes (32°22'53' to 32°24'66' N) and longitudes (44°41'62" to 44°44'66" E) in a silty loam soil to study foliar sprays of potassium and zinc and their interactions in certain soil physical properties and yield and quality indicators of maize plants *Zea mays* L. Glory cultivar for the autumn season 2022, Soil characteristics were analyzed at a depth of (0-30 cm) according to the methods mentioned in (Black) (15), (Page *et al.*, 1982), and a completely randomized block design was used with three replications. The first factor represented 4 levels of potassium, which are (0, 1.5, 3.0, 4.5 g K L⁻¹) represented by potassium sulfate

K₂SO₄ (41.5% K) and the second factor 4 levels of zinc element are (75, 50, 25,0 mg Zn L⁻¹) represented by hydrated zinc sulfate ZnSO₄.7H₂O 22.6% zinc). Nitrogen fertilizer level was 240 kg H⁻¹ (urea 46% nitrogen) added in two batches, the first two weeks after planting and the second one month after planting, in trenches 5 cm from the Al-Joura site. On the other hand, phosphate fertilizer was added at the rate of 120 kg H⁻¹ (superphosphate 21). % P₂O₅ Maize seeds were sown on 20/7/2022 in an experimental unit containing 5 rose plants, each 4 m long, and the distance between one seed and another is 75 cm and the distance between one hole and another is 20 cm (plant density 66.666 plants. H⁻¹), put 3 seeds in each hole before planting and when preparing the experimental site (Sahoki). Dilute to one plant after germination, use 10% granular pesticide diazinon as active substance, 10kg H⁻¹, control corn stalk borer 30 days after germination. The plants were sprayed with the element solution using a hand sprayer on the plant according to the required level after mixing it with a diffuser (Tween 20 at a rate of 0.1% based on volume) Reduce the surface strength of the spray solution particles and ensure complete wetting to increase absorption efficiency. During the spraying process, the test field is watered in the early morning and the day before to help activate the opening and closing mechanism of the stomata and increase the absorption of the solution by the leaves of the plants. Spray once 30 days after planting, it is in the vegetative growth period, spray twice after 45 days, it is in the elongation period. The interaction between the two elements is sprayed separately, and there is an hour of spraying time between spraying one element and the other, so the spraying process is done in one go, and the maintenance operation starts with manual weeding. Data were statistically analyzed and means were compared according to the least significant difference test at a probability level of 5%. After harvesting, the bulk density, average weighted diameter and hydraulic conductivity are calculated, and the yield index is the average value of 10 plants taken from the average gooseberry, that is, the number of rows of ears, the number of ears of fruit grains, the weight of

Table 1: Some characteristics of the soil used in the study

The Value	Adjective	
7.62	Soil reaction degree pH	
3.12	electrical conductivity (ECe) (dS.m ⁻¹)	
0.92	Organic matter (%)	
1.41	Bulk density gm cm ⁻³	
258.7	Calcium carbonate gm kg ⁻¹	
6.18	total nitrogen	Elements (mg.kg ⁻¹)
0.64	ready-made phosphorous	
9.78	ready-made potassium	
229.3	sand	Soil Separators (gm. kg ⁻¹)
542.4	silt	
228.3	clay	
Silty loam	Soil texture	

500 kernels, the total yield, protein and oil content (Al-Sahoki, 1990).

RESULTS AND DISCUSSION

Effects of Spraying Different Concentrations of Potassium and Zinc on Post-harvest Bulk Density

This is evident in table 2 where the researcher finds a significant difference in the post-harvest soil bulk density of the Gram cubic meters of mica in the leaves of plants which were sprayed with different potassium levels of fertilizer. The fourth level of treatment 4.5 gm L⁻¹ had the best density value out performing all the other elements in the same level. The systematic level was 0 and the apparent level was 1. Compared with the control treatment which recorded the highest reduction of 5, Eighty percent with a mean of one, the mean of the fifty nine mcg m³ increase the mean of the forty- nine mcg

m³ and the mean of the ninety-nine mcg m³ recorded a reduction of 3.47, the same with the table from Zhang's the differences in the levels of zinc added by spraying on the leaves are evident. The treatment (75 mg L⁻¹) enhanced significantly the test organisms mean mica gm³ compared to the comparative treatment, which gave the highest mean mica gm³ of 1.47 a decrease in the original five. 8% compared to the lowest mean 1 as presented below motivating a more in-depth analysis of the scores and the significance of achieving such results. 39 µgm³. Furthermore, the same level of the interaction treatment score with high level of both the potassium and zinc, 4.5 gm L⁻¹ potassium and 75 mg L⁻¹ zinc was solidified by scoring at least 1 above the average. 36 mcg m³, which was less (10.5%), in comparison with treatment, displayed the maximum value of 1.52 gm³ of mica.

Table 2: Effects of potassium, zinc spraying and their interaction on soil bulk density

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	1.52	1.49	1.45	1.42	1.47
1.5	1.48	1.46	1.44	1.40	1.45
3.0	1.45	1.43	1.40	1.38	1.42
4.5	1.42	1.39	1.38	1.36	1.39
average	1.47	1.44	1.42	1.39	
LSD 0.05	Potassium: 0.02		Zinc: 0.02		Overlap: 0.04

Effects of Spraying Different Levels of Potassium and Zinc on Postharvest Weighted Diameter Ratio

Table 3 also revealed that there were significant differences on the weighted diameter (mm) of plant leaves and the characteristic of the fourth treatment (4.5 g L⁻¹) of potassium application level. Performed significantly higher and gave the highest average of 0.85 mm, a growth rate (26.9%) higher than the comparison treatment which yielded an average of 1.47 mm adage,

the same Table presents considerable variation on the level of zinc sprays depending on the leaves add on. Its volume (17.4%) was the lowest making the average have a value of 0. Compared to the comparative treatment, 69 mm. Concerning the interaction treatment, the content of both of the elements at superior levels (4.5 gm L⁻¹ potassium and 75 mg L⁻¹ zinc) was superior to the mean by 0.94 mm while the comparison treatment which recorded the lowest mean of 0.62 mm.

Table 3: Effects of Potassium and Zinc sprays and their interactions on weighted decline rates

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	0.62	0.65	0.68	0.71	0.67
1.5	0.66	0.69	0.72	0.75	0.71
3.0	0.71	0.75	0.78	0.82	0.77
4.5	0.78	0.83	0.85	0.94	0.85
average	0.69	0.73	0.76	0.81	
LSD 0.05	Potassium: 0.05		Zinc: 0.05		Overlap: 0.10

Effect of spraying different levels of K and Zn on post-harvest soil hydraulic conductivity

The results in Table (4) show that the postharvest soil hydraulic conductivity (cm min⁻¹) and the fourth level treatment (4.5 gm liter⁻¹) of the leaves of plants sprayed with different potassium fertilizer levels are significantly better than and give the highest average It reached 13.96 cm min⁻¹, an increase (26.0%) compared to the

control treatment which gave the lowest mean value of 11.08 cm min⁻¹, the same table also shows a significant difference between the zinc levels sprayed on the leaves. The treatment (75 mg L⁻¹) was significantly superior giving the highest mean value of 13.23 cm min⁻¹ and increased (13.3%) to 11.68 cm min⁻¹ compared to the comparative treatment giving the lowest mean value. As for the interaction treatment, the combination of high

levels of both elements (4.5 gm L⁻¹ potassium +75 mg L⁻¹ zinc) outperformed the average level of 14.72 cm min⁻¹, increasing (40.9%) compared to the control treatment, gives the lowest mean He reaching 10.45 cm min⁻¹.

Table 4: Effects of Potassium, Zinc Spraying and Their Interaction on Soil Hydraulic Conductivity

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	10.45	10.94	11.15	11.76	11.08
1.5	11.12	11.82	12.25	12.77	11.99
3.0	12.08	12.95	13.22	13.67	12.98
4.5	13.08	13.82	14.23	14.72	13.96
average	11.68	12.38	12.71	13.23	
LSD 0.05	Potassium: 0.43		Zinc: 0.43		Overlap: 0.86

Effects of Spraying Different Concentrations of Potassium and Zinc on the Number of Grains Per Ear

As can be seen from Table (5) and at the level of potassium application, there are significant differences in the characteristics of grain number per panicle and the fourth level treatment (4.5 g·L⁻¹) is significantly better than that and gives the highest Average of 396.13 grains; whereas the other treatment group had a mean value of, which is greater than the value of the comparison treatment with mean of 328.65 grains an increase of (20.5) % whereas the same table shown that there is a

significant difference between the amount of Zinc added by spraying on leaves. As seen from the data above, Treatment (75 mg L⁻¹) produced the overall highest number as compared to the comparison treatment which produced the overall lowest count of 332.8 tablets, an increase of 19.7% of the highest of 398 of mean tablets used. 3 tablets. Concerning the interaction treatment, the two elements in higher concentrations: 4.5 gm L⁻¹ potassium and 75 mg L⁻¹ zinc had greater values than the maximum mean 425.8, which was, however, higher (40.8%) than the control treatment mean of 8.302.4 slices.

Table 5: Effects of potassium and zinc sprays and their interactions on grain number per panicle

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	302.4	320.8	340.5	350.9	328.65
1.5	325.2	350.7	370.6	400.4	361.73
3.0	342.7	361.8	385.8	415.9	376.55
4.5	360.8	385.3	412.6	425.8	396.13
average	332.78	354.65	377.38	398.25	
LSD 0.05	Potassium: 18.65		Zinc: 18.65		Overlap: 37.30

The effect of spraying different concentrations of potassium and zinc on the weight of 500 tablets (gm)

The results in Table (6) show that there is a significant difference in the leaves of plants sprayed with K levels on the characteristic of 500 grain weight (gm). The Tier 4 treatment (4.5 g L⁻¹) significantly outperformed the highest average of 136.6 gm, an increase (18.2%) compared to the comparative treatment giving the lowest average of 115.6 gm, the same table also shows that spraying on leaves

Significant differences were found between the zinc content on The treatment (75 mg L⁻¹) was significantly better than the comparison treatment giving the lowest mean value of 120.6 g, with an increase of (10.6%). As for the interaction treatment, the combination of high levels of both elements (4.5 gm L⁻¹ potassium + 75 mg L⁻¹ zinc) outperformed and gave the highest mean value of 138.9 g, an increase (25.7%) compared to the treatment group treatment, gave the lowest average value of 110.5 g.

Table 6: Effect of Potassium and Zinc Sprays and Their Interactions on the Weight of 500 Tablets (gm)

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	110.5	115.7	115.8	120.4	115.60
1.5	115.7	126.8	128.6	133.5	126.15
3.0	125.1	132.4	131.3	137.8	131.65
4.5	130.9	135.2	138.9	141.6	136.65
average	120.55	127.53	128.65	133.33	
LSD 0.05	Potassium: 4.58		Zinc: 4.58		Overlap: 9.16

Effects of spraying different levels of potassium and zinc on total grain yield (mg.ha⁻¹)

The following findings in Table (7) indicate that there are significant differences in the total leaf yield (mcg. ha⁻¹) characters of the plant which has been sprayed with K levels. Thus, the results revealed further that Tier 4 treatment (4.5 gm L⁻¹) has a much better efficiency than the highest average of 11.28 Mg. ha⁻¹ and augmented 96.9% of Mg. ha⁻¹ as compared with the other five treatments with the least average growth of 5.73, as it can also be seen in the same table There were also

significant differences recorded on the added levels of zinc spray on the leaves. Mean PL treatment (75 mg L⁻¹) had superior results that the highest mean level of 10.75 mcg. ha⁻¹ which is 64.1% higher than the lowest control treatment with mean of 6.55 mcg. ha⁻¹. Concerning the interaction treatment, The blend of concentration 4.5 gm L⁻¹ Potassium and 75 mg L⁻¹ Zinc surpass the average of 13 showed the highest response rate in this study. 4 mcg. ha⁻¹, an increase (197.8%) of an average of 4.5 Mg. the yield obtained in quintal per hectare (ha⁻¹) from the tested treatment is less as compared to control treatment.

Table 7: Effects of potassium, zinc spraying and their interaction on total grain yield traits (mg.ha⁻¹)

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	4.5	5.4	6.0	7.0	5.73
1.5	5.5	7.7	9.2	11.0	8.35
3.0	7.4	8.9	10.6	11.6	9.63
4.5	8.8	10.4	12.5	13.4	11.28
average	6.55	8.10	9.58	10.75	
LSD 0.05	Potassium: 0.86		Zinc: 0.86		Overlap:1.72

Effect of spraying different levels of potassium and zinc on protein content of grains (%)

In essence, the results presented in Table (8) indicate that there is a statistically significant difference of the trait grain protein content (%) in the level of K fertilizer sprayed on the aerial part of the plant. The Tier 4 treatment (4.5 g L⁻¹) gives the highest mean of 9 and it is significantly higher than the two preceding treatments. 15%, higher growth rate than the relative marker of (16.7%) in the comparable treatment averaged the lowest mean score of 7.84%, the same table also reveals and there were

differences in the amounts of zinc that were sprayed on the leaves. The treatment (75 mg L⁻¹) gave higher result than the highest mean of about 9. control were 76% and increased 41.7% compare to the comparison treatment which gave the lowest mean of 6.89%. This study has further shown that the interaction treatment with high levels of both fluids; 4.5 gmL⁻¹ potassium + 75 mg L⁻¹ zinc provided and garnered the highest mean value of 10.92%, which was higher than the comparison treatment by an increase of 70.4%, The lowest average value was 6.41%.

Table 8: Effects of potassium, zinc spraying and their interaction on grain protein content (%)

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	6.41	7.22	8.65	9.08	7.84
1.5	6.78	7.35	8.21	9.25	7.90
3.0	6.92	7.86	8.45	9.78	8.25
4.5	7.46	8.75	9.48	10.92	9.15
average	6.89	7.80	8.70	9.76	
LSD 0.05	Potassium: 0.74		Zinc: 0.74		Overlap: 1.48

Effect of spraying with different levels of potassium and zinc on the grain content of oils (%)

The findings presented in Table (9) reveal that the level of potassium application has a significant difference in the traits of plant leaf seed oil content (% where the fourth level (4.5 g. L⁻¹) treatment is significantly better than and gave the highest mean value of 6.31% and the growth rate The least mean of 4. In the same table 65% was given for (35.7%) over the control treatment and the above table also depicts the response of different levels of zinc either applied through spraying on the leaves.

Mean value of 6 The treatment (75 mg L⁻¹) was found to be the most effective and performed beyond expectation as compared to the other treatments. 24%, a relative improvement (42.8%) over the comparative treatment which yielded the lowest mean of 4.37%. In regarding to the interaction treatment, the level of both elements significantly high; 4.5 gm L⁻¹ K and 75 mg. L⁻¹ Zn exceeds the average showing the highest mean value of 7.52% while the mean of compared treatments reached (92.3%); thus the individual values of this parameter were the lowest and equal to 3.91%.

Table 9: Effects of spraying potassium, zinc and their interaction on grain oil properties (%)

Potassium gm.L ⁻¹	Zinc mg.L ⁻¹				Average
	0	25	50	75	
0	3.91	4.56	4.89	5.22	4.65
1.5	4.18	4.89	5.32	5.78	5.04
3.0	4.39	5.12	6.07	6.44	5.51
4.5	5.01	5.93	6.78	7.52	6.31
average	4.37	5.13	5.77	6.24	
LSD 0.05	Potassium: 0.46		Zinc: 0.46		Overlap: 0.92

The moral advantages (Table 2-9) of spraying high-level potassium fertilizer solution on the leaves of yellow maize plants of Glory variety in improving the average value of some indicators of soil physical properties and yellow maize yield and quality (Table 2-9) can be attributed to the role of potassium, because it is One of the elements necessary for plant growth, it has a variety of physiological and biochemical functions. Increased potassium content in plant tissues leads to a marked increase in the rate of photosynthesis and stimulates the formation of ATP required for the plant to fill the sieve tubes, forming large molecular weight compounds and then increasing the dry mass of the plant (Mengel & Krikby, 2001), possibly also due to environmental and The number of grains and their weight due to changes in growth factors are characterized, and the number of grains per plant is related to the number of rows of grains in the ear and the number of grains per row (Al-Sahoki, 1990). Potassium also extends the duration of the growing season and grain filling by keeping the leaves active for longer periods of time, which increases the amount of manufacturing material delivered to storage locations in the grain, resulting in increased weight, which is reflected in the overall grain yield increase (Havlin *et al.*, 2005).) and (Al-Murjani, 2005). The element zinc promotes the moral increase of the same characteristics above and in the same table, which can be attributed to the positive effect of zinc on growth rate and chlorophyll synthesis, thereby increasing the efficiency of photosynthesis and the transfer of processed material from leaves to grain, and the effect of zinc on fertilization Process and impact of high grain production Vital (Kanwal *et al.*, 2010) and (Ghazvineh & Yousefi, 2012).

CONCLUSION

We concluded from the study that the use of potassium and zinc at levels as high as (4.5 g Potassium. L⁻¹) and (75 mg Zn. L⁻¹) and combinations between them significantly outperformed other treatments and resulted in Glory Yellow maize plants increased the mean values of the studied traits, namely mean weighted diameter, soil hydraulic conductivity, number of grains per ear, 500 kernel weight, total grain yield, percentage of protein and oil in the grain, while decreasing the mean value of soil bulk density after planting.

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