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The influence of soil covers on the apparent density of the soil during the depth of the soil core and effects on the growth indicators of white corn

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Abstract:

The experiment was applied in the Field Crops Department at the College of Agriculture, University of Baghdad for the 2023 season. The study aimed to study the effect of soil covers on the apparent density of the soil during the depth of the sandy soil and the effects on the growth and yield of the white corn according to the factorial experiment according to the decision of the complete random complete block design (RCBD) with three replications. The first factor is covers (wheat straw, white polyethylene, sand, control). The second factor is irrigation methods (irrigation in ponds, irrigation). It also includes measurements of the apparent density of the soil randomly in the depths of the soil where the root mass of the plant is distributed white corn (0-10, 10-20, 20-30, 30-40, 40-50 cm) measurements during the growing season. White corn is planting for the fall season on 20/7/2023 at a depth of 5-10 cm after preparing the land for agriculture. The data of the moisture description curve the irrigation schedule is based on the addition of irrigation water when 50% of the available water is used up and the apparent density measurement before planting and after harvesting.

.Keywords: soil covers , apparent density, soil core, white corn

تأثير مغطيات التربة على الكثافة الظاهرية للتربة خلال اعماق مقد التربة وتأثيرها على مؤشرات نمو محصول الذرة البيضاء

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الخلاصة:

نفذت تجربة حقلية في حقل تجارب قسم المحاصيل الحقلية في كلية الزراعة – جامعة بغداد الواقع ضمن خط طول 44 12 شرقاً وخط عرض 20 33 شمالاً وارتفاع 34.1 م فوق مستوى سطح البحر للموسم الزراعي 2023 كانت نسجة تربة الحقل مزيجية رملية Sandy loam لدراسة تأثير مغطيات التربة على الكثافة الظاهرية للتربة خلال أعماق مقد تربة مزيجية رملية وأثرها في نمو وحاصل الذرة البيضاء، طبقت تجربة عاملية وفقاً لتصميم القطاعات العشوائية الكاملة RCBD بثلاثة مكررات، العامل الاول هو التغطية (قش حنطة ، البولي اثلين الابيض، الرمل ، بدون تغطية)، العامل الثاني هو طرق الري (ري بالأحواض ، ري بالمرور) ، كذلك شملت أخذ قياسات للكثافة الظاهرية للتربة بشكل عشوائي في أعماق مقد التربة الذي ينتشر فيه المجموع الجذري لنبات الذرة البيضاء وهي (0-10,10-20,20-30,30-40,40-50)سم وتم قياسها طيلة موسم النمو . تمت زراعة بذور الذرة البيضاء . للحرث الخريفية بتاريخ 2023/7/20، وعلى عمق 5-10سم، بعد تهيئة الارض للزراعة.

بالاعتماد على بيانات منحني الوصف الرطوبي تم جدولة الري على أساس إضافة ماء الري عند استنزاف 50% من الماء الجاهز , تم قياس الكثافة الظاهرية قبل الزراعة وبعد الحصاد
الكلمات المفتاحية: التغطية، الكثافة الظاهرية، الذرة البيضاء

Introduction

The climatic conditions that the Middle East region and our country are facing due to global warming, which requires the need to employ some methods of soil management including the employment of soil covers, which can be defined as crop residues after harvests, palm-white polyethylene and some industrial covers such as polyethylene in different colors (white and sand and others (Ren et al., 2019). It is used to reduce the effect of solar radiation and the associated high soil temperatures, which in turn affect the soil and plants, as well as changing the moisture and thermal regime of the soil. Change the conditions surrounding the plants during the maintenance of soil moisture, reducing the amount of water used in irrigation, reducing the evaporation rate from the soil surface, increasing the fertility, reducing the drifts and improving the biological systems (Chen and Weil, 2011). The product of white corn is one of the cereal crops for the production of fodder, oil, and fuel (Jokela et al., 2009). It is of increasing importance at the therapeutic level, the production of dyes, and its use as biofuel. From this point of view, this study was applied for the purpose of studying the effect of soil covers on the apparent density of the soil during the soil layers in which the root mass of the white corn plant is distributed.

Materials and methods

The experiment was applied in sandy loam soil. The experiment designed according to the factorial experiment using RCBD decision and three repetitions. The first factor is covers (wheat straw, white polyethylene sheets, sand, control). The second factor is irrigation methods (ponds, ponds), the control of some physical and chemical properties of the soil before planting (Tables 1 and 2). The comparison of the chemical properties of irrigation water (Table 3). The trial transactions consist of the following factors:

A- Soil covers: three types of cover have been used

1- Covers the ponds completely with white polyethylene sheets, but in lines, I completely cover them with white polyethylene sheets, leaving the bottom of lines without covers .

2- Covers the boards with sand, especially covers the side facing the sun with sand, this is where the crop is planted.

3- Straw mulching the lines of covers the boards, and especially for lines, covers the opposite side of the sun, which is the theme of crop cultivation.

4- No covers (Control).

B- Irrigation method: It includes two types of Irrigation methods:

1- Basins Irrigation (B)

2- Furrows Irrigation (F)

Planting in the form of lines and rows inside the ponds and in the upper third of lines, leaving a distance of 75 cm between the border and the end, and the distance between the row and the other row is 25 cm, the height of 3 seeds in each row. The theme of upgrading after two weeks of planting and drying the plants to a single plant in all varieties after reaching a height of 15-20 cm. The service of the product is done by weeding according to the needs of the plants and adding urea fertilizer (46 N%) in the amount of 200 kg/ha¹ twice.

The theme of adding the first batch after planting is 5 cm deep, and the second batch after two months of planting for the purpose of increasing vegetable growth, adding 240 kg of triple super phosphate fertilizer (20 P%)/ ha¹ once before planting and evenly distributed inside the ponds and fields. Also, add potassium sulfate fertilizer (41.5% K) in the amount of 100 kg/ ha⁻¹ once before planting according to the recommendations of the Ministry of Agriculture. Control of the white corn insects by using diazinon insecticide (10%) in the center of the plant.

The first irrigation scheme (germination) immediately after planting on 20/7/2023, the irrigation system of all experimental transactions with equal irrigation until germination, where later the irrigation scheme is based on the moisture depletion of 50% of the water available for planting. The aim is to add the depth of water required to reach the soil moisture to the extent of the field by relying on the data of the moisture description curve, and according to the following equation given in (Allen et al., 1998).

$$d = (\Theta_f \cdot c - \Theta_w) \times D \text{----- (1)}$$

D: The depth of the irrigation water is mandatory (cm).

Θ_w : the volume humidity before the lung and the subsequent cm³/cm³ (after draining 50% of the prepared water)

D: Soil depth (soil), where the depth of 10 cm is used for the germination and green growth stage, then it increases to 20 cm for the purification stage, and then it increases to 30 cm in the maturity and harvest stage, depending on the field follow-up to determine the root total depth of the crop.

The calculation of the volume of added water (V) per experimental unit and the time (T) according to the equations given in (Nunes et al., 2019) as follows:

$$V = d \times A \text{----- (2)}$$

$$T = V / Q \text{----- (3)}$$

d = water depth (m)

A = the area of the experimental unit m²

Q = Discharge (L/sec.)

The external density test for soil for all experiments before planting and at the beginning and end of the season and at five depths (0-10) (10-20) (20-30) (30-40) (40-50) cm soil surface soil using the cylinder method and core Sample.

Table (1) some physical characteristics of pre-planting

Depth (cm)	distribution for soil			Soil texture	Density mg/m ³	Real intensity mg/m ³	Soil porosity %	Water supply cm/h ⁻¹
	Sand g/kg ⁻¹	loam g/kg-1	clay g/kg-1					
0 -10	577	360	63	Sandy loam	1.16	10.476	55.9	10.476
10-20	549	375	76		1.20	10.368	54.5	10.368
20-30	551	360	89		1.23	10.188	53.6	10.188
30-40	557	350	93		1.27	10.044	52.1	10.044
40-50	570	335	95		1.27	9.792	52.4	9.792

Table (2) some chemical properties of soil before planting

Depth cm	Electrical (dsm ⁻¹)	degree of reactivity (pH)	Dissolved ions (mmol.L ⁻¹)								Organic matter g/kg ⁻¹
			Ca ⁺²	Mg ⁺²	Na ⁺	K ⁺	CO ₃ ⁻ ₂	Cl ⁻	HCO ₃ ⁻	SO ₄ ⁻ ₂	
0 -10	1.89	7.15	9.2	4.4	3.11	2.2	0	12.8	4.8	1.31	6.5
10-20	1.79	7.13	8.9	3.8	2.92	2.0	0	12.5	4	1.28	5.8
20-30	1.49	7.11	7.7	3.1	2.70	1.81	0	10.6	3.6	1.1	5.8
30-40	1.34	7.09	6.4	2.6	2.63	1.63	0	10	3.1	1.4	5.5
40-50	1.32	7.11	6.3	2.6	2.61	1.62	0	10	3.0	1.2	5.3

Table (3) some of the chemical properties of irrigation water

trial	Ec	PH	Ca ⁺²	Mg ⁺²	Na ⁺	K ⁺	CO ⁻²	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻²
units	dsm ⁻¹ (1)	Dissolved ions (mmol.L ⁻¹)								
	1.4	6.76	5.6	4	3.6	0.641	0	5	7	1.5

Results and Discussion

The effect of soil surface covers and depth on the apparent density of soil during the growing season

Tables (4 and 5) show the effect of soil surface covers on apparent density at the beginning and end of the season compared to the values before planting. It is clear that the apparent density at the beginning of the season is not affected by soil surface covers. The apparent density values reached 1.23 µg/m⁻³ for the comparative treatment and covered with sand and white polyethylene sheets

compared to the values before planting which was $1.23 \mu\text{g}/\text{m}^{-3}$, while there is a significant difference in the apparent density values in the middle of the season for the comparative treatment. $1.24 \mu\text{g}/\text{m}^{-3}$, with an increase of 0.81% compared to the external density value for soil before planting.

The reason for this is attributed to the collapse and destruction of sedimentary bodies during irrigation, which results in the deposition of fine particles in the large pores. And with that, the reduction of the total surface area and the increase of the apparent density, and these are in agreement with what we have come to (Jabro et al., 2021; Bam et al., 2005). However, covers with sand and covers with white polyethylene sheets has no effect on the value of the apparent density in the middle of the season compared to the value before planting, while it is clear that there is a significant effect of the soil surface covers factor on the value of the apparent density for the comparative transactions and covers with sand and white polyethylene sheets at the end of the season (Villami et al., 2015; Sivarajan et al., 2018).

They were reached 1.24, 1.25, $1.26 \mu\text{g}/\text{m}^{-3}$ respectively, compared to the values before planting, the reason is due to the effect of mulching on the vitality of the aerobic organisms, which reduces the secretions that play an important role in building the soil and reducing the apparent density. This is in agreement with (Qin et al., 2018; Blanco-Canqui et al., 2020). The results note in Tables (4 and 5), the decrease in the values of the apparent density for the mulching process at the beginning, middle and end of the season, where the values were 1.21, 1.22, $1.22 \mu\text{g}/\text{m}^{-3}$, respectively. The decrease in apparent density was 0.81% at the beginning and middle of the season and 1.63% at the end of the season compared to our prices before planting.

The reason for this is due to the effect of the growth and penetration of the roots of the white corn plants due to the conditions that are available, such as adequate temperature and humidity, which helps to improve the characteristics of the soil during the mixing of minutes and increase the porosity. In addition, to the presence of soil organisms and excreta, they help in improving the structure of the soil. This is in agreement with (Hubbard et al., 2013; Jiang and Thelen, 2004).

The explanation of tables 4 and 5 is that the depth factor has a significant effect on the value of the apparent density of the soil and all the parameters. When comparing the apparent density of the upper layers of the soil at the end of the season with the values before planting, we do not notice an increase in the value of the apparent density with the depth. The reason for this is attributed to the decrease in the percentage of organic matter with the increase in soil depth, since the decrease in organic matter with depth affects some physical properties, especially the apparent density, where the percentage of organic matter is high in the surface layer compared to the rest of the substratum (Tracy and Zhang, 2008). Obtaining a slight increase in the apparent density values for all soil depths at the end of the growing season compared to the values in the rest of the growing stages and before planting.

This is in agreement with (Dal Ferro et al., 2014), as observes the continuation of the increase in prices until the end of the season. This is the effect of irrigation operations that lead to the rearrangement of soil particles (Roldan et al., 2007). The decrease in the percentage of increase in the value of the apparent density relative to the subsurface depths compared to the upper depths at the end of the season, where the increase in the 0-30 cm layer was 5.08% and in the 30-50 cm layer was 3.23%. This may be due to the growth and penetration of roots with the advance of the

growing season, which binds the soil grains, as well as the presence of microscopic organisms and secretions that improve the structure of the soil, where there are more in the surface layers than in the lower layers (Tracy and Zhang, 200

Table (4) The effect of irrigation method, covers and depth on surface density at the beginning of the season

Treatment (irrigation, covers and depth)		depths				
Basins Irrigation	Control	1.17	1.21	1.23	1.27	1.27
	organic	1.15	1.19	1.23	1.27	1.27
	White polyethylene sheets	1.16	1.21	1.23	1.27	1.27
	sand	1.16	1.20	1.23	1.27	1.27
Furrows Irrigation	Control	1.16	1.20	1.22	1.27	1.27
	organic	1.16	1.21	1.22	1.27	1.27
	White polyethylene sheets	1.16	1.21	1.22	1.27	1.27
	sand	1.16	1.20	1.22	1.27	1.27
(irrigation, covers)		control	organic	polyethylene		
Basins Irrigation		1.23	1.22	1.23	1.23	
Furrows Irrigation		1.22	1.23	1.23	1.22	
(irrigation, depth)		10-0	20-10	30-20	40-30	50-40
Basins Irrigation		1.16	1.20	1.23	1.27	1.27
Furrows Irrigation		1.16	1.21	1.22	1.27	1.27
(covers and depth)		10-0	20-10	30-20	40-30	50-40
control		1.17	1.21	1.23	1.27	1.27
organic		1.16	1.20	1.23	1.27	1.27
White polyethylene sheets		1.16	1.21	1.23	1.27	1.27
sand		1.16	1.20	1.23	1.27	1.27
Irrigation average		Basins		Furrows		
		1.23		1.23		
Covers average		control	organic	polyethylene	sand	
		1.23	1.22	1.23	1.23	
Depth average		10-0	20-10	30-20	40-30	50-40
		1.16	1.20	1.23	1.27	1.27
LSD	Irrigation	Covers	Depth	Irrigation+ Covers	Irrigation+ depth	Irrigation+ depth+ Covers
	0.0131	0.0026	0.0065	0.0107	0.0110	0.0180

This is in agreement with (Dal Ferro et al., 2014), as observes the continuation of the increase in prices until the end of the season. This is the effect of irrigation operations that lead to the rearrangement of soil particles (Roldan et al., 2007). The decrease in the percentage of increase in the value of the apparent density relative to the subsurface depths compared to the upper depths at the end of the season, where the increase in the 0-30 cm layer was 5.08% and in the 30-50 cm layer

was 3.23%. This may be due to the growth and penetration of roots with the advance of the growing season, which binds the soil grains, as well as the presence of microscopic organisms and secretions that improve the structure of the soil, where there are more in the surface layers than in the lower layers (Tracy and Zhang, 2008).

Table (5) Effect of irrigation method, covers and depth on apparent density at the end of the season

Treatment (irrigation, covers and depth)		depths				
		10-0	20-10	30-20	40-30	50-40
Basins Irrigation	Control	1.22	1.25	1.26	1.29	1.30
	organic	1.14	1.18	1.21	1.25	1.26
	White polyethylene sheets	1.19	1.24	1.25	1.29	1.29
	sand	1.18	1.22	1.25	1.29	1.29
Furrows Irrigation	Control	1.20	1.24	1.25	1.29	1.29
	organic	1.14	1.18	1.20	1.24	1.26
	White polyethylene sheets	1.19	1.23	1.25	1.28	1.28
	sand	1.17	1.22	1.24	1.28	1.29
(irrigation, covers)		control	organic	polyethylene	sand	
Basins Irrigation		1.26	1.21	1.25	1.25	
Furrows Irrigation		1.25	1.20	1.25	1.24	
(irrigation, depth)		10-0	20-10	30-20	40-30	10-0
Basins Irrigation		1.18	1.22	1.24	1.28	1.18
Furrows Irrigation		1.18	1.22	1.24	1.27	1.18
(covers and depth)		10-0	20-10	30-20	40-30	10-0
control		1.21	1.25	1.26	1.29	1.21
organic		1.14	1.18	1.21	1.25	1.14
White polyethylene sheets		1.19	1.24	1.25	1.29	1.19
sand		1.18	1.22	1.25	1.29	1.18
Irrigation average						
Basins				Furrows		
1.24				1.24		
Depth average		10-0	20-10	30-20	40-30	50-40
		1.18	1.22	1.24	1.28	1.28
Covers average		control	organic	polyethylene	sand	
		1.26	1.21	1.25	1.24	

The results in (Tables 4, 5) show that the highest apparent density was in the lower layer before and after planting, perhaps the reason for this is that this layer was exposed to decking or in the first stages, which led to a decrease in internal pores and an increase in apparent density. This is because of the gravity of the soil in the upper layers, but because of the decrease in apparent density in the upper and middle layers before planting and after the end of the season. The reason may be due to covers before planting and around the roots, which is good for the soil structure, as the increase in

the total root mass of the crop leads to an increase in the apparent volume of the soil, and as a result, a decrease in the apparent density.

This agrees with (Tracy and Zhang, 2008) that explanation of tables 4 and 5 and the effect of bilateral interaction between covers and depth in the value of apparent density at the end of the season, the treatment without covers (comparison) for the depth of 40-50 cm achieved the highest value of apparent density, reaching $1.30 \mu\text{g}/\text{m}^{-3}$. However, the treatment to a depth of 0-10 cm obtained the lowest value of the apparent density of $1.14 \mu\text{g}/\text{m}^{-3}$ due to the frequent irrigation process, it leads to the destruction of the aggregates and the deposition of fine particles in the large pores, thereby reducing the total porosity and increasing the apparent density (Tracy and Zhang, 2008).

Conclusions

The study concludes that the highest apparent density was in the lower layer before and after planting, perhaps the reason for this is that this layer was exposed to decking or in the first stages, which led to a decrease in internal pores and an increase in apparent density.

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