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وحماية المستهلك

THE EFFECT OF MAGNESIUM IN CHEMICAL EQUILIBRIUM FORMS OF POTASSIUM AND THE GROWTH OF YELLOW CORN IN TOW SOILS OF DIFFERENT TEXTURE

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ABSTRACT

This study was conducted to determine the effect of adding magnesium on the chemical equilibrium of potassium. The study included five levels of magnesium, Mg_0, Mg_1, Mg_2, Mg_3, and Mg_4, and two levels of potassium, K_0 and K_{100}, in two soils of different textures. The results of the study showed that adding magnesium contributed to increasing soluble, exchangeable, and non-exchangeable potassium. And by 64.706, 105.882, 164.706, and 235.294% / 13.986, 29.680, 47.945, and 77.169% / 4.538, 8.372, 13.224, and 26.682% for the level Mg_1, Mg_2, Mg_3, and Mg_4 compared to Mg_0, respectively. The soil with a silt clay texture outperformed the soil Silt Clay Leom texture with percentages of 131.818, 15.074 and 8.254%, for dissolved, exchangeable and non-exchangeable potassium, respectively.

key words: dispersion Clay, release of potassium, exchanged potassium, Unexchanged potassium.

تأثير المغنيسيوم في صور الاتزان الكيميائي للبوتاسيوم ونمو الذرة الصفراء في تربتي ذات نسجة مختلفة

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الخلاصة

جريت هذه الدراسة لمعرفة تأثير اضافة المغنيسيوم في صور الاتزان الكيميائي لعنصر البوتاسيوم تضمنت الدراسة أضافة خمس مستويات من المغنيسيوم Mg_0 وMg_1 وMg_2 وMg_3 و Mg_4 ومستويين من البوتاسيوم K_0 و K_{100} في تربتين مختلفتي النسجة ،اظهرت نتائج الدراسة ان اضافة المغنيسيوم قد ساهم في زيادة البوتاسيوم الذائب والمتبادل وغير المتبادل وبنسبة 64.706 و105.882 و164.706 و235.294 % 13.986 و29.680 و47.945 و77.169%، 4.538 و 8.372 و13.224 و26.682 % وللمستوى Mg_1 وMg_2 وMg_3 وMg_4 بالمقارنة مع Mg_0 على التوالي وتفوقت التربة ذات النسجة طينية غرينية على التربة ذات النسجة مزيجية طينية غرينية وبنسبة 131.818 و15.074 و8.254% وللبوتاسيوم الذائب والمتبادل وغير المتبادل على التوالي .

الكلمات المفتاحية : تشتيت ، تحرر البوتاسيوم ، البوتاسيوم المتبادل ، البوتاسيوم غير المتبادل

INTRODUCTION

Potassium is an essential nutrient in plants. Therefore, it has become necessary to know the condition and fate of the potassium added to the soil, the extent of the crops' response to it, and whether the added potassium, which may be subject to fixation in the soil, can be released again, how quickly it is released, and what are the factors affecting the speed of its release. The results also showed that 28-76% of the added potassium is subject to fixation in minerals clay. **(Al-Shamare & Essa, 2020; AL-Taee & Al-Maamouri, 2020; AlKhalil &Essa, 2020; AlKhalil &Essa, 2021; Al-Shamary *et al.*, 2022).** The chemical behavior of any element affects the effectiveness and behavior of some other elements, either directly through the process of competition for the surface of the complex exchange and displacement, or indirectly through influencing other soil properties Magnesium is one of the elements that has the ability to disperse soil particles, and the main reason for this specific effect is due to the large size of its hydrosphere compared to calcium and the small size of the real ion, as it is (0.078 nm) while calcium (0.106 nm), in addition to its role in influencing the process of Ion exchange, as it carries a dual charge, **(Al-Marsoumi & Jarallah, 2019).** Also, magnesium is mobile in the soil, unlike other cations, and because of the large volume of the hydrosphere, this results in a relatively high abundance of this element in the soil solution and thus a decrease in its deposition. Also, the mobility of magnesium in the soil and the extent of its availability to plants is determined not only by its quantity but also by soil characteristics When the pH Soil. When the soil is less than 6.0, it is exposed to leaching in acidic soils, cation exchange capacity, concentration of other ions, humidity, temperature, and agricultural management practices such as fertilization. The magnesium ion is characterized by behavior and physicochemical properties that distinguish it from the rest of the other ions existing in the soil, such as the ion charge, diffusion coefficient, ionic diameter, polarity, and its role in dispersion clay and its reflection on the equilibrium forms of potassium in the soil, its relationship to plant growth **(Nafawa, 2017)**. The current study aims to study the effect of magnesium and texture on the chemical equilibrium of potassium and the growth of maize plants.

MATERIALS AND METHODS

A biological experiment was carried out on two soils of different textures (silt clay and silt clay Leom) after the soil was brought from the field, dried and ground with a sieve with holes diameter of 4 mm. Chemical and physical analyzes of the soil were also conducted according to what was stated in (Black, 1965, and Jackson, 1958), the characteristics of which are shown in Table 1. Magnesium was added at five levels in the form of magnesium sulphate (100, 75, 50, 25.0) kg.ha^{-1}. Potassium was also added at two levels (0 and 100) kg.ha^{-1} in the form of potassium sulphate (41% K) and 200% was added kg ha^{-1} of nitrogen in the form of urea (46% N) and 100 kg ha^{-1} of phosphorus in the form of superphosphate fertilizer (21 P%). The seeds of yellow corn, a local variety, were planted in plastic pots with a capacity of 25 kg of soil, at a rate of 5 seeds per pot. They thinned out after a week of Germination into three plants. The forms of potassium (soluble, exchangeable and non-exchangeable) were estimated 90 days after germination. The absorbed potassium, plant height and leaf area were also estimated**.**

Table (1): Some chemical and physical properties of soil

Traits	Measurement value	value (S_1)	value (S_2)
Ece	$dS.m^{-1}$	3.80	2.04
pH	------	7.82	8.02
Ca^{2+}	$mmol.L^{-1}$	9.88	5.25
Mg^{2+}		6.65	3.71
Na^{+}		4.60	2.30
K^{+}		0.34	0.18
Cl^{-}		7.30	4.73
HCO_3^{-}		5.00	3.51
SO_4^{2-}		12.85	6.08
CO_3^{2-}		NiL	NiL
CEC	$Cmmol.Kg^{-1}$	35.40	28.20
Organic matter	$gm.Kg^{-1}$ Soil	7.12	6.30
Total Carbonate		265.8	278.6
Active Carbonate		175	100
Clay		423.00	374.90
Silt		462.00	524.50
Sand		115.00	100.60
Texture	-------	Silt Clay	Silt Clay Leom
Solube K^{+}	$Cmmol.Kg^{-1}$ Soil	0.03	0.02
Exchangeable K^{+}		0.27	0.24
Unexchangeable K^{+}		1.46	1.33
Mineral K^{+}		30.98	27.21
Total K^{+}		32.75	28.80

RESULTS AND DISCUSSION

1. The effect of soil texture and the levels of magnesium and added potassium in the concentration of solube potassium cmmol $K^{+}.kg^{-1}$ soil

Table (2) showed the effect of soil texture and the levels of magnesium and added potassium in the amount of soluble potassium. The results showed that there were significant differences between the treatments in increasing the amount of soluble potassium by 131.818% in the S_1 treatment compared to the S_2 treatment, and this was confirmed by **(Hamid *et al.*, 2021)**. On the role of soil texture, the amount of clay and silt, and its mineral composition in the amount of dissolved potassium in the soil, where there is a positive significant relationship with clay and silt and a negative relationship with sand in increasing the amount dissolved potassium in the soil. As for the effect of added magnesium levels, the results showed a significant increase in the amount of dissolved potassium by 64.706, 105.882, 164.706 and 235.294% for the levels Mg_1, Mg_2, Mg_3 and Mg_4 compared to the control treatment Mg_0, respectively. The results also showed that Mg_4 was superior to all levels of Mg in both soils. Which may have contributed to increasing the readiness of potassium through the role of magnesium in displacing potassium on the surface of soil particles and thus increasing its dissolved content due to concentration and equivalence. The results also showed that adding potassium fertilizer at different levels led to a significant increase in soluble potassium by 165% in the K_{100} treatment compared to the K_0 control treatment, and this is consistent with what was indicated by **(Al-Aqrawi, 2018; AlObaidi & Abdel-Rida, 2021)**. it Increasing the levels of potassium fertilizer added led to an increase in the amount of dissolved potassium. As for the bilateral interaction between soil texture and magnesium levels, the results showed significant differences between the different treatments, and the highest value in the S_1Mg_4 treatment was 0.071 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with S_2Mg_0 was 0.008 cmmol K^+. kg^{-1} soil. This is due to the interplaying effect of soil texture and magnesium levels in the amount of dissolved potassium. The same trend also occurred with the bilateral interaction between the levels of added magnesium and potassium. The results showed significant differences between the different treatments, and the highest value in the $K_{100}Mg_4$ treatment was 0.082 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with K_0Mg_0 was 0.008 cmmol $K^+.kg^{-1}$ soil. The reason for this is attributed to the interfering effect of the levels of magnesium and potassium fertilizer in the amount of dissolved potassium. The bilateral interaction between soil texture and potassium levels had a significant effect in the amount of dissolved potassium, and the highest value when treated with S_1K_{100} was 0.075 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with S_2K_0 was 0.013 cmmol $K^+.kg^{-1}$ soil.

Table (2): Effect of soil texture and levels of magnesium and added potassium in the concentration of solube potassium Cmmol K^+. kg^{-1} soil.

S*K	**Mg_4**	**Mg_3**	**Mg_2**	**Mg_1**	**Mg_0**	**K**	**S**
0.08	0.10	0.09	0.08	0.07	0.04	K100	S_1
0.03	0.04	0.03	0.03	0.02	0.01	K0	
0.03	0.06	0.04	0.02	0.02	0.01	K100	S_2
0.01	0.02	0.015	0.013	0.01	0.006	K0	
0.006			**0.01**			**LSD**	
S Average							
0.05	0.07	0.06	0.05	0.04	0.03	S1	S*Mg
0.02	0.04	0.03	0.018	0.01	0.01	S2	
0.004			0.004			LSD	
K Average							

0.05	0.08	0.07	0.05	0.04	0.03	K100	K*Mg
0.02	0.03	0.03	0.02	0.02	0.01	K0	
0.004			**0.004**			**LSD**	
	0.06	0.05	0.04	0.03	0.02	Mg Average	
			0.003			LSD	

As for the triple interaction between soil texture, magnesium levels, and potassium fertilizer, the results indicate that there are significant differences in the amount of dissolved potassium. The highest value appeared in the S_1K_{100} Mg_4 treatment, amounting to 0.101 cmmol K^+. kg^{-1} soil, while the lowest rate of soluble potassium in the $S_2K_0Mg_0$ treatment was 0.006 cmmol K^+. kg^{-1} soil.

2. Effect of soil texture and levels of magnesium and added potassium in the concentration of exchangeable potassium centimol K^+.kg^{-1} soil.

Tables (3) showed the effect of soil texture, magnesium fertilizer, and potassium fertilizer in the amount of potassium exchanged. The results showed that there were significant differences between the treatments. The results also indicated that the S_1 treatment was superior to S_2 due to its high clay content, which contributes to increasing the amount of potassium exchanged over The surface, as the silty clay texture outperformed the soil with a mixed clay-silty texture, by 15.074%, and this was confirmed by **(Hamid *et al.*, 2021)** about the role of soil texture and the amount of clay and silt in the amount of potassium exchanged in the soil, as there is a positive significant relationship with clay and silt. And negative with sand in increasing the amount of potassium exchanged in the soil. As for the effect of added magnesium levels, the results showed a significant increase in the amount of exchangeable potassium, as the percentage increase in exchangeable potassium for magnesium fertilizer levels reached 13.698, 29.680, 47.945, and 77.169% for the levels Mg_1, Mg_2, Mg_3, and Mg_4 compared to the control treatment Mg_0, respectively, which may have contributed In increasing the readiness of potassium through the role of magnesium in displacing potassium on the surface of soil particles and thus increasing its exchange rate due to concentration and equivalence. The results also showed that adding potassium fertilizer at different levels led to a significant increase in potassium exchanged in the K_{100} treatment by 42.149% compared to the K_0 control treatment, and this is consistent with what was indicated **by (Al-Aqrawi, 2018; Al-Obaidi & Abdel-Rida, 2021)** on the role of added potassium in preparing exchangeable potassium during the growth stage, which led to an increase in the amount of exchangeable potassium. As for the bilateral interaction between the levels of soil texture and magnesium, the results showed significant differences between the different treatments, and the highest value in the S_1Mg_4 treatment was 0.436 cmmol K^+.kg^{-1} soil and the lowest value when treated with S_2Mg_0 was 0.205 cmmol K^+.kg^{-1} soil, the reason for this is attributed to the interplaying effect of soil texture and magnesium levels in the amount of potassium exchanged. The same trend also occurred with the bilateral interaction between the levels of added magnesium and potassium. The results showed significant differences between the different treatments, and the highest value in the $K_{100}Mg_4$ treatment was 0.436 cmmol K^+.kg^{-1} soil and the lowest value when treated with K_0Mg_0 was 0.169 cmmol $K^+.kg^{-1}$ soil, the reason for this is attributed to the interfering effect of magnesium levels and potassium fertilizer in the amount of potassium exchanged. The bilateral interaction between soil texture and potassium levels had an effect Significant in the amount of potassium exchanged, the highest value when treated with S_1K_{100} was 0.362 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with S_2K_0 was 0.219 cmmol $K^+.kg^{-1}$ soil. As for the triple interaction, the results showed that there were significant differences between the treatments in the amount of potassium exchanged, as the highest rate of potassium exchanged in the S_1K_{100} Mg_4 treatment was 0.482 cmmol $K^+.kg^{-1}$ soil, while the lowest rate of exchangeable potassium in the $S_2K_0Mg_0$ treatment was 0.157 cmmol $K^+.kg^{-1}$ soil.

Table (3): Effect of soil texture and levels of added magnesium and potassium in the exchangeable potassium concentration Cmmol K^+. kg^{-1} soil.

S*K	Mg_4	Mg_3	Mg_2	Mg_1	Mg_0	K	S
0.36	0.48	0.41	0.33	0.30	0.29	K_{100}	S_1
0.26	0.39	0.29	0.25	0.21	0.18	K_0	
0.33	0.39	0.36	0.34	0.29	0.25	K_{100}	S_2
0.22	0.29	0.24	0.21	0.20	0.16	K_0	
0.006	0.014					LSD	
S Average							
0.31	0.44	0.35	0.29	0.26	0.23	S_1	S*Mg
0.27	0.34	0.30	0.28	0.24	0.21	S_2	
0.005	0.01					LSD	
K Average							
0.34	0.44	0.39	0.33	0.29	0.27	K_{100}	K*Mg
0.24	0.34	0.26	0.23	0.21	0.17	K_0	
0.005	0.01					LSD	
	0.39	0.32	0.28	0.25	0.22	Mg Average	
	0.007					LSD	

3. **The effect of soil texture and the levels of magnesium and added potassium in the concentration of unexchanged potassium centimol $K^+.kg^{-1}$ soil.**

Tables (4) showed the effect of soil texture, magnesium fertilizer, and potassium fertilizer in the amount of non-exchangeable potassium. The results showed that there were significant differences between the treatments. The results also indicated that the S_1 treatment was superior to S_2 due to its high content of clay and non-exchangeable potassium, as the percentage of increase in The amount of non-exchangeable potassium in the S_1 treatment was 8.254% compared to the S_2 treatment. This was confirmed by **(Hamid *et al.*, 2021)** about the role of the amount of clay in increasing the amount of non-exchangeable potassium through the stabilization process between the layers.in addition to the type of clay mineral in the soil, which contribute It greatly increases the amount extracted from it in the analysis process**.** As for the effect of added magnesium levels, the results showed a significant increase in the amount of unexchanged potassium, as the percentage increase in unexchanged potassium reached 4.538, 8.372, 13.224, and 26.682% for the levels Mg_1, Mg_2, Mg_3, and Mg_4 compared to the control treatment Mg_0, respectively. This is attributed to the effect of magnesium on Dispersion of layers of minerals and the release of a portion of the potassium fixed between those layers. This is what was confirmed by **(Nafawa ,2017)** in the role of magnesium in dispersion soil particles due to the expansion of the volume of its hydrosphere and to the small crystal radius, which is 0.78A° . The results also showed that adding potassium fertilizer at different levels led to a significant increase in non-exchangeable potassium by 18.056% in the K_{100} treatment compared to the K_0 control treatment. This is consistent with what **(Mahmood *et al.*, 2019)** indicated about the role of the effect of the potassium fertilizer fraction added. In occupying the fixation sites, which leads to an increase in the amount of non-exchangeable potassium, and the excess is ready for absorption by the plant.

Table (4): Effect of soil texture and levels of added magnesium and potassium in concentration Unexchanged potassium Cmmol K^+. kg^{-1} soil.

S*K	**Mg_4**	**Mg_3**	**Mg_2**	**Mg_1**	**Mg_0**	**K**	**S**
1.61	1.79	1.61	1.57	1.54	1.52	K100	S_1
1.33	1.54	1.38	1.32	1.28	1.15	K0	
1.45	1.64	1.49	1.44	1.36	1.35	K100	S_2
1.26	1.51	1.32	1.21	1.16	1.10	K0	
0.006	**0.014**					**LSD**	
S Average							
1.47	1.66	1.49	1.45	1.41	1.33	S1	S*Mg
1.36	1.57	1.40	1.32	1.26	1.22	S2	
0.004	0.010					LSD	

K Average							
1.53	1.71	1.55	1.50	1.45	1.43	K100	K*Mg
1.30	1.52	1.35	1.27	1.22	1.12	K0	
0.004	**0.010**					**LSD**	
	1.62	1.45	1.39	1.34	1.28	Mg Average	
	0.007					LSD	

As for the bilateral interaction between soil texture and magnesium levels, the results showed significant differences between the different treatments, and the highest value in the S_1Mg_4 treatment was 1.664 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with S_2Mg_0 was 1.224 cmmol $K^+.kg^{-1}$ soil. This is due to the interplaying effect of soil texture and magnesium levels in the amount of non-exchangeable potassium. The same trend also occurred with the bilateral interaction between the levels of added magnesium and potassium. The results showed significant differences between the different treatments, and the highest value in the $K_{100}Mg_4$ treatment was 1.714 centimoles K^+. Kg^{-1} soil and the lowest value when treated with K_0Mg_0 was 1.124 cmmol K^+. kg^{-1} soil, the reason for this is attributed to the interfering effect of magnesium levels and potassium fertilizer in the amount of unexchanged potassium. The bilateral interaction between soil texture and potassium levels had a significant effect in the amount of unexchanged potassium, and the highest value when treated with S_1K_{100} was 1.606 cmmol $K^+.kg^{-1}$ soil and the lowest value when treated with S_2K_0 was 1.259 cmmol $K^+.kg^{-1}$ soil. As for the triple intervention, the results showed that there were significant differences between the treatments in the amount of non-exchanged potassium, as the highest rate of non-exchanged potassium in the S_1K_{100} Mg_4 treatment reached 1.787 centimol $K^+.kg^{-1}$soil, while the lowest rate of non-exchangeable potassium in the $S_2K_0Mg_0$ treatment was 1.101 cmmol $K^+.kg^{-1}$ soil.

4. The effect of soil texture and levels of magnesium and added potassium in the amount of potassium absorbed, mg $K.plant^{-1}$

Figure (1) shows the effect of soil texture, magnesium fertilizer, and potassium fertilizer in the amount of potassium absorbed (mg K. $plant^{-1}$). The results showed that the S_1 treatment was superior to S_2 due to its higher content of clay and ready-made potassium compared to S_2, as the percentage of increase in the amount of absorbed potassium was In the S_1 treatment, 11.111% respectively compared to the S_2 treatment, and this was confirmed by **(Hamid *et al.*, 2021)** . about the role of soil texture and the amount of clay in the properties of the soil and its ability to supply plants With nutrients and its effect on increasing the amount of potassium absorbed. As for the effect of magnesium fertilizer levels, the results showed that there were significant differences in the amount of potassium absorbed, as the percentage increase in the amount of potassium absorbed when using magnesium fertilizer levels reached 5.488, 12.670, 21.815, and 39.597% for the levels Mg_1, Mg_2, Mg_3, and Mg_4 compared to the comparison treatment Mg_0 on respectively, this is consistent with what was obtained by **(Al-Fadhly *et al.*, 2019)** who showed that adding levels of magnesium positively affected the amount of potassium absorbed in the plant. The results also showed that there were significant differences between the treatments. Adding potassium fertilizer at different levels significantly affected the amount of potassium absorbed by the plant, as the percentage increase in the amount of potassium absorbed in the K_{100} treatment when using potassium fertilizer levels was 20.262% compared to the comparison treatment K_0, and the reason for this is Added potassium increases the efficiency of the photosynthesis process, then increases the weight of the plant and absorbs the largest amount of nutrients during the growth stage. This is consistent with what was indicated by **(Asaad & Abdel-Rasoul, 2017; Elfahdawi *et al.*, 2020)**. As for the bilateral interaction between soil texture and magnesium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and magnesium levels in the amount of potassium absorbed. The same trend also occurred when the bilateral interaction between magnesium levels and potassium fertilizer in the soil. The results showed significant differences. between different transactions this is due to the interfering effect of magnesium and potassium fertilizer levels in the amount of potassium absorbed. As for the bilateral interaction between soil texture and potassium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and potassium levels in the amount of potassium absorbed. As for the three-way interaction between soil texture and the levels of added magnesium and potassium, the results indicate that there are significant differences in the amount of potassium absorbed, as the highest rate in the amount of potassium absorbed in the S_1K_{100} Mg_4 treatment reached 7533.51 mg K.plant^{-1}, while the lowest rate was in the amount The potassium absorbed in the $S_2K_0Mg_0$ treatment amounted to 3987.92 mg K. plant^{-1}, and the reason for this is attributed to the interfering effect of both the soil texture and the levels of added magnesium and potassium in influencing the amount absorbed by the plant.

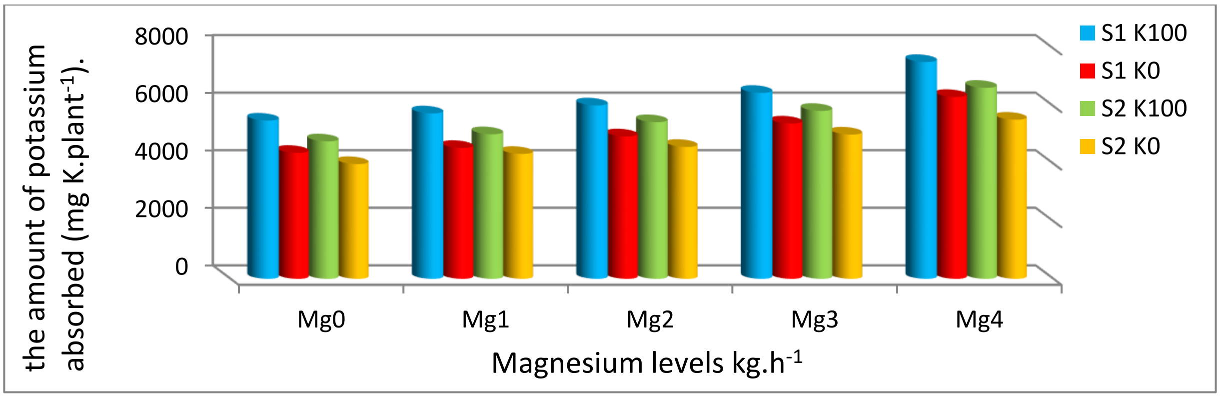

Figure (1): The effect of soil texture and the levels of magnesium and added potassium in the amount of potassium absorbed, mg K. plant^{-1} after 90 days of planting.

5. The effect of soil texture and levels of magnesium and added potassium in plant height, cm

Figure (2) shows the effect of soil texture, magnesium fertilizer, and potassium fertilizer in plant height in cm. The results showed that there were significant differences between the treatments. The esults also indicated the superiority of the S_1 treatment due to its higher of clay and content ready-made potassium compared to S_2, where the percentage of increase in plant height was In the S_1 treatment, 3.527% compared to the S_2 treatment, and this was confirmed by **(Hamid *et al.*, 2021)** about the role of soil texture, the amount of clay and silt, and its mineral composition in the properties of the soil and its ability to supply plants. With nutrients and its effect in increasing plant height. As for the effect of magnesium fertilizer levels, the results showed that there were significant differences in plant height with an increase rate of 3.139, 6.688, 9.911 and 14.905% for the levels Mg_1, Mg_2, Mg_3 and Mg_4 compared to the control treatment Mg_0, respectively, and this is consistent with what was obtained **(Mahmood *et al.*, 2020).**who indicated that adding magnesium contributed to increasing plant height due to the role of magnesium in increasing the plant's photosynthesis process .The results also showed that adding potassium fertilizer at different levels led to a significant increase in plant height in the K_{100} treatment compared to the control treatment K_0, by a rate of 6.891%. The increase in plant height can be attributed by increasing the levels of adding potassium fertilizer to the role of potassium in the accumulation of carbohydrates in the stem and increasing The number of nodes and their thickness, and thus the elongation of the stem, which is reflected positively in increasing the height of the plant, and this is consistent with the findings of **(Al-Rawi & Al-Jumaili, 2018; Ali & Hamoud ,2022)**. As for the bilateral interaction between soil texture and magnesium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and magnesium levels in plant height. The same trend also occurred with the bilateral interaction between the levels of magnesium and added potassium. The results showed significant differences between the different treatments. The reason for this is attributed to the interfering effect of the levels of magnesium and potassium fertilizer in plant height. As for the bilateral interaction between soil texture and potassium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and potassium levels in plant height.As for the three-way interaction between soil texture and the levels of added magnesium and potassium, the results indicate that there are significant differences in plant height, as the highest rate of plant height in the S_1K_{100} Mg_4 treatment reached 124.330 cm, while the lowest rate of soluble potassium in the $S_2K_0Mg_0$ treatment reached 98.330 cm. The reason for this is due to the interfering effect of soil texture and magnesium and potassium fertilizers on plant height.

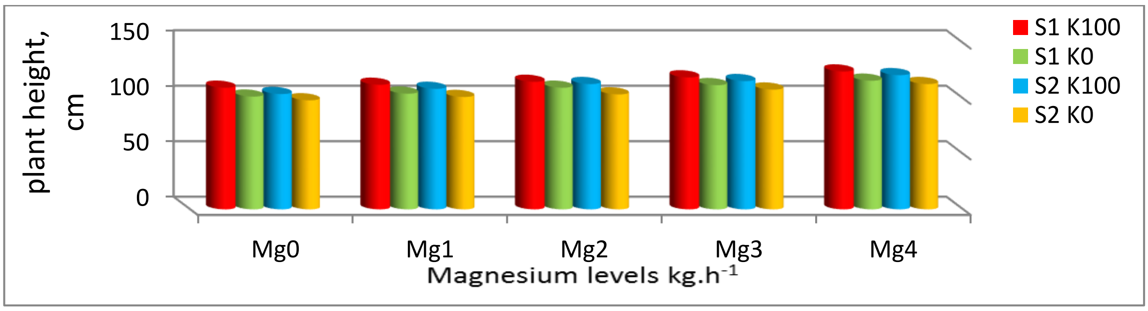

Figure (2): The effect of soil texture and levels of magnesium and added potassium in plant height, cm after 90 days of planting.

6. Effect of soil texture and levels of magnesium and potassium added in leaf area cm^2

Shown in Figure (3) the effect of soil texture, magnesium fertilizer, and potassium fertilizer in leaf area cm^2, the results showed that there were significant differences between the treatments. The results also indicated the superiority of the S_1 treatment due to its high clay content, which contributed to increasing the ready potassium compared to S_2, where it reached The percentage increase in leaf area in the S_1 treatment was 21.044% compared to the S_2 treatment, and this was confirmed by **(Hamid *et al*., 2021)** about the role of soil texture and the amount of clay and silt and its mineral composition in Soil characteristics and its ability to supply the plant with nutrients and its effect on increasing the leaf area of the plant, as there is a positive significant relationship with the amount of clay and silt and a negative relationship with sand in plant growth. As for the effect of magnesium fertilizer levels, the results showed that there were significant differences in the leaf area. The percentage increase reached 13.496, 26.660, 36.867 and 53.500% for the levels Mg_1, Mg_2, Mg_3 and Mg_4 compared to the control treatment Mg_0, respectively. that The increase in the leaf area of the yellow corn plant is a result of increasing The level of magnesium addition is attributed to its effective role in vital processes within the plant, such as the process of photosynthesis and respiration, due to its inclusion in the chlorophyll molecule, in addition to its role in activating a number of enzymes, which led to an increase in the leaf area of the yellow corn plant. This is consistent with what was obtained by **(Saaseea & Al-Amri, 2018)**. who indicated that the leaf area of yellow corn plants increased by increasing the level of magnesium addition. The results also showed that adding potassium fertilizer at different levels led to a significant increase in leaf area. The percentage increase in leaf area in the K_{100} treatment compared to the control treatment K_0 was 29.105%. The increase in leaf area can be attributed to the role of potassium in increasing growth rates. cells and improve vegetative growth, which reflects positively on the leaf area of the plant, and this is consistent with the findings of **(Al-Rawi & Al-Jumaili,2018).** As for the bilateral interaction between soil texture and magnesium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and magnesium levels in leaf area. The same trend also occurred with the bilateral interaction between the levels of added magnesium and potassium. The results showed significant differences between the different treatments in leaf area. The reason for this is attributed to the overlapping effect of the levels of magnesium and potassium fertilizer in increasing the amount of ready potassium and its release from the mineral layers, which contributed to its absorption by the plant . As for the bilateral interaction between soil texture and potassium levels, the results showed significant differences between the different treatments. The reason for this is attributed to the overlapping effect of soil texture and potassium levels in leaf area. As for the three-way interaction between soil texture and levels of added magnesium and potassium, the results indicate that there are significant differences in leaf area, as the highest average leaf area in the S_1K_{100} Mg_4 treatment reached 5684.00 cm^2, while the lowest average leaf area in the $S_2K_0Mg_0$ treatment reached 2275.00 cm^2. The reason for this is due to the interfering effect of soil texture and magnesium and potassium fertilizers.

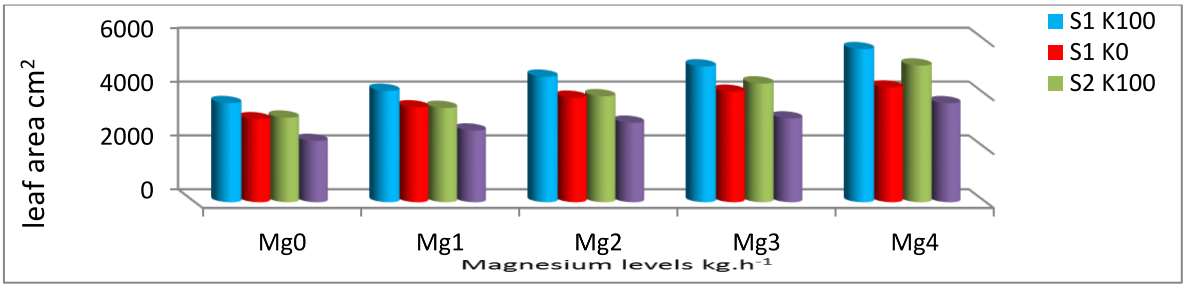

Figure (3): Effect of soil texture and levels of added magnesium and potassium on leaf area cm^2 after 90 days of planting

CONCLUSION

The addition of magnesium affected the chemical equilibrium of Solube, exchangeable and non-exchangeable potassium due to its effect in the mineral composition**.**

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