Original Article

Effect of organic fertilizers and spraying with potassium nanoparticals on some growth characteristics of maize plant (*Zea mays* L.)

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Abstract

A field trial was conducted in one of the fields of Ibn Al-Bitar Preparatory Vocational- Holy Kerbala Governorate, during spring season at 2021, to know the effect of organic fertilizes (0, 2000 Kg ha-1 Cow, 2000 Kg ha-1 Poultry ,1500 Kg ha-1 cow+ 500 Kg ha-1 Poultry,1000 Kg ha-1 cow+1000 Kg ha-1 Poultry and 1750 Kg ha-1 cow+ 250 Kg ha-1 Poultry) and spraying with potassium nanoparticals (0,1000 and 2000mg L-1) on some growth characteristics of maize plant. A Randomized Complete Block Design (RCBD) was used with three replications The data were statistically analyzed using the Genstat program, and the averages were compared with the least significant difference at level 5% . the results showed the (1750 Kg ha-1 cow+ 250 Kg ha-1 Poultry treatment was superior by give highest values in all characteristics under study. Also (2000 mg L-1) treatment from potassium nanoparticals was outperformed in all studied traits Except for the characteristics of ear diameter and stem diameter, they did not differ significantly from treatment K1.

Keywords: maize plant, growth characteristics, potassium nanoparticals, organic fertilizers.

INTRODUCTION

The addition of organic fertilizers in recent years has received great attention because of its many benefits in improving soil properties and increasing production. Organic fertilizer is more effective and environmentally friendly in addition to being an effective way to get rid of waste as it is characterized by containing more concentration of nutrients and less content of C/N ratio(Ingham, 2002) . Yellow maize *(Zea mays L.)* belongs to the family poaeceae, It is a C4 plant type as it is a short-lived and fast-growing , it is ranks third in the world among cereal crops after wheat and barley, and it is a basic and important food in many countries where its grain contains 13% moisture and 10% crude protein and 70.3% carbohydrates (martin et al, 2006). It is one of the basic nutritional components for millions of people in several parts of the world, specifically in Asia, Africa and the United States of America, and it is part of the important cereal crops grown worldwide(Dows well, 2019). Nanofertilizers provide a large area for various metabolic reactions in the plant, which increases the rate of representation Photosynthesis and more dry matter production and crop productivity (Singh et al., 2017).In addition, it increases the availability of nutrients by the plant and improves 17-54% of crop yield, more release of various beneficial enzymes, and improved soil quality (Rameshaih et al., 2015). Potassium is one of the basic plant nutrients on which crop production is based, specifically the quality, as it has many effects on plants, including its effect on the rate of photosynthesis, as well as potassium fertilization improves the quality of crops as it increases the weight of grains (Sharma, 2005). Therefore, this study setup to know the best organic fertilizer and its combinations and spraying with nano potassium in the growth of maize.

MATERIALS AND METHODS

A field experiment was carried out in the fields of Ibn Al-Bitar Preparatory Vocational School - Holy Karbala Governorate in Spring season 2021. Randomized complete block design (RCBD) was used with three replications. All soil service operations were carried out from plowing, smoothing and leveling, and organic fertilizers were added. The experiment included two factors: the first factor was organic fertilizers combinations (0, 2000 Kg ha^{-1} Cow, 2000 Kg ha^{-1} Poultry ,1500 Kg ha^{-1} cow+

500 Kg ha^{-1} Poultry,1000 Kg ha^{-1} cow+1000 Kg ha^{-1} Poultry and 1750 Kg ha^{-1} cow+ 250 Kg ha^{-1} Poultry), the second factor included potassium nanoparticle concentration (0,1000 and 2000mg L^{-1}). The following data were recorded at the 100% flowering stage of the experimental unit plants by randomly selecting 5 plants from the two intermediate lines and the following characteristics were measured: Plant Height (cm), height of the cob , number of leaves (leaf $plant^{-1}$), Cob diameter (mm) and Stem Diameter (mm).

RESULTS AND DISCUSSION

Plant height (cm)

The results of Table (1) showed that there were high significant differences for the combinations of organic fertilization and spraying with nano-potassium in the characteristic of plant height (cm), where the treatment (1750 Kg ha^{-1} cows +250 Kg ha^{-1} poultry) outperformed by giving the highest value of plant height which reached (217.13) cm, while the lowest value was (206.97 cm) recorded at control treatment. The reason for this is attributed to the role of organic fertilizers in increasing the availability of nutrients, especially nitrogen, which leads to an increase in plant height (Khalifah et al, 2017), as well as potassium concentration (2000 mg L^{-1}) gave the highest rate for plant height (cm) which reached (215.04) cm and the lowest rate was (206.38cm),The reason for the increase is due to the role of the potassium element in increasing the accumulation of carbohydrates and increasing the knots and thus causing elongation in the stem and this leads to an increase in the height of the plant (Das and Vig, 1997),

Table (1) Effect of organic fertilizers combinations and spraying with nano-potassium on plant height (cm)

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	197.90	211.00	212.00	206.97
T1	208.27	208.33	213.00	209.87
T2	204.33	210.00	214.50	209.61
T3	210.67	212.53	214.00	212.40
T4	203.60	210.67	216.47	210.24
T5	213.50	217.60	220.30	217.13
Mean	206.38	211.69	215.04	
LSD 0.05	O.M	Kco.	Interaction	
	2.919	3.877	8.135	

while the results of the interactions showed high significant differences, where the treatment (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) with potassium concentration (2000 mg L^{-1}) outperformed by giving it the highest rate, which was(220.30 cm), while the lowest value was (206.97 cm) recorded at control treatment (197.90cm).

Height of Cob (cm)

The results of Table (2) show that there are high significant differences for the combinations of organic fertilization and spraying with nano potassium in the cob height (cm), where the treatment T5 (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) gave the highest rate, which reached(95.93 cm), while the lowest rate was recorded in (T0) treatment which reached (89.51 cm), the increase is due to more photosynthesis activities at the expense of adequate supply of nitrogen because it is a basic requirement for the growth of the cob (fanuel, 2013). Also, the nano- potassium concentrations indicated a difference Significantly, where the highest rate was recorded at K2(2000 mg L^{-1}) which reached (96.63 cm), while the lowest rate was recordeded at K0 which reached (89.95cm), This is due to the role of potassium as a catalyst in increasing the activity of photosynthesis, as well as being a catalyst for many enzymes (IJaz et al, 2014), The results of the interactions indicated that there were high significant differences, where the highest rate was recorded in (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) with K2(2000mg L^{-1}) which reached (99.00 cm), the lowest rate (85.00 cm) was recorded at control treatment.

Table (2) Effect of organic fertilizers combinations and spraying with nano-potassium on cob height (cm**)**

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	85.00	90.67	92.87	89.51
T1	89.30	95.07	97.33	93.90
T2	90.33	96.33	98.87	95.18
T3	90.00	98.00	95.07	94.36
T4	91.53	94.33	96.67	94.18
T5	93.53	95.27	99.00	95.93
Mean	89.95	94.94	96.63	
LSD 0.05	O.M	Kco.	Interaction	
	4.083	2.422	6.058	

Leaves number (leaf plant^{-1})

The results of Table (3) showed a significant effects of the organic fertilization combinations and spraying with nano-potassium on the leaves number, where the treatment T5 (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) gave the highest rate, which reached(13.60 leaf plant^{-1}), while the lowest rate was recorded in (T0) treatment which reached (12.36 leaf plant^{-1}), This is due to the role of organic fertilizers in improving soil fertility, increasing organic matter in the soil, enhancing microbial activities, and increasing nutrients resulting from the decomposition of organic fertilizer, and thus leads to the rapid growth of roots and then increasing the number of leaves in the plant(Abou El-Magd, 2005).

Table (3) Effect of organic fertilizers combinations and spraying with nano-potassium on number of leaves in plant (leaf plant^{-1}).

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	11.50	12.53	13.06	12.36
T1	12.83	12.86	13.20	12.96
T2	12.53	13.30	13.86	13.23
T3	12.80	12.66	13.86	13.11
T4	12.86	13.00	13.20	13.02
T5	13.40	13.53	13.86	13.60
Mean	12.65	12.98	13.51	
LSD 0.05	O.M	Kco.	Interaction	
	0.7581	0.4955	1.1963	

The nano- potassium concentrations indicated a difference Significantly, where the highest rate was recorded at K2 (2000mg L^{-1}) which reached (13.51 leaf plant^{-1}), while the lowest rate was recorded in K0 (12.65 leaf plant^{-1}), This is due to the role of potassium in activating the vital activities of the plant and increasing growth and food processing and transportation, which causes an increase in the number of nodes on the stem and thus leads to an increase in the number of leaves in the plant (Ali, 2016 et al.). The results of the interactions indicated that there were high significant differences, where the highest rate was observed at (T5with K2, T3withK2 and T3 withK2) treatments which reached(13.86 leave plant^{-1}) , while the lowest rate was recorded in control treatment which reached(11.50 leaf plant-^{1}).

Cob diameter (mm)

The results of Table (4) indicated that there were a significant effects of organic fertilization and spraying with nano-potassium on cob diameter (mm), the highest rate was recorded at T5 (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) which reached(46.60 mm),while the lowest rate recorded at (T0) treatment (43.86 mm). It is possible that the use of organic fertilizers lead to an increase in the cob diameter and the increase is higher compared to inorganic fertilizers(Abou El-Magd, 2005).

Table (4) Effect of organic fertilizers combinations and spraying with nano-potassium on cob diameter (mm).

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	42.20	43.97	45.40	43.86
T1	45.30	47.40	45.93	46.21
T2	45.87	45.73	44.43	45.34
T3	45.60	46.23	47.10	46.31
T4	46.13	47.13	45.60	46.29
T5	46.07	46.40	47.33	46.60
Mean	45.19	46.14	45.97	
LSD 0.05	O.M	Kco.	Interaction	
	1.381	0.897	2.171	

As well as the concentrations of nano potassium indicated a significant effects, where the highest rate was recorded at K1(1000mg L^{-1}) which reached (46.14 mm) Which did not differ significantly from the K2 treatment,The increase in the cob diameter may be due to the balanced potassium application, which led to the production of deeper roots and the absorption of more nutrients (Kirkby et al., 2009). while the lowest rate was reached when treatment T0 (45.19mm). Also, the results of the interactions indicated the high significant effects, where the highest rate was observed in T1 treatment with K1 treatment, which reached (47.40 mm) and the lowest rate was recorded in T0 (42.20 mm).

Stem Diameter (mm)

The results of Table (5) show that there a significant differences for the combinations of organic fertilization and spraying with nano-potassium in the characteristic of stem diameter (mm), where the treatment T5 (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) gave the highest rate, which reached(25.54 mm), while the lowest rate was recorded in (T0) treatment which reached (22.94 mm).This may be due to the fact that adding organic fertilizer in the early stages of growth gave the best results, such as the width of the stem and the height of the plant, so adding it increases the thickness of the stem (Gonzalez et al, 2001; Oad et al., 2004) . the potassium nanoparticle concentration K1(1000 mg L^{-1}) gave the highest rate (24.55 mm). the lowest rate (23.27mm) was recorded in K0. This is due to the role of potassium in increasing plant growth by increasing the process of photosynthesis and food processing and increasing the size of cells and its division, which leads to an increase in the leaf area and then an increase in the diameter of the stem (Abu Dahi, 1997), while the results of the interactions indicated the a significant differences for the combinations of organic fertilization and spraying with nano-potassium in the characteristic of stem diameter, where the highest rate was recorded in (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) with K2(2000mg L^{-1}) which reached (25.97 mm), the lowest rate (22.03 mm) was recorded at control treatment.

Table (5) Effect of organic fertilizers combinations and spraying with nano-potassium on stem diameter (mm).

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	22.03	23.23	23.57	22.94
T1	22.37	27.10	24.07	24.51
T2	23.60	24.17	23.83	23.87
T3	22.93	27.47	24.93	24.11

T4	23.60	22.73	22.40	22.91
T5	25.07	25.60	25.97	25.54
Mean	23.27	24.55	24.13	
LSD 0.05	O.M	Kco.	Interaction	
	0.625	0.478	1.142	

DISCUSSION

By reviewing the results of our current study, it becomes clear to us the effect of adding organic fertilizers at T5 in all the traits under study, this is due to the increased availability of the organic matter in improving the physical, chemical and biological properties of the soil as well as its content of nutrients needed by the plant.The results also show us the importance of spraying with nano-potassium, especially the (2000mg L^{-1}) concentration, nanofertilizers provide a large area for various metabolic reactions in the plant, which increases the rate of representation Photosynthesis and more dry matter production and crop productivity.

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AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the international committee of medical journal editors (ICMJE) requirements/guidelines.

CONFLICTS OF INTEREST

The authors report no financial or any other conflicts of interest in this work.

ETHICAL APPROVALS

This study does not involve experiments on animals or human subjects.

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