

EFFECT OF SOIL MOISTURE AND PULVERIZATION IMPLEMENTS ON TILLAGE APPEARANCE AND SOIL PROPERTIES

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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 in order to evaluate the effect of soil moisture level and pulverization implement on tillage appearance and some soil physical properties. Two levels of soil moisture included first moisture level 14-16% and second moisture level 18-20% and pulverization implements included: disc harrow, Spring Spike tooth harrow and rotary harrow were used. Soil surface roughness, number of clods with diameter larger than 5 cm/m², disturbed soil volume, and soil total porosity were measured. Split plot design under randomized complete block design (RCBD) with three replicates was used. The results were showed that Rotary harrow and 14-16% moisture level superior in obtained the best soil surface roughness, less number of clods > 5cm/m² which was 7.56 clod/m², while Spring Spike tooth Harrow and 18-20% moisture level was superior in record highest disturbed soil volume which was 761.56 m³/ hr and soil porosity of 55.78 %. Using locally manufactured ultrasonic device for measuring soil surface roughness was done successfully in this experiment with high performance efficiency.

Keywords: Soil surface roughness, number of clods, disturbed soil volume, soil total porosity.

تأثير مستويات رطوبة التربة ومعدات تنعيم التربة في مظهر الحراثة وبعض الصفات الفيزيائية للتربة

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المستخلص

أجريت التجربة في أحد حقول كلية الزراعة - جامعة بغداد/ الجادرية للعام 2015 في تربة مزيجيه رملية وذلك لدراسة تأثير مستويات رطوبة التربة ومعدات التنعيم في مظهر الحراثة وبعض الصفات الفيزيائية. أشتمل البحث على دراسة عاملين الاول مستويات الرطوبة واشتمل: المستوى الاول 14-16% و المستوى الثاني 18 - 20 % والثاني أشتمل على ثلاثة أنواع لمعدات التنعيم هي الأمشاط القرصية، والأمشاط المسننة الصلبة المحملة نابضيا ، والمنعمة الدورانية. درس تأثير هذين العاملين في خشونة سطح التربة وعدد الكتل الترايبية < 5 سم و حجم التربة المثار والمسامية الكلية. استخدم في تنفيذ التجربة ترتيب الألواح المنشقة وبتصميم القطاعات العشوائية الكاملة وبثلاث مكررات. أظهرت النتائج تفوق مستوى رطوبة التربة 14-16% والمنعمة ذات الأمشاط الدورانية في حصولها على أفضل استواء وخشونة لسطح التربة وأقل معدل لعدد الكتل الترايبية < 5سم بلغ 7.56 كتلة في المتر المربع ، بينما تفوق مستوى رطوبة التربة 18-20% والمنعمة ذات الأمشاط المسننة الصلبة المحملة نابضيا في تسجيلها اعلى معدل لحجم التربة المثار بلغ 761.56 م³ / ساعة واعلى مسامية كلية للتربة بلغت 55.78%. اتضح نجاح استخدام جهاز الموجات فوق الصوتية في قياس خشونة سطح التربة بكفاءة عالية.

الكلمات المفتاحية: خشونة سطح التربة ، الأمشاط المسننة الصلبة المحملة نابضيا ، مستوى رطوبة التربة ، حجم التربة المثار ، المسامية الكلية للتربة

Introduction

Tillage play an important role in improving the quality of plowing to prepare a good cradle of seeds and provide appropriate conditions for germination by improving the physical characteristics of the soil and vital to give a better appearance for tilling good and roughness of soil surface. Getting positive results for plowing through the selection of the proper depth and the use of appropriate tillage implements conducted a soil preparation operations in favorable moisture conditions (Mckenzie, et al., 2009; Jasim and Saadoon, 2016a). The optimal choice of tillage implement maintains the properties of soil quality and if you did not choose the implement properly lead to adverse effects on the physical characteristics of the soil and vitality and makes them unsuitable for plant growth. Tilling the soil process is the process through which the soil can be installed to create a favorable shrine for germination and growth of seeds (Claudem, 1984; Jasim and Saadoon, 2016_b). The process of tilling the soil must be evaluated efficiency depending on what caused the changes in the physical properties of the soil rather than relying on what has been caused by changes in the quantity of the crop (Makki and A. EI-amin Mohamed, 2008; Moreno, et al, 2008_a). The multiplicity of soils and different climate conditions and multiple types of crops has

created many types of implement soil preparation, and these totals that are used in the operations of the soil creating secondary implement is pulverization and types of pulverization, disc harrows, spike harrows, Spring Spike tooth harrows and rotary harrows , and other (Barbara, 1995, and Smith and Lambert, 1990 and Jasim et al. 2019, Moreno, et al, 2008_b). Multiple types of secondary tillage implement and lack of knowledge of the efficiency and productivity of the imported implement which should preferably be selected the effect of these implement and equipment in giving good appearance for plowing, which in turn affects the creation of good seed bed and must be chosen the most appropriate for each type of soils. ALTalabani, (2008) showed that pulverization by rotary cultivation got the fewest clods with diameter larger than 5cm/ m² and the highest number of clods with diameter larger than 5cm/ m² was got by disc harrow. Jasim and Al-Ajeli, (2008) and Zhao, et al. (2014) were concluded that the pulverization implement had affected the disturbed soil volume and soil roughness. In order to find out the most suitable level of soil moisture and pulverization implement, which gives a good appearance for plowing, this study was conducted.

Materials and Methods

The experiment was conducted at the fields of Agriculture College-University of Baghdad Al- Jadiriyah in 2015 in sandy loam soil in order to evaluate the effect of soil moisture levels and pulverization implement on tillage appearance and some soil physical properties. New Holland tractor was used in this study. Table (1) showed some soil physical and chemical characteristics. Two levels of soil moisture including, first moisture level 14-16% and second moisture level 18-20% and pulverization implements including: disc harrow, Spring Spike tooth harrow and rotary harrow were used. Soil surface roughness, number of clods with diameter larger than 5 cm, disturbed soil volume, and soil total porosity were measured. Split plot design under randomized complete block design (RCBD) with three replicates was used in this study. Least significant differences (LSD = 0.05) was used to compare between treatments mean.

Table 1. Some soil physical and chemical characteristics

Soil PH	Soil Ec ds.m ⁻¹	Soil permeability cm.hr ⁻¹	Soil Porosity%	soil true density (Mk gm.m ⁻³)
7.79	2.4	3.12	44	2.65

Soil bulk density (Mk gm.m ⁻³)	Soil Moisture contact %	Soil Texture	Soil particles analysis		
1.40	18-20	sandy loam	Sand %	silt %	Clay %
	14-16		65	16	18.4

Studied properties:

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.

Component of Ultrasonic device:

Ultrasonic device (figure,1) consists of the following parts: 1- supportive device 2- electrical control unit 3- frame 4- power distribution complex 5- pulley Leader 6- slide emitting and receiving of Ultrasound 7- handles 8- middle of the frame opening 9- conveyor belt 10 battery 11- pulley seat 12- operation key 13- supportive pulleys 14-limit switch 15- ruler flat 16 - base load slide emitting and received 17- chair sliding rectangle 18- motor.

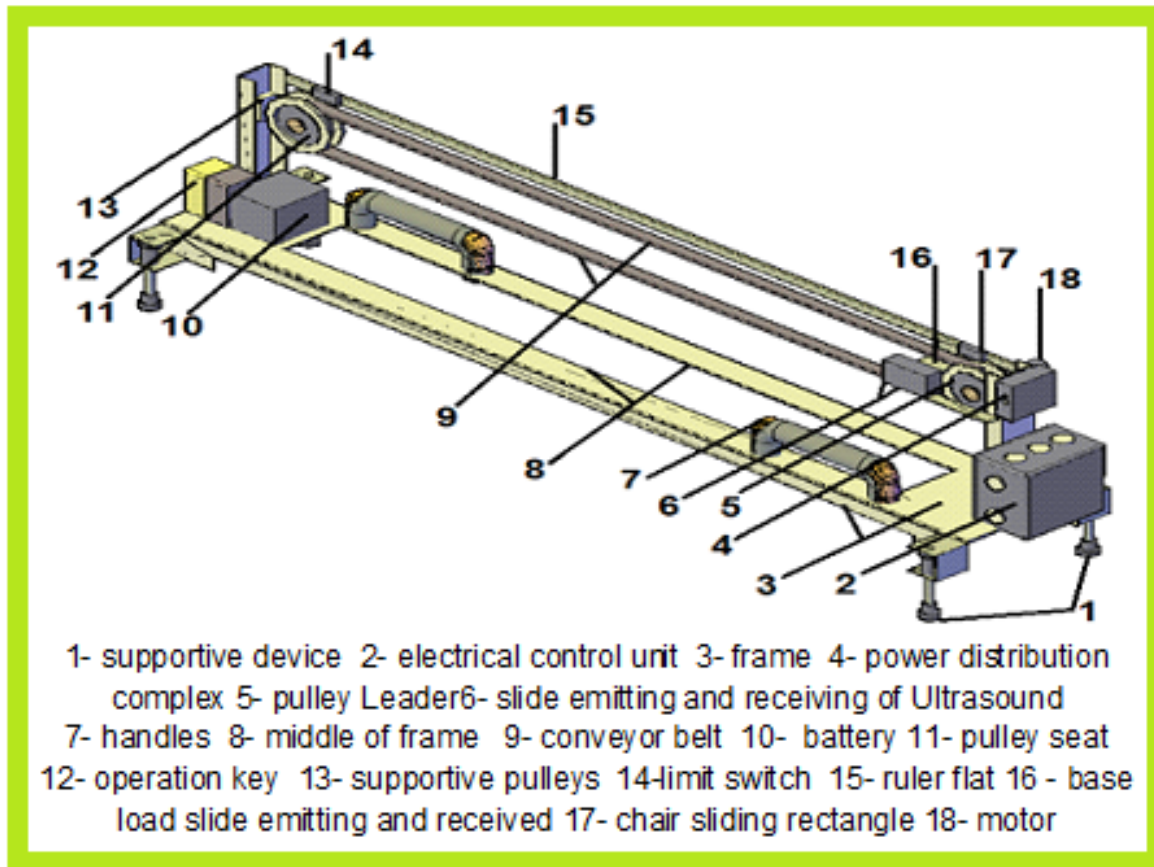


Figure 1. Ultrasonic device for measuring soil surface roughness.

Number of clods with diameter larger than 5cm (clods.m⁻²)

It was measured by using one square meter wire sieve metal with distance between the wire (5 x 5 cm), (Al- zubaidy, 2004).

Disturbed soil volume (m³.h)

It calculated by using the following equation which proposed by Bukhari, et al, (1988).

Soil total porosity

It was measured by using the following equation, (Black, 1965).

Results and Discussion

Soil Surface roughness

The results of figure (2) showed the effect of soil moisture level and pulverization implements on soil surface roughness. Second moisture level 14-

16% was the superior in getting best value of soil surface roughness. This may be due to that soil first moisture level 14-16% was suitable for soil pulverization which caused the best soil surface roughness, this result is agreed with the results obtained by Alzubaidy, (2004).

Rotary harrow the superior in getting less soil surface roughness. this may be due to that using rotary harrow, caused increase soil pulverization which means getting the best soil surface roughness, this results are agreed with the results obtained by Jasim and Alajeli, (2008) ; Al-Tahan (2008).

The interaction between rotary harrow and second moisture level was the superior in getting less soil surface roughness.

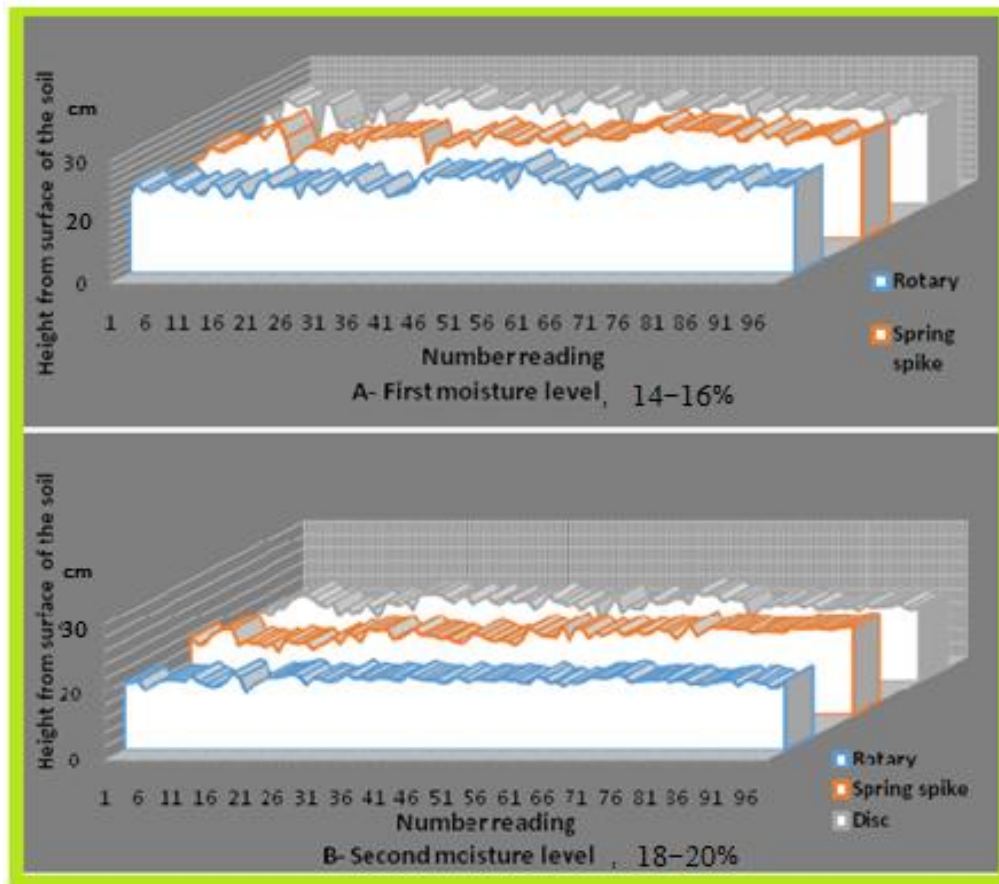


Figure 2. The effect of soil moisture level and pulverization implements on soil surface roughness, A- First soil moisture level B- Second soil moisture level

Number of clods with diameter larger than 5cm (clods.m⁻²)

The results of figure (3) showed the effect of soil moisture level and pulverization implements on number of clods with diameter larger than 5cm. There was no significant effect between moisture levels on number of clods with diameter larger than 5cm. Rotary harrow was the superior in getting less number of clods with diameter larger than 5cm stood 8.61 clods. m⁻². The reason may be due to good soil pulverization which obtained by using rotary harrow, and caused getting the best soil surface roughness, this result is agreed with the results obtained by Jasim , et al., (2019) and Al-Tahan (2008).

The interaction between rotary harrow and second moisture level was the superior in getting less number of clods with diameter larger than 5cm 7.56 colds. m⁻².

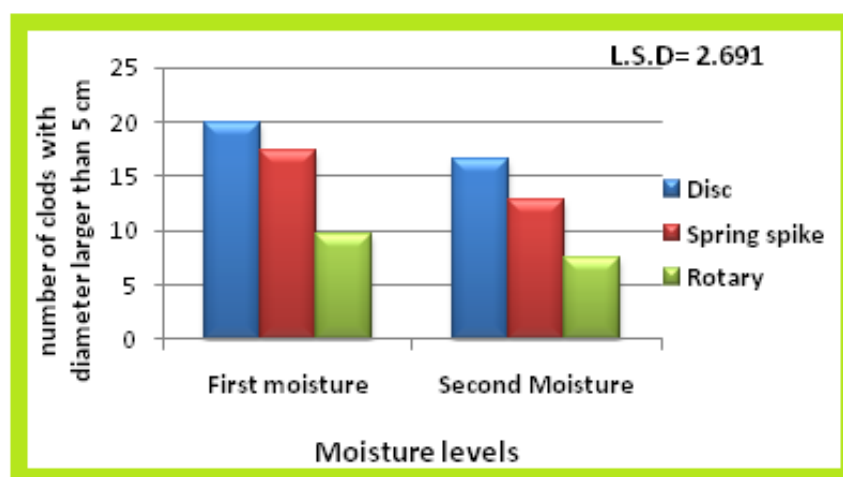


Figure 3: The effect of soil moisture level and pulverization implements on number of clods with diameter larger than 5cm

Disturbed soil volume (m³.h⁻¹)

The results of figure (4) showed the effect of soil moisture level and pulverization implements on disturbed soil volume (m³.h⁻¹). There was no significant effect between moisture levels on disturbed soil volume. Spring spike tooth harrow treatments got higher rate of disturbed soil volume stood 752.94 m³.h⁻¹. This may be due to that operation width of Spring spike tooth harrow , caused

increase disturbed soil volume , this results are agreed with the results obtained by Jasim and Alajeli, (2008) and Al-Tahan ,(2008).

The interaction between spring spike tooth harrow and the first moisture level got higher disturbed soil volume stood $761.56 \text{ m}^3 \cdot \text{h}^{-1}$.

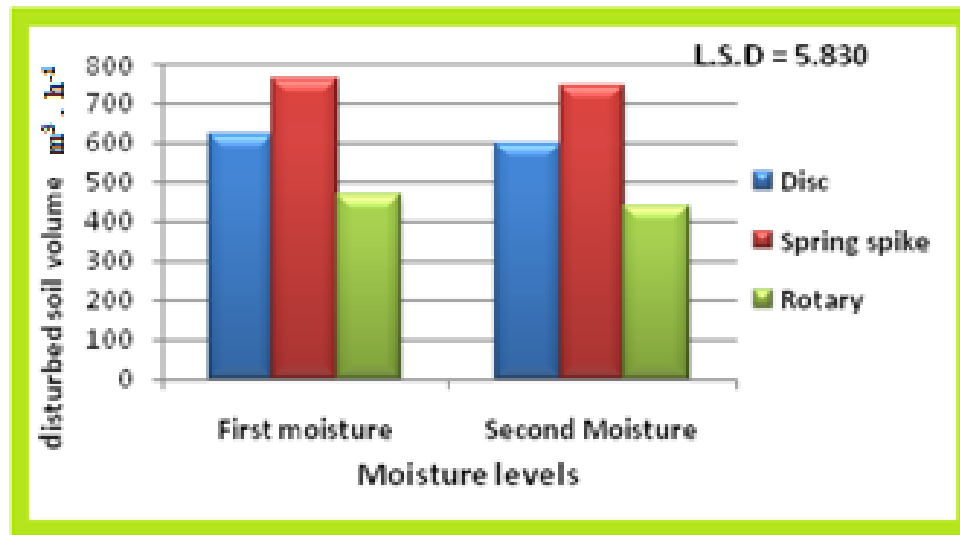


Figure 4: The effect of soil moisture level and pulverization implements on disturbed soil volume

Total porosity of the soil

The result of figure (5) showed the effect of soil moisture level and pulverization implements on Total porosity of the soil. First moisture level got higher rate of total soil porosity stood 53.59%. This may be due to that soil first moisture level (14-16%) was suitable for this soil texture to the secondary tillage which caused the best soil porosity; this result is agreed with the results obtained by Alzubaidy, (2004).

Spring spike tooth harrow treatments got higher rate of total soil porosity stood 54.44%. This may be due to that using spring spike tooth harrow leaves soil roughness less pulverization which caused increase soil porosity, this results are agreed with the results obtained by Jasim and Alajeli, (2008) and Al-Tahan, (2008).

The interaction between spring spike tooth harrow and the first moisture level got higher rate of total soil porosity stood 55.78%.

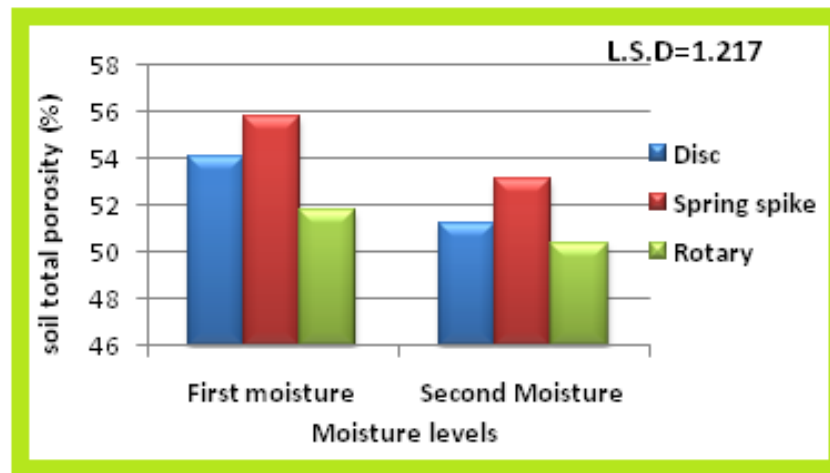


Figure 5: The effect of soil moisture level and pulverization Implements on total soil porosity

Conclusion

Rotary harrow and second moisture level 18-20% was the superior in getting less soil surface roughness and less number of clods with diameter larger than 5cm. While the spring spike tooth harrow and the first moisture level 14-16% got higher value of disturbed soil volume and higher total soil porosity. Using locally manufactured ultrasonic device for measuring soil surface roughness is recommended. Using rotary harrow for pulverization and second moisture level is recommended also for small area.

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