Original Article

Response of corn (*Zea mays L.*) to combinations of organic fertilization and spraying with potassium nanoparticles in some yield characteristics

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Abstract

A field experiment was conducted in one of the fields of Ibn Al-Bitar Preparatory Vocational School - Holy Kerbala Governorate for the spring season 2021, to know the effect of different sources of organic matter and spraying with potassium nanoparticleson yield of corn (*Zea mays* L.).Randomized Complete Block Design (RCBD) with three replications was used to setup this study. The study included two factors, first factors was the combinations of organic fertilizers:(control, 2000kg ha^{-1}cows, 2000kg ha^{-1}Poultry, 1500 kg ha^{-1} cows + 500kg ha^{-1} poultry, 1000 kg ha^{-1} cows +1000 kg ha^{-1} poultry and 1750 kg ha^{-1} cows + 250 kg ha^{-1} poultry . the Second factor was spraying with nano-potassium (0,1000 mg $L^{-1}$and 2000 mg L^{-1}) .data were statistically analyzed and the averages were compared according to the least significant difference at the 5% probability level. The results showed that the treatment T5 (1750 kg ha^{-1} cows + 250 kg ha^{-1} poultry) was a significantly exceeded in all studied traits. the concentration of potassium nanoparticals (2000 mg L^{-1}) was superior to give highest values in all characteristics under study.We conclude from this study that the integrated application of combinations of organic fertilization and spraying with potassium nanoparticles is more effective in improving yield of corn.

Keywords: organic fertilizer, potassium nanoparticles, yield, corn (*Zea mays L.*)

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

Corn is considered one of the important strategic crops in Iraq and the world, as it ranks third after the wheat and rice crops in the cultivated and has many uses human food , as well as an essential component as animal feed in addition to other industrial purposes (Bukhsh et al., 2010). Also, corn has many useful properties and its importance in current and future global food security is no less important than C4 plants. In addition, it bears it For arid and semi-arid environments (Ghannoum, O.2009). Organic waste, such as crop residues and animals, has many benefits for the microbiological properties of the soil in addition to supplying the soil with nutrients (Stone, D.M 1998) .They enhance soil nutrients as well as regulators of plant growth and biodiversity Thus, an integrated nutrient management system is required to maintain soil health and obtain high productivity , therefore there is an urgent need to use many sources of organic fertilizers as an alternative to reduce the rate The use of inorganic fertilizers (Kakar, K; Nitta.; 2019).Nanofertilizers improve productivity Crops through seed germination carbohydrates And the synthesis of proteins (Solanki, 2015). It is also distinguished from traditional fertilizers by its ease of absorption and reduction of waste As a result of the increase in the ratio of surface to volume, which increases its connection with the parts of the plant that contract with it, as well as because of its molecules which have high surface energy and catalytic properties (Lei et al, 2008, FeiZi et al, 2012) . Potassium is one of the most important nutrients for plant growth and plays an important role in activating photosynthesis enzymes and producing growth, photosynthesis activity and nitrogen metabolism along with Protein and carbohydrates as well as disease and insect resistance (EL-shal R, 2016). Therefore, the study aims to knowing the best organic fertilizer and its combinations and spraying with nano potassium in the yield of corn.

MATERIALS AND METHODS

A field experiment was conducted in the fields of Ibn Al-Bitar Preparatory Vocational School in the Holy Karbala Governorate in Spring season 2021 . 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 (0,1000 and 2000 mg L^{-1}). Superphosphate fertilizer was added before planting and after planting ,Urea fertilizer was added in two doses the elongation stage and flowering stage. while nano potassium was added by spraying on the leaves in two batches. When the plants were harvested at full maturity ,The following characteristics were measured: number of grains in row (grain row^{-1}),number of row in cob(row cob^{-1}), length of cob(cm), grains yield(Mg h^{-1}) and Biological yield (Mg ha^{-1}).

RESULTS AND DISCUSSION

Number of grains in row (grain row^{-1})

The results of Table (1) indicate that there was a significant effect of the organic fertilizer combinations and potassium nanoparticles concentrations on the number of grains per row, where the treatment T5(1750 Kg ha^{-1} cows +250 Kg ha^{-1} poultry) superior to gave the highest rate(43.69) ,the lowest value was observed in the T0 treatment (40.24). The increase in the number of grains in the row was attributed to the role of organic matter in the release of nutrients, including phosphorous, nitrogen and potassium, which led to a significant increase in the number of grains in the row(Mahmood et al 2010) It is also attributed to the role of organic matter in increasing the absorption of elements by the plant and when decomposing it results in organic acids that have the ability to dissolve minerals and release them into the soil solution, and thus increase its readiness and absorption by the plant (Al-Zaydi, 2017). the concentration of potassium nanoparticles(2000mg L^{-1}) was superior by give the highest value (43.23). while the lowest rate was recorded at K0 which reached

(41.26), this is due to the role of potassium in raising the efficiency of the plant in photosynthesis, and consequently more carbohydrate production (Abu Dahi and Younes, 1988).

Table (1) Effect of organic fertilizers combinations and spraying with potassium nanoparticles on number of grains per row (grain row^{-1})

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	38.80	40.47	41.47	40.24
T1	40.70	41.60	42.67	1.66
T2	40.40	41.07	42.87	41.44
T3	42.07	43.53	43.67	43.09
T4	42.47	43.93	44.0 7	43.44
T5	43.13	43.13	44.67	43.69
Mean	41.26	42.29	43.23	
LSD 0.05	O.M	Kco.	Interaction	
	1.578	0.934	2.339	

The interaction also showed a significant differences for the combinations of organic fertilizers and nano potassium concentrations in the number of grains per row, as the highest rate reached when the interaction T5 (1750 Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) with concentration of nano potassium (2000 mg L^{-1}) which amounted (44.67), while the control treatment had the lowest value for the characteristic of the number of grains in a row, which amounted (38.80) .

Number of rows in cob (row cob^{-1})

The results of Table (2) indicate that were a significant differences for the combinations of organic fertilizers and nanopotassium concentrations in the number of rows per cob. T5 treatment (1750 Kg ha^{-1} cows +250 Kg ha^{-1} poultry) was superior to gave the highest rate, which amounted (18.77) ,while the lowest value was recorded in T0 treatment (17.13).The reason for this is due to the role of organic fertilizers in providing nutrients during the growth stage, which in turn works to increase the leaf area of the plant and thus increase the dry matter and then increase the number of rows in the cob(Wuhaib and others, Sharif and others).The concentration of Nano-potassium (2000 mg.L^{-1}) gave the highest rate, which amounted (18.71), while the concentration of Nano-potassium (K0) gave the lowest rate, which amounted (17.36). The reason for the increase is due to the role of potassium in activating enzymes and stimulating their work and thus regulating many vital processes of the plant, thus increasing the number of rows in the cob (Al-Kinani, (2013). The interaction also showed the significant effects of organic combinations and nano-potassium concentrations on the number of rows in the cob. the highest rate recorded in T5 treatment 1750 Kg ha^{-1} cows+250 Kg ha^{-1} poultry) with (2000 mgL^{-1} of potassium nanoparticles (19.13), while the lowest rate was observed at the T0 with K0 treatment which amounted (16.00).

Table (2) Effect of organic fertilizers combinations and spraying with potassium nanoparticles on number of rows per cob (row cob^{-1})

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	16.00	16.93	18.47	17.13
T1	17.40	18.80	18.53	18.24
T2	17.00	17.40	18.63	17.68
T3	18.00	18.00	18.87	18.29
T4	17.47	18.27	18.60	18.11
T5	18.30	18.87	19.13	18.77
Mean	17.36	18.04	18.71	
LSD 0.05	O.M	Kco.	Interaction	
	1.055	0.682	1.653	

Length of cob (cm)

The results of Table (3) indicate that there were a significant differences for the combinations of organic fertilization and the concentrations of nano-potassium in the length of cob (cm), the highest rate was recorded at T5(1750 Kg ha^{-1} cows+250 Kg ha^{-1} poultry) (22.31 cm), the lowest rate was observed at T0 (20.44 cm). The reason for the increase is due to the role of organic matter in raising the efficiency of photosynthesis as well as the adequate supply of nutrients, including nitrogen(Fanuel, Gifole, 2013).The concentrations of potassium nanoparticles indicated that were a significant differences, as the highest rate recorded at(2000 mg L^{-1}) which amounted (22.49 cm), the lowest rate was(20.87cm) recorded at K0 . This is due to the role of potassium in many photosynthesis activities (Ijaz et al.). The results of the interactions also indicated that there were significant differences for the combinations of organic fertilization and potassium nanoparticles concentrations, where the highest rate recorded at T5(1750) Kg ha^{-1} cows + 250 Kg ha^{-1} poultry) with K2 (2000mg L^{-1}) which amounted (22.90 cm), and the lowest rate reached when the control treatment (T0)and K0, which amounted (19.40 cm).

Table (4) Effect of organic fertilizers combinations and spraying with potassium nanoparticles on length of cob(cm)

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	19.40	20.27	21.67	20.44
T1	20.53	21.73	22.87	21.71
T2	21.20	21.60	22.53	21.78
T3	20.80	21.47	22.20	21.49

T4	21.40	21.40	22.80	21.87
T5	21.87	22.17	22.90	22.31
Mean	20.87	21.44	22.49	
LSD 0.05	O.M	Kco.	Interaction	
	0.826	0.540	1.3	

Grains yield(Mg ha^{-1}).

The results of Table (4) indicate that were a significant differences for the combinations of organic fertilization and spraying with nano-potassium in the grains yield, the highest rate observed at T5 (1750 Kg ha^{-1} cows + 250 kg ha^{-1} poultry) which amounted (11.65Mg ha^{-1}) ,While the lowest rate was(9.48 Mg ha^{-1}) in the T0treatment . this is due to the role of the organic matter in improving the physical and chemical properties of the soil and thus increasing the availability of nutrients (ELkurtany, 1989 and Havlin et al ; 2005).The concentrations of potassium nanoparticles also indicated that were high significant differences, the highest rate recorded at K2 (2000 mg L^{-1}) which amounted (10.99 Mg ha^{-1}), the lowest rate (10.18 Mg ha^{-1}) was recorded at K0. The reason for the increase is due to the availability of potassium at the stage of grain formation. It is also due to the role of potassium in activating many enzymes, as well as to its role in building amino acids and proteins, as well as transporting carbohydrates, which. increases the efficiency of photosynthesis and thus leads to an increase in grains yield.

Table (3) Effect of organic fertilizers combinations and spraying with potassium nanoparticles on Grains yield(Mg ha^{-1})

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	8.13	9.80	10.50	9.48
T1	10.78	11.86	11.52	11.38
T2	9.47	9.85	10.07	9.79
T3	10.67	11.46	11.88	11.33
T4	9.43	10.81	11.31	10.52
T5	11.22	11.68	12.06	11.65
Mean	10.18	10.91	10.99	
LSD 0.05	O.M	Kco.	Interaction	
	0.799	0.561	1.377	

The interactions indicated that were a significant effects of the combinations of organic fertilization and nano -potassium concentrations, the highest rate recorded at T5 with K2 (12.06 Mg ha^{-1}) , the lowest rate was observed at T0 with K0 treatment (8.13 Mg ha^{-1}).

Biological yield (Mg ha^{-1})

The results of Table(5) indicated that there were significant differences for the combinations of organic fertilization and spraying with nano-potassium in the biological yield, the highest value was observed at T5 (1750Kg ha^{-1} cows +250 Kg ha^{-1} poultry)which amounted (21.08 Mg ha^{-1}), The lowest rate was recorded at T3 and T4 which amounted (17.85 Mg ha^{-}). This is due to the fact that the addition of organic matter at this level led to an increase in the biological yield of the plant (the dry matter yield) due to its role in increasing the plant's readiness for nutrients such as nitrogen, phosphorous and potassium, and consequently an increase the dry matter of the plant, in addition to the role of organic matter in improving soil properties (Idris, 2003; Al-Baldawi, 2006; Al-Kartani and Al-Ta'I, 2011). The nano- potassium concentrations also indicated a significant differences, where the highest rate recorded at (2000 mg L^{-1}) which amounted (19.42 Mg ha^{-1}) , the lowest rate was recorded at K0 which amounted (18.25 Mg ha^{-1}). The reason for the increase is due to the role of potassium in the formation of sclerenchyma cells, thus increasing the thickness of the stem and its hardness and consequently an increase in the height of the plant and then the increase in the dry matter of the plant (2000, IPI).The results of the interactions also indicated that there were significant

differences, as the highest rate observed at T5 with K2 which amounted (23.83 Mg ha^{-1}), the lowest rate was observed at T0 with K0 which amounted (15.99 Mg ha^{-1}) .

Table (5) Effect of organic fertilizers combinations and spraying with potassium nanoparticles on Biological yield (Mg ha^{-1}).

Organic fertilizers combinations	K concentration			Mean
	K0	K1	K2	
T0	15.99	20.69	19.83	18.83
T1	18.51	18.79	17.30	18.20
T2	19.61	18.92	18.66	19.06
T3	17.76	16.93	18.85	17.85
T4	18.15	17.33	18.06	17.85
T5	19.50	19.90	23.83	21.08
Mean	18.25	18.75	19.42	
LSD 0.05	O.M	Kco.	Interaction	
	1.884	0.798	1.139	

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