

The impact of Plowing Systems and Type of Plows on Some Soil Characteristics and The production of Maize Crop

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ABSTRACT

This experimental study was carried out in one of the farmers’ fields affiliated to Kirkuk governorate to study the impact of the plowing systems and the type of plows, i.e., the chisel, disc and moldboard plows, and three types of plowing techniques, i.e., once, twice orthogonal, and 3 times on some soil characteristics and the productivity of yellow maize (class 106) at autumn season (2020-2021). The results showed that chisel plow significantly outperformed the other plow systems in the bulk density of the soil, the weighted mean diameter (the length of the ear, the number of rows in the ear, and the grain yield which amounted 1.29, 0.82, 18.06, 16.76 and 6907, respectively. Furthermore, the results showed that there were no significant differences between the variables. Plowing for two times has significant impact on the characteristics of bulk density, weighted diameter rate, ear length, number of rows per ear and grain yield which amounted to 1.36 g/cm³, 0.83 mm, 17.73 cm, 16.4 and 7371.33 kg/hectares, respectively. Nevertheless, the system of plows do not have any significant impact on the moisture content. Besides, the interaction between the chisel plow and the twice tillage has impact on the bulk density, the weighted diameter rate, the length of the ear, the number of rows per ear. The grain yield amounted to 1.36 g/cm³, 0.98 mm, 19.7 cm, 19.7 cm and 7522 kg/hectares, respectively.

Keywords: Farmers, plowing techniques, bulk density

INTRODUCTION

The failure in applying the scientific techniques in using of heavy agricultural machines to the soil may lead to a negative or positive impact on some of the soil characteristics and plant growth. So, the use of different plow machines and their different style of plowing helps to influence the characteristics of soil and plant growth (Raed & Saifuldeen, 2020). In the same vein, Alban et al. (1985) showed that the increasing number of plows led to the breakdown of agglomerations in soils, as the percentage of the largest agglomerations of (0.34) mm in strategic soil which is plowed twice is larger than that compared with soils which were plowed four, eight and twelve times. Asmir (1983) pointed out that the weighted diameter rate of a strategic soil was higher when using the Moldboard Plow when compared to no- tillage soils. Moreover, Al-Rawi (1986) pointed out that there is a decrease in the moisture content of plowed soils to the point of depth (50 cm), and then moisture begins to be similar in two cases, and for the more depth, when he compared it with of soils plowing with Disc plow and with soil without tillage and their effects on the moisture content of the soil. Black (1965) confirmed that the use of superficial serrated plowing at the depth of (5-7 cm) has led to an increase in the apparent density compared to the use of the Moldboard Plow at the depth of (15-20 cm). Allison (1954) found differences in the height of plants as a result of using Moldboard and disc plows of two locations in Iraq in the number of branches for one plant of wheat. Douglas and Goss, (1982) stated that the moisture content of the soil has increased by increasing the depth of the soil and that this trait had moral superiority in the treatment of drifting soil compared to the non-saving soils for the first depth (0-15 cm). They also found that the number of plants growing per square meter is more in the treatment of plowing, as well as the study concluded that the greater the depth of tillage the more number of plants. Finally, Unger (1986) showed in studying the effect of traditional plowing and leaving the soils without plowing that the total water content for a depth (84 cm) was the highest significant in the unprecedented soils and for the first year of the study.

MATERIALS AND METHODS

This study was implemented using three types of plows:

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1. Chisel Plow
2. Moldboard Plow
3. Disc Plow

The study also based on three types of plowing systems, noting that the repetition of plowing was carried out on the same day, namely, plowing once, plowing twice orthogonally, and plowing three times. Table 1 shows the description of the plows used.

Table 1. The specifications of the plows used in the study.

	Number of plows	Required power horse	Depth of the plow	Width of the plow	Type of plow
Chisel Plow	9	70	15	10	Duck Foot Plow
Disc Plow	3	90	20	50	Disc
Moldboard Plow	3	80	20	20	Moldboard

The researchers used the completely randomized block design with three replications. The results were tested by Duncan's polynomial test using 40 cultivars of yellow corn that were cultivated manually and were planted in the autumn season of 2021. The amount of nitrogenous fertilizer used (180 kg / hectare of Urea is 46 % nitrogen added in two phases, the first was after planting with two weeks and the second after planting with a month. The fertilizer was added when preparing the soil for cultivation. All care for the crop were carried out, including fertilizer, irrigation, weeding, and management in a homogeneous manner for all elements of experience (Younis et al. 2022). The studied characteristics were:

The soil characteristics: It is the moisture content, as it was estimated in the virtual weighted way and the plants of gatherings according to the methods mentioned in (Unger, 1986).

Plant characteristics: It represents the length of ear and the number of rows in the ear and the amount of the yield (Saifuldeen & Raeed, 2020). The results were statistically analyzed according to the criteria mentioned by (Ellis et al., 1982). Soil characteristics were analyzed in the laboratory of the Department of Soil and Water Resources at the College of Agriculture - Tikrit University.

Table 2. Physical and chemical analysis of the soil and water in the studied experimental fields.

Characteristics	Measurement unit	Hawija
Physical properties of soil and water		
Sand	g/kg	42%
Clay	g/kg	41%
Silt	g/kg	35%
Soil texture		Silt mixture
bulk density	Mg/m ³	2,7
true density	Mg/m ³	1,34
porosity	%	45,5%
Chemical properties of soil and water		
Calcium Carbonate (Lime) Ca Co3	g/kg	7.13
Calcium Sulfate (Gypsum) CaSO4	g/kg	less than 0.5%
Soil Reaction (pH)(		6,49
Salinity / Electrical Conductivity (EC)(	ms/cm	3,97
Acidity of water (pH).		1,35
Electrical conductivity of water (EC)	ms/cm	1,27

RESULT AND DISCUSSION

A- Effect of the amount of plowing time and the type of plow on some soil characteristics degree with the components.

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MOISTURE CONTENT OF THE SOIL

The results depicted in Table 3 showed that there were no significant differences between the coefficients of the number of plowing times and the type of plow. The reason is that the soil characteristics can be associated to a great

BULK DENSITY OF SOIL

Table 2 indicated that there are significant differences, as the disc plow was superior to 1.28 g/cm³ compared to the chisel plow and the moldboard plow. The values of the chisel plow and the moldboard plow 1.32 and 1.29 g/cm³, respectively. Regarding to the interaction s, plowing two times and using chisel plow were the most significant, it amounted 1.36 g/cm³. This finding indicates that relying on the bulk density is a determinant of plant growth, the disc plow can be used. It gave the lowest value for the bulk density. Thus, the reason behind the increase value of the bulk density may be due to the excitation of the soil to great depths using chisel and moldboard plows. Furthermore, the results indicated that the number of plowing times did not show significant differences between the variables on the values of bulk density (Saifuldeen & Raed, 2021).

Table 3. The effect plowing times and the type of plow on some soil properties

Characteristics		The moisture content of soil			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	15.3	12.7	13.2	13.73
	2	12.3	14.8	13.5	13.53
	3	11.3	13.7	11.2	12.06
Average		12.96	13.73	12.63	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		No significant	No significant	No significant	
Characteristics		The moisture content of soil			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	1.4	1.3	0.54	1.32
	2	1.34	1.36	0.84	1.35
	3	1.24	1.21	0.64	1.22
Average		1.32	1.29	0.67	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		No significant	0.065	0.134	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		No significant	No significant	No significant	
Characteristics		Weighted diameter (mm)			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	0.61	0.64	0.54	0.59
	2	0.67	0.98	0.84	0.83
	3	0.71	0.84	0.64	0.73
Average		0.66	0.82	0.67	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		0.05	0.05	0.015	

WEIGHTED DIAMETER RATE

The chisel plow was significantly superior to the increase the weighted diameter of the soil. Similarly, plowing the soils two times was significantly superior over rest of the amount of plowing numbers as shown in Table 3. The weighted diameter rate resulted due to using chisel plow was .82mm compared with other plowing types in which the weighted diameter amounted 0.66 and 0.67 mm to moldboard plow and the disc plow respectively. Besides, the value of the weighted diameter rate increased to 0.83 mm at two plowing times over the values of plowing once and three times (0.59 and 0.73 mm), respectively. Moreover, the interaction between the chisel plow and the amount of plowing two times was high and amounted to 0.98 mm. The reason beyond this can be interpreted that the chisel plow can give a degree of coarse construction that causes the formation of large-sized clumps, and plowing the soil more than twice may lead to the destruction of those clumps (Saifuldeen & Raed, 2020; Younis et al., 2022).

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EFFECT OF THE AMOUNT AND THE TYPE OF PLOWS ON SOME CHARACTERISTICS OF MAIZE YIELD

Table 4 indicated the superiority of the chisel plow treatment significantly in the positive effect on the increase in the number of rows in the maize ear which reached 16.76 compared to the treatment of the moldboard plow and disc plow, which amounted to 14.96 and 15.96, respectively. Furthermore, the variable of numbers of plowings, plowing twice has significantly outperformed other number of plows which reached the 16.4. The interaction between using chisel plow and plowing twice increased the length of the maize ear which amounted to 19.7 cm. The reason for this may be due to the response, resistance and response of this crops to the various influences of the tillage, especially the two-plowing, and this is reflected positively on the final yield.

Table 4: The effect of the number and the type of plows on some characteristics of the maize yield

Characteristics		Length the maize ear			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	17.3	18.7	16.6	17.53
	2	16.3	19.7	17.2	17.73
	3	15.3	15.8	15.5	15.53
Average		16.3	18.06	16.43	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		2.102	2.105	2.26	
Characteristics		Grain yield kg/hectare			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	5981	6813	6674	6489.33
	2	7214	7378	7522	7371.33
	3	6415	6530	6517	6487.33
Average		6536.66	6907	6904.33	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		315	314	431	
Characteristics		Numbers of rows in the maize ear			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	14.3	15.9	15.5	15.23
	2	15.3	17.7	16.2	16.4
	3	15.3	16.7	16.2	16.06
Average		14.96	16.76	15.96	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		315	314	431	
Characteristics		Grain yield kg/hectare			Average
Type of plow		Moldboard	Chisel	Disc	
Amount of plowing times	1	5981	6813	6674	6489.33
	2	7214	7378	7522	7371.33
	3	6415	6530	6517	6487.33
Average		6536.66	6907	6904.33	
Less than the significant value (.05)		Amount of plows	Plow	Interaction	
		315	314	431	

GRAIN YIELD

Table 4 indicated the superiority of the chisel plow treatment in increasing the yield of maize grains significantly which amounted to 6907 kg/hectares compared to the treatments of the moldboard plow and disc plow, as the grain yield of these treatments amounted 6536.66 and 6904.33 kg. hectares, respectively. With reference to the number of plowing, plowing twice treatment was significantly superior in increasing the grain yield rate, it amounted to 7371.33 kg/hectares compared to the other types of plowings. Furthermore, the interaction between disc plow and plowing twice was high and amounted to 7522 kg/hectares. The reason beyond this is due to the superiority of the grain yield components (plant length and number of grains in the ear), which was positively reflected on the final yield.

CONCLUSIONS AND RECOMMENDATIONS

As a result of the clear effects of the plowing method, the results of the study showed that there is a response to some soil characteristics and some characteristics of growth and yield of maize (class 106). Using the chisel plow improves the soil characteristics. The disc plow can be used in the case that the values of the bulk density are a determined. On the other hand, there were no significant differences between these treatments on other characteristics such as soil moisture content on the maize yield. Since this study was carried out for one season, its results recommend using the chisel plow and plowing twice when the same experimental conditions are available, such as soil, serving the crop, cultivated variety and environmental conditions for cultivation.

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