Effect of seed depth and organic matter level on the germination and growth rate.

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Abstract

This experiment was conducted at the College of Agriculture, Al-Qasim Green University, to determine the effect of organic waste addition level and planting depth on the seedling emergence rate of wheat variety IPA 99. A silty clay-loam soil was collected from the surface layer (30----0) cm of an agricultural field in the Abu Ghraq district, located north of the center of Hillah city. The soil was air-dried, then crushed and sieved using a sieve with a diameter of (4) mm. The sifted soil was divided into three sections. The first section was mixed with buffalo manure at a rate of (1%) by weight, the second section was mixed with the same waste at a rate of (2%) by weight, and the third section was left unmixed. Nine plastic pots were filled for each of the three sections with the soil mixed at a rate of (1%) and (2%), without adding organic waste, to a height of (25 cm) from a depth of (30 cm) in the pots. Wheat grains were planted in three pots of each addition ratio at depths of (2.5, 5, and 7.5) cm, resulting in a total of (27) experimental units. A completely randomized design with three replicates was used, and the experimental units were randomly distributed. The pots were irrigated after germination. After two weeks, the seedlings were counted and the bulk density of the soil in each pot was measured. The results showed that the interaction between the organic matter level and planting depth significantly affected the seedling emergence rate. It was observed that the treatment with the addition level (2%) of organic waste significantly excelled on the treatment without adding waste at all depths in the emergence rate (100%) at all depths. The treatments with the addition level of 1% and 2% at planting depths of 2.5 and 5 cm also excelled on the control treatment in the emergence rate. Organic matter also significantly affected the average values of bulk density. It was found that with increasing the level of organic waste addition, the bulk density decreased. The results also showed that with decreasing bulk density, the seedling emergence rate increased at any soil depth.

Keywords: Seeding depth, soil properties, wheat crop growth traits, organic matter

Introduction:

A proper soil and crop management program is a key component of optimal agricultural production for all crops. Preparing a suitable bed for seed germination and seedling emergence is the first step to ensuring optimal production. Choosing the optimal planting depth for grains is of great importance in terms of its direct impact on germination, seedling emergence, root system spread, survival ability, competition with weeds, regularity of ripening, and yield [22]. The appropriate planting depth for each crop and variety depends on the soil type, moisture level, seed size, the systems used, and the cultivated variety [2]. [10] indicated that two depths (3 and 6 cm) were excelled for the 1000-seed weight. [3] also found that increasing the planting depth (7.5) cm increased the weight of (1000 grains). [24] noted that the planting depth (5 cm) as excelled on the highest grain yield compared to planting at depths of 3 cm, 7 cm, and 9 cm. While [11] found that the wheat varieties used in their study gave the highest average number of spikes and weight of 1000 grains at a planting depth of (6 cm) when using planting depths of (3, 6, 9, and 12) cm. [4] found that a planting depth of (3 cm) at a moisture stress of (50) kilopascals recorded the highest germination rate for wheat seedlings in all soils used in the study, including clay loam, sandy loam, and heavy clay soils. The highest germination rate was recorded in sandy loam soil at depths of (3, 6) cm under moisture stresses of (50, 500) kilopascals, while a depth of (9) cm as excelled on in germination rate in clayey soils. [11] also found that a seed depth of (6) cm for the IPA 99 variety gave the highest average yield. Organic matter, when added to soil, plays an important role in improving soil properties, including physical properties, due to its effects on reducing the mineral content, increasing the total soil volume [32], increasing aggregate stability, improving soil porosity and pore size distribution, improving the soil's ability to hold water, and improving aeration [15]. [29] noted that there is an inverse relationship between the bulk density of the soil and the addition of amendments, as they found a decrease in the bulk density values when amendments were added to the soil as a result of improving the soil structure and redistributing the pores in it. The addition of organic matter and organic carbon to the soil caused a decrease in the soil resistance to penetration, and the reason for the decrease is due to the role of organic matter in improving the soil structure and mechanical properties as an insulating material between the particles that prevents their cohesion [1 and [12]. While [23] indicated that organic matter has a high surface area, which increases its ability to hold water, which leads to a decrease in the penetration coefficient. Iraqi soils are considered weak soils with a high silt content and a low organic matter content, which affects the germination and emergence of seedlings under the influence of the planting depth of grains. [8] also indicated that the س of organic matter achieved superiority in most growth characteristics, yield and its components, NPK concentration in grains and soil, and iron concentration in leaves. Therefore, this study aimed to determine:

1. The effect of planting depth on seedling emergence rate, plant height, wheat yield, and apparent density.
2. The effect of adding organic matter to the soil on seedling emergence rate, plant height, wheat yield, and apparent density of the soil.
3. The interaction between planting depth and organic matter on seedling emergence rate and determining the optimal depth for planting wheat grains.

Materials and Methods:

Physical, chemical, and moisture content analyses were conducted before planting in the graduate laboratory of the Soil and Water Resources Department at the College of Agriculture, Al-Qasim Green University, as shown in Table (1).

Table (1) General characteristics of toils properties

Characteristics	values	units
Soil particle size analysis		
Sand	18.00	%
Silt	53.00	%
Clay	28.00	%
texture	Loam clay silty	
Moisture content at (33) kPa	29	%
Moisture content at (1500) kPa	18	%

Electrical conductivity	**4.6**	**ds.m-1**
pH degree	**7.8**	
Organic matter	**0.66**	**%**
Carbonate minerals	**27**	**%**
Soluble ions in solution		
A - Positive ions:		
Ca+2	**275.0**	**Meq.L^{-1}**
Mg+2	**43.5**	**Meq.L^{-1}**
K+	**90.8**	**Meq.L^{-1}**
Na+	**255.8**	**Meq.L^{-1}**
B - Negative ions:		
Hco3	**20.00**	**Meq.L^{-1}**

The volume distribution of soil particles was estimated using the absorbent method in [21]. The soil moisture content at the field capacity and permanent wilting point limits was also estimated using a pressure plate device, according to the method mentioned in the aforementioned source. The bulk density was estimated using the core method for undisturbed soil samples, according to the method mentioned in [21]. The following chemical properties were estimated according to the specific working methods mentioned in [30]. The electrical conductivity of the saturated paste extract was estimated using an EC-meter, and the soil reaction rate was determined using a pH-meter. Carbonate minerals were estimated by calculating the weight difference after treating the soil with HCl, and organic matter was estimated using the wet digestion method. The positive ions dissolved in the solution, calcium, magnesium, and calcium + magnesium, were determined using the titration method, while potassium and sodium were determined using the flame method. As for negative ions, chlorine, sulfate, carbonate, and bicarbonate were determined by the titration method. Soil was collected from the surface layer at a depth of (0-- 30) cm from an agricultural field in the Abu Ghraq district. The soil was air-dried, then crushed and sieved with a 4 mm sieve. It was then ground and sieved with a 2 mm sieve. It was then divided into three parts. The first part was filled into 25 cm high plastic pots. The second part was well mixed with 1% organic matter by weight and filled into pots of the same height. The third part was mixed with 2% organic matter by weight and filled into pots of the same height. Three depths were determined for planting Aba 99 wheat grains: 2.5, 5, and 7.5 cm. Two factors were used in the experiment: animal waste at three levels and planting depth at three depths. A completely randomized design RCBD was used, and treatments were randomly planted with three replicates. The number of experimental units reached (27). Fertilization was carried out before planting wheat grains, followed by heavy irrigation of the potted soil (germination irrigation) to saturation, and seedling emergence was monitored.

Study traits:

The percentage of seedling emergence was measured, as was the apparent density of the soil after emergence, according to the method described in [21]. Plant length was measured using a metal tape from the soil surface to the top of the spike at the 100% flowering stage. Grain yield of the pots was measured by harvesting the entire plant, separating the grains from the straw, and weighing the grains using a sensitive balance.

Statistical Analysis:

Data was analyzed by using SPSS, and comparisons were made based on the least significant difference at a probability level of (5%). Discussion:

The results of Table (2) showed significant differences in the average values of apparent density under the influence of adding organic matter. There were no significant differences for this trait under the influence of the aforementioned planting depths. The highest average was (1.34) Mg/m3 under the influence of the zero-addition level (Mo) and the lowest average was 1.18 Mg/m3 under the influence of the (2%) addition level (M2). This result shows that with the increase in the level of organic matter addition, the decrease in the value of apparent density increases. This is due to the role of organic matter in improving soil structure by increasing the stability of soil aggregates and porosity ([31]). Also, its addition to the soil reduces the percentage of mineral particles per unit volume in the soil [17]. In addition, its effective role in improving the properties of soil structure [29] is also confirmed by [15] that organic fertilizers increase the soil content of organic matter, which is a positive indicator in improving soil structure, as it works to improve its physical, chemical and biological properties.

Table (2) Effect of organic matter quantities and planting depth on the values of apparent density (Mg/m^3 at the end of the experiment

Organic matter level (%)	Planting depth (cm)			average
	D_1	D_2	D_3	
(0.0) M_0	1.34	1.35	1.37	1.35
(1%) M_1	1.31	1.33	1.35	1.33
(2%) M_2	1.29	1.30	1.32	1.30
average	1.31	1.32	1.34	1.32
L.S.D (M D) = 0.01	L. S.D (D)= o.oo1			L.S.D (M)=0.001

The results of bi-interaction in the table above between the organic matter addition levels (M) and the depth levels (D) indicated significant differences in the average bulk density values. The highest and lowest soil bulk density values were found to be 1.34 and 1.18 Mg/m^3 under the influence of treatments M0D0 and M2D2, respectively. The interaction results show that increasing the organic matter addition level at any planting depth resulted in a significant decrease in bulk density values. The highest significant decrease in the values of the aforementioned trait occurred at the (M2) addition level for all planting depths, followed by (M1) for all depths, compared to the (M0) addition level for all planting depths.

This result is consistent with what was obtained by [28] and [33]. The results of Table (3) show no significant differences in the average seedling emergence percentage under the influence of planting depth. The results also showed no significant differences between the levels of organic matter addition in the average emergence percentage. However, the results of bi-interaction between the level of organic matter addition and planting depth indicated significant differences in the seedling emergence percentage.

Table (3) Effect of organic matter quantities addition and seeding depth on the seedling emergence percentage (%)

Organic matter level (%)	Planting depth (cm)			average
	D_1	D_2	D_3	
(0) M	86.7	73.3	73.3	77.8
(1%) M	100.0	100.0	93.3	97.8
(2%) M	100.0	100.0	100.0	100.0
average	95.6	91.1	88.9	91.8
L.S.D (M)=n's		L.S.D (D) =0.05	L.S.D (MD)=0.011	

The above-mentioned germination rate (100%) was observed for treatments D2M1, D1M1, and M2 at all planting depths, and the lowest percentage for the trait under study (73.3%) was under the influence of treatments D2M0 and D3M0. These two results show that increasing the level of organic matter addition reduced the effect of mechanical hindrance to soil development against seedling emergence, as it has positive effects on improving soil development, including reducing the apparent density value, as shown in Table 2 [5], increasing the soil moisture content, reducing the cohesion of mineral particles due to reducing their proportion per unit mass or volume, and improving the stability of aggregates [13]. The results of Table (4) showed significant differences in the average plant length values under the influence of adding different percentages of organic matter. The highest average was (47) cm under the influence of the (M2) addition level, and the lowest average was (37.33) cm under the influence of the (M0) addition level. This result shows that the higher the percentage of organic matter, the longer the plant. This result is consistent with [16], which showed that organic matter releases organic acids upon decomposition, which play a role in increasing cell volume, elongation, and division, leading to an increase in plant height. The table also indicated significant differences in average plant heights affected by depth, with the highest average length reaching 46.33 cm for depth (D2) and the lowest average length reaching 38 cm for depth (D0). From this result, we conclude that at depth (D2), the plant obtains water and nutrients, which facilitates their access to the roots. This result is consistent with [3].

Table (4) Effect of organic matter addition levels and seed depth on plant height (cm)

Organic matter quantities (%)	Planting depth (cm)			Effect of organic matter quantities
	D_1	D_2	D_3	
(0.0) M_0	35	36	41	37.33
(1%) M_1	37	45	46	42
(2%) M_2	42	47	52	47
average	38	42	46.33	42.11
L.S.D (M)= 0.01	L. S.D (MD)=0.6			L. S.D (D)=0.01

The results of the statistical analysis was showed that the organic matter and seed depth treatments significantly affected the yield, while the interaction did not significantly affect this trait. Table (5) showed that the planting depth significantly affected the grain yield, as depth D2 gave the highest grain yield of 7.56 g/pot, while depth D0 gave the lowest grain yield of 5.73 g/pot. This result was consistent with [26] and [18], who indicated that increasing the seed depth to 6 cm gave the highest grain yield compared to depths (3, 9, 12) cm. The table also shows the effect of organic matter levels on the grain yield, as level M2 gave the highest yield of 7.36 g/pot, while level M0 gave the lowest grain yield of 5.66 g/pot. This result was consistent with ([24] and [27]) where they indicated that the addition of organic waste led to improving the physical properties of the soil and providing the plant with the necessary nutrients, which was reflected in the increase in the dry matter of the plants .

Table (5) Effect of the quantities of organic matter and seed depth on the grain yield (g/pot).

Organic matter level (%)	Planting depth (cm)			Effect of organic matter
	D_1	D_2	D_3	
(0.0) M_0	4.5	5.6	6.9	5.66
(1%) M_1	6.1	6.7	7.6	6.8
(2%) M_2	6.6	7.3	8.2	7.36
average	5.73	6.53	7.56	6.60
L.S.D (M)= 0.001	L. S.D (MD)=n’s		L. S.D (D)=0.001	

The study demonstrated the following results:

1. With increasing levels of organic waste addition, the seedling emergence rate

increased at any planting depth compared to the control treatment and at the same planting depth. Apparent density decreased, leading to an increase in the emergence rate at all planting depths.

2. With increasing levels of organic waste addition, the apparent density decreased further, leading to an increase in the emergence rate at all depths.

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