Influence of poultry manure , Bentonite and element on the amounts of N, P, K in corn (Zea mays L.)

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Abstract

This study was conducted to determine the effect of Bentonite mineral, poultry manure, and the addition of some elements on the level of N, P, and K in corn plants. A randomized complete block design (RCBD) was used arranged in split plot. The treatments were consisting of 81 experimental units resulting from the three levels of Bentonite mineral (P_0,P_1, and P_2)and three levels of poultry manure (M_0, M_1 ,M2) and three chemical element , which are magnesium, zinc, and copper (E_{mg}, E_{zn}, and E_{cu}), and the effect of these factors on the elements in the plant. The results showed : The level of P_2 addition to the bentonite mineral outperformed the rest of the levels in influencing the element content in the plant . The level M_2 application addition to poultry manure is superior in influencing the content of elements in the plant over other levels. Binary interactions between the mineral and poultry manure showed a significant effect at a probability level of 0.05, and the P_2M_2 treatment outperformed the rest of the treatments . The P_2E_{mg} treatment gave the best effect on the N and K content, and the P2Ecu treatment gave the best effect on the P content of the interaction between the mineral and the chemical elements, while the M_2E_{mg} treatment gave the best effect on the N and K content, and the M_2E_{cu} treatment gave the best effect on the P content of the interaction between poultry manure and the elements.

Keywords: mineral, Organic matter, maize plants. Concentration elements.

Introduction

Bentonite is considered a physical and chemical conditioner to improve some properties of soils, especially sandy ones that occupy vast areas of agricultural land (1) . This type of soil has limitations that make it low productive, as a result of its low content of mineral and organic colloids, which play an important role in the processes of adsorption, exchange, and liberation ionic . As well as its low ability to retain water, ions of nutrients that are quickly lost from the body of sandy soil, and other properties with negative consequences (4). Bentonite is a secondary silicate mineral (1:2) that expands during hydration and dehydration processes, and because it has a high ability to absorb water (2), its volume increases 15 times over its natural form. It is also characterized by a high specific surface area and a high exchange capacity for positive ions. In addition to the other properties that Bentonite has in preparing plant nutrients, all of these contribute to stimulating and quality exploitation of sandy soils for agriculture (5). the addition of poultry manure enhances the effectiveness and activity of the mineral content of sandy soil through the formation of mineral-organic complexes that play an important role in the behavior and movement of ions (3) . The interference of the Bentonite content of accompanying ions during its geological formation with the content of some elements in the organic matter can provide a type of integrated management to improve the properties of sandy soil and the readiness of plant nutrients necessary for plant growth and yield (6). Recent studies have indicated that soil minerals are often linked to organic

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matter, due to the role of minerals in improving soil properties, especially sandy soils, through the physical properties of minerals and providing the soil with nutrients (7).

Materials and Methods

After determining the sandy soil, in the Holy Governorate of Karbala - Al-Hussein Agricultural Project, a field experiment was carried out, adding selected levels of Bentonite at 0, 8, and 12 tons ha^{-1} (P_0, P_1, and P_2) respectively, and poultry waste at levels of 0, 8 and 12 tons ha^{-1} (M_0, M_1, and M_2) respectively, as well as choosing three elements of magnesium, copper, and zinc. The experiment was carried out in a completely randomized block design and in a split-plot arrangement, so that the total number of experimental units reached (81) experimental units resulting from the interaction of the three factors included in the experiment, with three replications (3 x 3 x 3 x 3 = 81), noting that the area of the experimental unit was 3 x 2 m^2. The corn crop for the fall season was planted in lines. NPK chemical fertilizer was added based on the fertilizer recommendation for the corn crop in sandy soils 300 N: 50 P: 120 K kg ha^{-1} (8). Nitrogen was added in two portions at planting and a month after germination as urea , while phosphorus and potassium were added in one application at planting stage as (P_2O_5) and potassium sulphate (K_2O), respectively. magnesium was added in the form of magnesium sulphate ($7H_2O.MgSO_4$) 120 kg. ha^{-1} .while copper and zinc are added in the form of chelated fertilizers (EDTA) 5 kg.ha^{-1}. Random samples were taken from different areas of the field at a depth of (0-30 cm), then they were air-dried, ground, and passed through a sieve with a diameter of 4 mm. Then the samples were mixed well to homogenize, and a single composite sample was taken from them. Then, the chemical and physical characteristics of the study soil were determined in Table 1.

The following methods were used in the analyses:

-The percentage distribution of soil particle sizes was estimated using the pipette method (9).

- The electrical conductivity (EC) was measured in the 1:1 extract using a Mi 180 Bench meter (10).

-The degree of soil interaction in the 1:1 extract was measured using a pH meter (11).

- Dissolved calcium: estimated by elution with EDTA Na_2 Versenate (11).

- Dissolved sodium and potassium : Dissolved sodium and potassium were estimated using a Flame Photometer (11).

- Carbonates and bicarbonates: determined by trituration with sulfuric acid N 0.01 (12).

- Chloride: Determined by electrophoresis with silver nitrate 0.01 N (13).

- Sulfate: Sulfate was determined by precipitation with barium chloride (14).

- Magnesium: Dissolved magnesium was estimated using an atomic absorption device.

- Organic matter was estimated using the Black and Walkely method (11).

Carbonate minerals were estimated by calculating the loss by weight when neutralizing the soil with 3N hydrochloric acid (11).

- The positive ion exchange capacity (CEC) was estimated by saturating the soil with 1N of sodium acetate solution (NaOAC) with pH=8.2, then washing it with ethanol, and sodium ions were displaced with 1N of ammonium acetate solution (12).

Organic waste analyses

Samples of organic manure were taken and dried at 65°C for use in laboratory analyses. Nitrogen, phosphorus, and potassium were

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determined in the organic waste by the wet method (11). Its organic carbon content was estimated in the same way as to estimate the soil's organic matter content. Table 2 shows some chemical characteristics of organic manure

Table 1: Some chemical and physical characteristics of the experimental soil.

Adjective	Unit	value
EC	ds.m^{-1}	4.4
PH		7.5
dissolved ions		
Calcium	meq .L^{-1}	20
magnesium		7
Sodium		30
Potassium		3.8
Chloride		32
Sulfat		5.95
Bicarbonate		1
Carbonate		0.00
Carbonate minerals	%	17.05
OM		0.7
CEC	Kg^{-1} . cmol	3.21
sand	gm.kg^{-1}	981.4
silt		13.1
Clay		5.5
texture		Sandy

Table 2. Some chemical characteristics of organic waste.

Adjective	Unit	value
Total N	gm.kg^{-1}	15. 92
Total P		7.89
total K		6.5
organic carbon		231.67
C:N		14.55

Statistical analysis

our data were analyzed using software program Genstat (2009) at 0.05 level of significancy.

Results and Discussion

Table 3 shows the effect of Bentonite mineral, poultry manure, and elements on the nitrogen values in the plant. The results showed that there were significant differences between the addition levels, of the treatments to which the mineral was added had a significant effect on

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the plant's nitrogen, if the p_2 level, which amounted to (3.654%), exceeded the level p_0 and p_1, which amounted to (2.547, 3.220%) respectively, and this is attributed to the role of the Bentonite mineral in the ion exchange process of potassium in sandy soils. These results are consistent with the findings of (15).

As for the effect of poultry manure, the treatments to which poultry manure was added affected the rest of the treatments, then the M_2 level, which amounted to (3.777%), exceeded the M_0 and M_1 levels, which amounted to (2.303 , 3.341 %) respectively, and this is attributed to the role of organic matter. In improving the chemical properties of the soil and fertility, and preserving potassium in the soil as well as its potassium content, which is released to the equilibrium medium, This result in line with (13,14). As for the effect of the added element on plant nitrogen values, it had a significant effect, as the treatment with the element E_{mg} which amounted to (3.397),

Table 3: Effect of Bentonite mineral, poultry waste, elements and their interaction on nitrogen in leaves %.

Treatments		Elements			P*M
Bentonite	Poultry waste	E mg	E zn	E cu	

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P_0	M_0	1.580	1.733	1.523	1.612
	M_1	2.850	2.760	2.430	2.680
	M_2	3.727	3.213	3.110	3.350
P_1	M_0	1.960	2.373	2.310	2.214
	M_1	4.050	3.360	3.390	3.600
	M_2	4.357	3.773	3.410	3.847
P_2	M_0	3.363	3.053	2.830	3.082
	M_1	4.147	3.563	3.523	3.744
	M_2	4.540	3.823	4.040	4.134
)0.05(LSD		P*M*E=0.2874			P*M=0.1695
Average elements		3.397	3.073	2.952	
LSD(0.05)		E= 0.0987			
					Average Bentonite
P*E	P_0	2.719	2.569	2.354	2.547
	P_1	3.456	3.169	3.037	3.220
	P_2	4.017	3.480	3.464	3.654
(0.05LSD)		P*E= 0.1744			P =0.1367
					Average poultry waste
M*E	M_0	2.301	2.387	2.221	2.303
	M_1	3.682	3.228	3.114	3.341
	M_2	4.208	3.603	3.520	3.777
)0.05 (LSD		M*E== 0.1642			M=0.0958

outperformed the treatment with the elements E_{zn} and Ecu, which amounted to (3.073 , 2.952) , respectively. We claim this result to the application of is attributed to the effect of the added elements on the corn plant because it Achieved a balance between nutrients in the soil (18). As for the effect of the interaction between mineral levels and poultry manure , the results show that there are significant differences between the treatments as a result of the joint interaction between the metal and the waste if the highest value is for the P_2M_2 treatment (4.134%) and the lowest value is for the P_0M_0 treatment (1.612%). And the interaction between mineral and elements, the results show that there are significant differences between the treatments if the highest value is for the treatment P_2E_{mg} (4.017%) and the lowest value is for the treatment P_0E_{cu} (2.354%). This is due to the interfering effect between the levels of metal and residues, the levels of mineral and elements, and the role of metal and organic matter. In improving soil properties and preserving nutrients in the soil and its effect on the elements added to the soil,

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which have an important role in increasing the growth rate and stimulating enzymes within the plant (19, 20). As for the effect of the interaction between poultry manure and the elements, the results showed that there were significant differences between the treatments if the highest value was for the M_2E_{mg} treatment (4.208) and the lowest value for the M_0E_{cu} treatment (2.221). This is attributed to the overlapping effect between the poultry manure and the elements and the role of organic matter in preserving the elements in the soil and increasing Its readiness to plant (23). As for the effect of the triple interference between the treatments, the results showed that there were significant differences between the treatments, with the highest value for the treatment $P_2M_2E_{mg}$ (4.540) and the lowest value for the treatment $P_0M_0E_{cu}$ (1.523). Table 4 shows the effect of the mineral Bentonite, poultry manure, and elements on the phosphorus values of the plant. The results showed that there were significant differences between the addition levels if the treatments to which the mineral was added had a significant effect on the plant's phosphorus, and if the P_2 level, which amounted to (0.3867%), exceeded the p_0 level. And P_1, which amounted to (0.2644, 0.3152%) respectively. This is attributed to the role of clay minerals that are added to

Treatments	Elements	

Table 4: Effect of Bentonite mineral, poultry waste, elements and their interaction on phosphorus in leaves %.

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Bentonite	**Poultry waste**	E mg	E zn	E cu	P*M
P_0	M_0	0.2167	0.2333	0.2233	0.2244
	M_1	0.2467	0.2733	0.2733	0.2644
	M_2	0.2733	0.3167	0.3233	0.3044
P_1	M_0	0.2200	0.2333	0.2500	0.2344
	M_1	0.2867	0.3333	0.3367	0.3189
	M_2	0.3667	0.3800	0.4300	0.3922
P_2	M_0	0.2500	0.2900	0.3067	0.2822
	M_1	0.3300	0.3600	0.3933	0.3611
	M_2	0.4533	0.5567	0.5400	0.5167
)0.05(LSD		P*M*E= 0.02632			P*M=0.01550
Average elements		0.2937	0.3307	0.3419	
LSD(0.05)		E= 0.00902			
					Average Bentonite
P*E	P_0	0.2456	0.2744	0.2733	0.2644
	P_1	0.2911	0.3156	0.3389	0.3152
	P_2	0.3444	0.4022	0.4133	0.3867
)0.05(LSD		P*E= 0.01424			P =0.00864
					Average poultry waste
M*E	M_0	0.2289	0.2522	0.2600	0.2470
	M_1	0.2878	0.3222	0.3344	0.3148
	M_2	0.3644	0.4178	0.4311	0.4044
)0.05 (LSD		M*E=0.01577			M=0.01016

the soil as fertilizers or amendments that lead to increased plant growth because they contain elements necessary for growth as well as improving soil properties (21).

As for the effect of adding poultry manure , the treatments to which poultry manure was added affected the rest of the treatments, then the M_2 level, which amounted to (0.4044%), exceeded the M_0 and M_1 levels, which amounted to (0.2470, 0.3148%), respectively. This is attributed to the role of organic matter. Because it provides nutrients continuously, creates a new balance of nutrients for the plant, and reduces the loss of elements by absorbing them on the surface of soil particles (22).

As for the effect of the added element on plant phosphorus values, it had a significant effect. The E_{cu} treatment, which amounted to (0.3419), outperformed the treatment of the E_{mg} and E_{zn} elements, which amounted to (0.2937, and 0.3307), respectively. This is

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attributed to the effect of the element fertilizers added to the soil and what they achieve. Balance of nutrients in the soil. As for the effect of the interaction between mineral levels and poultry manure, the results showed that there were significant differences between the treatments, as the highest value was for the P_2M_2 treatment (0.5167%) and the lowest value was for the P_0M_0 treatment (0.2244%), as well as the interaction between mineral and elements, where the highest value was for the P_2E_{cu} treatment (0.4133%) ، and the lowest value for the transaction P_0E_{mg} (0.24564%) ,This is due to the interfering effect between the levels of mineral and residues, the levels of mineral and elements, and the role of mineral and organic matter. In improving soil properties, preserving nutrients in the soil, and its effect on the elements added to the soil, which have an important role in increasing the growth rate and stimulating enzymes within the plant (3). As for the effect of the interaction between poultry manure and the elements, the results showed that there were significant differences between the treatments if the highest value was for the M_2E_{cu} treatment (0.4311) and the lowest value was for the M_0E_{mg} treatment (0.2289). This is attributed to the overlapping effect between the poultry manure and the elements and the role of organic matter in preserving the elements in the soil and increasing Its readiness to plant, (23). As for the effect of the triple interference between the treatments, the results showed that there were significant differences between the treatments, with the highest value for the treatment $P_2M_2E_{zn}$ (0.5567) and the lowest value for the treatment $P_0M_0E_{mg}$ (0.2167). This is due to the overlapping effect of the triple factors involved in the experiment.

Table 5 shows the effect of the mineral Bentonite, poultry manure, and elements on the potassium values of the plant. The results showed that there were significant differences between the levels of addition. If the treatments to which the mineral was added had a significant effect on the potassium of the plant, if the p_2 level, which amounted to (1.4130%), exceeded the level p_0 and p_1, which amounted to (0.9363, 1.1470%) respectively. This is attributed to the role of Bentonite mineral in improving the chemical properties of the soil and increasing the readiness of the elements in the soil, because of its high exchange capacity for positive ions that achieves a balance of nutrients in the soil (3).

As for the effect of adding poultry manure, if the treatments to which poultry manure was added affected the rest of the treatments, then the M_2 level, which amounted to (1.43594%), exceeded the M_0 and M_1 levels, which amounted to (0.8944, 1.1659%) respectively, and this is attributed to the role of organic matter. Its action as a chelating substance works to retain nutrients, in addition to the release of these elements when it dissolves, which leads to an increase in the readiness of the plant (24).

As for the effect of the added element on plant potassium values, it had a significant effect. The treatment with the element E_{mg}, which amounted to (1.2037), outperformed the treatment with the elements E_{zn} and E_{cu}, which amounted to (1.19157, 1.1011), respectively. This is attributed to the effect of the elements added to the soil and their role in supplying The soil contains the nutrients necessary for plant growth. As for the effect of the interaction between mineral levels and poultry manure, if the results show that there are significant differences between the treatments

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as a result of the joint interaction between the metal and the waste if the highest value is for the P_2M_2 treatment (1.8333%) and the lowest value is for the P_0M_0 treatment (0.7589%). And the interact

ion between the mineral and the elements, if the results show that there are significant differences between the treatments if

Table 5: Effect of Bentonite mineral, poultry waste, elements, and their interaction on potassium in leaves, %.

Treatments		**Elements**			
Bentonite	**Poultry**	E mg	E zn	E cu	P*M

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	waste				
P_0	M_0	0.8067	0.7933	0.6767	0.7589
	M_1	0.9833	0.9767	0.9500	0.9700
	M_2	1.1000	1.1067	1.0333	1.0800
P_1	M_0	0.8967	0.9333	0.8300	0.8867
	M_1	1.1567	1.2067	1.1167	1.1600
	M_2	1.3167	1.4767	1.3900	1.3944
P_2	M_0	1.0567	1.0533	1.0033	1.0378
	M_1	1.2967	1.4467	1.3600	1.3678
	M_2	2.2200	1.7300	1.5500	1.8333
)0.05(LSD		P*M*E=0.12732			P*M=0.05590
Average elements		1.2037	1.1915	1.1011	
LSD(0.05)		E= 0.04769			
					Average Bentonite
P*E	P_0	0.9633	0.9589	0.8867	0.9363
	P_1	1.1233	1.2056	1.1122	1.1470
	P_2	1.5244	1.4100	1.3044	1.4130
)0.05(LSD		P*E= 0.07067			P=0.03003
					Average poultry waste
M*E	M_0	0.9200	0.9267	0.8367	0.8944
	M_1	1.1456	1.2100	1.1422	1.1659
	M_2	1.5456	1.4378	1.3244	1.4359
)0.05 (LSD		M*E== 0.07506			M=0.03693

the highest value is reached for the treatment P_2E_{mg} (1.5244%) and the lowest value is for the treatment P_0E_{cu} (0.8867%), and this is attributed to the interfering effect between the mineral and the organic matter and the preservation of ready potassium in the equilibrium medium, and thus It is easily absorbed by the plant and is not washed off (15). As for the effect of the interaction between poultry manure and the elements, the results showed that there were significant differences between the treatments if the highest value was for the M_2E_{mg} treatment

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(1.5456) and the lowest value for the M_0E_{cu} treatment (0.8367). This is attributed to the overlapping effect between the poultry manure and the elements and the role of organic matter in preserving the elements in the soil and increasing Ready to plant, (23). As for the effect of the triple interference between the treatments, the results showed that there were significant differences between the treatments, with the highest value for the treatment $P_2M_2E_{mg}$ (2.2200) and the lowest value for the treatment $P_0M_0E_{cu}$ (0.6767). This is due to the overlapping effect of the triple factors involved in the experiment.

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