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Using Locally Made Ultrasonic Device to Determine Tillage Appearance for Different Tillage Equipment under Two levels of Soil Moisture

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ABSTRACT

The experiment was conducted at the fields of Agriculture College-University of Baghdad Al- Jadiriyah in 2015 in sandy loam soil to evaluate using locally made ultrasonic device for determining tillage appearance for different primary tillage equipment. New Holland tractor was used in this study. Two levels of soil moisture included 18-20% and 14-16% and primary tillage implements included: disc plow, chisel plow and sweep plow were used. Soil surface roughness, number of clods with diameter larger than 10 cm, disturbed soil volume, soil bulk density, soil total porosity were measured. Split plot design under randomized complete block design (RCBD) with three replicates was used. The results were showed that the best soil surface roughness was obtained at the second moisture level, and higher porosity 53.89 % at the first moisture level and there were no significant differences for moisture levels on number of clods with diameter larger than 10cm , disturbed soil volume and bulk density. Sweep plow superior in obtained less soil surface roughness, less number of clods with diameter larger than 10cm stood 10.00 clod / m^2 and higher porosity stood 53.94 % compared with chisel plow and disc plow. Higher disturbed soil volume obtained at the chisel plow stood 1193.00 m^3 / hr, while no significant differences on bulk density attributed by plows types. Sweep plow with second moisture level was the superior in obtained less soil surface roughness and less number of clods with diameter larger than 10cm stood 9.33 clod / m^2 , and sweep plow with first moisture level obtained less bulk density stood $1.17 \text{ mg} / \text{cm}^3$, higher porosity stood 55.33% while higher disturbed soil volume stood 1202.00 m^3 / hr. obtained by chisel plow with first moisture level treatment.

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Introduction

Tillage play important role in improving arable land to proper seedbed and providing a good environment to grow seeds. By improving physical and vitality characters by giving best form of tillage and good surface roughness Jasim, [1]. Acceptable results were obtained by choosing a correct depth and equipment to proper land in suitable environment conditions Mckenzie, [2]. The verity of crop, soil type and conditions of weather lead to find different types of equipment to proper land Barbara, [3] Smith and Lamber [4]. Equipment is divided according to the frame and shares design, type of soil and depth required. The shares reduce the surface roughness and uneven. Quality of tillage depends on the surface of soil and how equipment leave it, and whenever the surface was even and less clumps it will be better and gives good land shape. Roughness measurement tools differ between hand tools to electrical equipment operated by laser or using high accuracy camera, so it is important to find new digital ways which gives fast results on lab top screen immediately in special programs. Banna, [5] clarified that soil roughness, soil ditty and dissociation is affected by soil moistures content and texture. Ranivoson, [6] showed that chisel plow give better soil surface roughness compared with moldboard plow. Al-Ajeli, [15]showed that chisel plow got on highest rate of disturbed soil volume stood 798.83 m3 / h, while moldboard plow got on less rate stood 390.98 m3 / h .

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Cassel et al. [13] noticed that bulk density of soil was higher for zero - tillage than tillage by disc plow and chisel plow .

This study was conducted to evaluate using locally manufacturing ultrasound waves for measuring soil surface roughness, soil shape, tillage quality and find the suitable tillage equipment give best soil surface roughness under two soil moisture levels.

Materials and Methods

The experiment was conducted to evaluate using locally manufacturing Ultrasonic device to determine the tillage appearance for different tillage equipment under two levels of soil moisture at the field of Agriculture College - University of Baghdad - Al- Jadiriyah in sandy loam soil in 2015. Table (1) is showing soil physical characteristics.

The experiment was designed and carried out according to a split plot design under randomized complete block design (RCBD) with three replications. Two levels of soil moisture included 18-20 and 14-16% which represented main plot and three type for primary tillage implements included: disc plow, chisel plow and sweep plow which represented sub plot, were used in this experiment. Soil Surface roughness, number of clods with diameter larger than 10cm, soil disturbed volume, bulk density, total porosity were measured in this study. New Holland 80-66s, 2003 tractor was used in the experiment.

Soil PH	Ec soil ds.m-1	Soil permeability	Soil Porosity%	soil true density	Soil bulk density(Mk gm/ m ³)	Soil Moisture contact %	Soil Texture	Soil par	ticles	
7.79	2.4	3.12	44	2.65	1.4	20-18	sandy loam	Sand%	silt %	Clay%
								65	16	18.4

Table (1). Some soil physical and chemical characteristics.

Studied Properties 1- Soil Surface Roughness

Soil surface roughness was measured by using the locally made Ultrasonic device which manufactured, designed and assembled in the workshop of the College of Agriculture in cooperation with the mechanical Al-Rubaie factory in Baghdad, Figure (1).



1- Supportive device 2- Electrical control unit 3- frame 4-Power distribution complex 5- Pulley Leader 6- The slide emitting and receiving of Ultrasound 7- Handles 8- The middle of the frame opening 9- Conveyor Belt 10- The battery 11- Pulley seat 12- Operation key 13- Supportive pulleys 14-Limit switch 15- Ruler flat 16 - Base load The slide emitting and received 17- The chair sliding rectangle 18-

Motor

Figure (1). Locally ultrasonic device for measuring soil surface roughness.

2- Number of Clods with Diameter Larger than 10cm $(clods/m^2)$

It was measured by using one square meter wire sieve metal with distance between the wire $(10 \times 10 \text{ cm})$ Al-Zubaidy, [7].

3- Soil Disturbed Volume (m³/hr)

It calculated by using the following equation which proposed by Bukhari, [9].

S.V.D = Pp * Dp

S.V.D.= Soil disturbed volume (m^3/hr) Pp= practical productivity (m^2/hr) Dp= Actual depth (m)

4- Soil Bulk Density (gm/cm³)

It was measured by Core method according to the fallowing formula Blake, [10].

$Pb = Ms / V_{To}$

Pb= Bulk density(gm / cm^3)

Ms= Mass of solid the minutes(gm)

 V_{to} = The total volume of the soil(cm³)

5-Soil Total Porosity

It was measured by using the following equation Blake, [10].

f = (1 - Pb/Ps)*100

f = total porosity(%)

Ps= The true density of the soil) g / cm3) and of 2.65 (g / cm3) Pb= Bulk density (gm / cm³)

Results and Discussion

1- Soil Surface Roughness

Fig (2) showed the effect of soil moisture levels on the soil surface roughness. Second moisture level gave better soil surface roughness, compared with the first moisture level.



Figure (2). The effect of soil moisture levels on soil surface roughness.

Figure (3) showed the effect of tillage equipment types on the soil surface roughness, Sweep plow gave better soil surface roughness compared with chisel plow and disc plow which gave worse soil surface roughness, the reason for that disc plow inverts soil without breaking it up which leaves big clods on surface meanwhile sweep plow and chisel plow break big clods of soil and penetration soil surface, this in conform with Al-Saadi (2011) and Al- Zubaidy, (2004).



Figure (3). The effect of primary tillage equipment types on soil surface roughness.

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Figure (4) showed the effect of soil moisture levels and tillage equipment types on soil surface roughness, Sweep plow with second moisture level gave better soil surface roughness compared with chisel plow and disc plow, while disc plow and first moisture level gave worse soil surface roughness compared with the chisel plow and sweep plow.





A- The first soil moisture level B - the second soil moisture level

Figure (4). The effect of soil moisture levels and tillage equipment types on soil surface roughness.2- Number of Clods with Diameter Larger Than 10cm

Table (2) shows the effect of soil moisture levels and plow type on number of clods with diameter larger than 10 cm, the results showed no significant difference between

moistures contact levels on number of clods with diameter larger than 10 cm.

The results also showed that plow type has significant effect on number of clods with diameter larger than 10cm. Sweep plow got less number of clods with diameter larger than 10 cm which was 10.00 clod / m^2 compared with chisel plow and disc plow which getting higher rate which was 13.33 and 16.00 clod / cm² the reason for that is sweep plow and chisel plow considered plows work under the surface of soil Which leaves a less clods then the disc plow which invert soil and leaves large clods behind it. This conform with Al-Zubaidy (2004) and AL – Hashimy (2003).

The effect of the interference between plow type and moisture level got significant effect on number of clods with diameter larger than 10cm. Sweep plow with second moisture level was superior on getting less rate of clods with diameter larger than 10 cm which was 9.33 clod / cm² compared with

disc plow and first moisture level which got higher rate which was $18.67 \text{ clod} / \text{cm}^2$.

Table (2).	The effect	of moistu	ure leve	el and	plow 1	type on
number of c	lods with d	liameter	larger	than 1	0 cm,	clods/m ²

Moisture Level	Primary Tillage Equipment					
	Disc Plow	Chisel Plow	Sweep Plow	Medium Moisture		
First moisture	18.67	14.67	10.67	14.67		
Second	13.33	12.00	9.33	11.56		
Moisture						
L.S.D.=0.05	9.324		NS			
Medium Tillage	16.00	13.33	10.00			
Plow						
L.S.D.=0.05	2.944					

3- Disturbed Soil Volume (M³ / hr)

Table (3) showed the effect of moisture contact levels and plow type on disturbed soil volume. The results showed no significant effect of moisture contact levels on disturbed soil volume.

While plow type showed a significant effect on disturbed soil volume, where in chisel plow had higher rate disturbed soil volume which was 1193.00 m³ / hr compared with sweep plow and disc plow 889.00 and 787.00 m³ / hr, may be the reason for that because of operational width of plows. That in conform with Al-Zubaidy (2004) and Al-Jubouri (2011).

The interference between soil moisture contact levels and plow type showed significant effect on disturbed soil volume. Chisel plow with first moisture level superior on recorded higher rate of disturbed soil volume which was 1202.00 m³ / hr, while disc plow and second moisture level recorded less rate of disturbed soil volume which was 748.00 m³ / hr.

 Table (3). The effect of moisture level and plow type on disturbed soil volume.

Moisture Level	Primary Tillage Equipment					
	Disc	Chisel	Sweep	Medium		
	Plow	Plow	Plow	Moisture		
First moisture	826.00	1202.00	959.00	996.00		
Second	748.00	1185.00	819.00	917.00		
Moisture						
L.S.D.=0.05	181.8			NS		
Medium Tillage	787.00	1193.00	889.00			
Plow						
L.S.D.=0.05 136.4						

4 – Soil Bulk Density (gm / cm³)

Table (4) showed the effect of soil moisture contact levels and plow type on soil bulk density. The results showed no significant effect for both moisture levels and plow type on bulk density but there was physically effects, but there is physically differences between bulk density attributed by soil moisture contact levels and plow type.

Table (4). Effect of moisture level and plow type on soil bulk density.

Moisture Level	Primary Tillage Equipment			
	Disc	Disc Chisel Sweep		Medium
	Plow	Plow	Plow	Moisture
First moisture	1.27	1.20	1.17	1.22
Second	1.32	1.27	1.26	1.28
Moisture				
L.S.D.=0.05	0.1421			NS
Medium Tillage	1.30	1.23	1.22	
Plow				
L.S.D.=0.05	NS			

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The interference between moisture contact levels and plow type showed significant effect on bulk density. Sweep plow with first moisture level got less rate on bulk density which was 1.17 gm / cm^3 , while disc plow and second moisture level got height rate which was1.32 gm / cm^3 .

5- Soil Total Porosity (%)

Table (5) showed the effect of moisture contact levels and plow type on total porosity. The results showed significant differences for the moisture contact levels on porosity, the first moisture level superior on obtaining highest rate which was 53.89 % while second moisture level got less rate which was 51.56%, this in conform with Al-Jubouri (2011).

The results also showed that the plow type had a significant effect on porosity, sweep plow superior on obtaining highest rate which was 53.94%, while chisel plow and disc plow got fewer rates which was 53.17 and 51.06 % respectively. The reason for the sweep plow and chisel plow height average is that creep under surface and they disrupted of soil, which leave it loses and soft that increase porosity unlike traditional tillage with disc or moldboard plow, which leave big clods unloose ground which deer ease porosity of soil, this in conform with Jasim and Al-saadi, (2010) and Zubaidy, (2004).

The interference between moisture contact levels and plow type showed significant effect on total porosity. Sweep plow with first moisture level recorded highest rate which was 55.33% while disc plow and second moisture level got lowest rate which was 50.11%.

 Table (5). Effect moisture level and plow type on total porosity of soil.

Moisture Level	Primary Tillage Equipment				
	Disc	Chisel	Sweep	Medium	
	Plow	Plow	Plow	Moisture	
First moisture	52.00	54.33	55.33	53.89	
Second	50.11	52.00	52.56	51.56	
Moisture					
L.S.D.=0.05	1.167			1.461	
Medium Tillage	51.06	53.17	53.94		
Plow					
L.S.D.=0.05	0.702				

Conclusions

1- The above results showed the successful of using the locally manufacturing ultrasonic device for measuring soil surface roughness for different tillage equipment.

2- The second moisture level got best soil surface roughness while first moisture level got higher rate of soil porosity.

3- Sweep plow superior in getting best soil surface roughness and less rate of number of clods with diameter larger than 10cm and highest rate of total porosity compared with chisel plow and disc plow, while chisel plow got higher disturbed soil volume.

4- The Interference between sweep plow with second moisture level superior on getting best soil surface roughness and less rate of number of clods with diameter larger than 10cm, while sweep plow with first moisture level recorded less rate of bulk density and highest rate of total porosity, also chisel plow with first of moisture level recorded highest rate of disturbed soil volume.

Recommendations

1- It is proper to favorite tillage operations with second moisture content level 14-16 and use sweep plow in preparing seedbed.

2- Using the locally manufacturing ultrasonic device for measuring soil surface roughness for different tillage equipment is recommended.

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