EFFECT OF SOME SEEDBED PREPARATION SYSTEMS ON LAND LEVELING DURATION

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ABSTRACT

A comparative study of three different tillage systems on traditional and accuracy land leveling duration was carried out on a clayey soil during three successive seasons.

The obtained results revealed that the seedbed preparation system (Chisel plough followed by rotary tiller) recorded the longest land leveling duration and the highest water use efficiency in comparison with rotary tiller and chisel plough twice forward by wooden leveler treatments.

INTRODUCTION

Accurate land leveling plays an important role in success or fizzle of the following agricultural operations such as sowing, fertilization, crop protection, harvesting and water management (irrigation and drainage). Soil physical properties are strongly affected with land leveling. Michael (1990) indicated that leveling operation had significantly increasing of soil bulk density at soil layer depth of 10 cm. He recorded that soil bulk density increased about ten percent or more due to leveling. Youssef (1991) found that soil penetration resistance increased about 45.8 %, 36.5% and 41% after accurate land leveling, whereas the traditional method recorded about 27.1%, 18.3% and 10.3% at field capacities of 80%, 70% and 60%, respectively. El-banna et al. (1994) reported that using accurate leveling with primary tillage system (chisel plough twice followed by disk harrow) increased the soil bulk density and soil penetration resistance about 1.7% and 8.8% respectively, in comparison with traditional leveling method. El-Samra (2004) showed that the effect of traffic movement of the land leveling equipment on some physical properties of soil surface until 30cm depth using laser equipment for accurate leveling increased the soil bulk density from 1.124 to 1.142 g/cm^3 and soil penetration resistance from 95 to 105.67N/cm^2. Abo-Habaga (2004) reported that the fine soil aggregate specially (ط < 1 mm) move from the upper to the lower layer. They settle in the pore space especially the biggest. Consequently, the soil shear resistance increased about 26% and the required time for water intake rate increased between 2-7 times more than the leveled soil with traditional method.

MATERIALS AND METHODS

The experiments were carried out on a clayey soil at El-Gemmeza Agric. Res. Station, Gharbia Governorate. The experimental area (about 1.5

feddans) was divided into three plots according to the tested leveling systems (accurate leveling using LASER with slope 0.03%, 0.00% and traditional method using wooden leveler). Every plot was divided into three strips in accordance with the seed-bed preparation systems (rotary tiller “R”, chisel plough one forward by rotary tiller “Ch-R” and wooden leveler after chisel plough twice “2Ch-L”). The present work was carried out during the rainfall growing season in three successive seasons.

The relief formation was measured using a relief measurement apparatus according to Söhne et al. (1962). The soil surface slope was calculated from graphics elevation points by straight-line equation. The soil surface roughness was determined by using Kuipers equation (1957).

Water application efficiency was estimated as the following formula:

$$\mathbf{Ea = 100 * Wav / Wa} \qquad (1)$$

Where :

Ea : water application efficiency, %

Wav : water stored in the soil root zone during the irrigation, m^3/fed.

Wa : water delivered to the farm, m^3/fed.

Water use efficiency (WUE) was defined according to **Jensen (1983)** by the following equation:

$$\mathbf{WUE} = \frac{\textbf{Yield (kg/fed)}}{\textbf{Total applied water (m}^3\textbf{/fed)}} \qquad (2)$$

RESULTS AND DISCUSSION

The soil surface after accurate leveling using **LASER** equipment at slope 0.03 and 0.00%, had actual surface slope 0.0323 and 0.005%, 91.71 and 89.28% leveling and 1.21 and 1.28 cm standard deviation of different points at soil surface (Figs. 1and 2) respectively. While traditional leveling method recorded actual surface slope 0.0072, 86.0% leveling and 1.38 cm standard deviation (Fig. 3).

Results in tab. 1 show the effect of seedbed preparation systems on the previous parameters during three progressive seasons. Treatment (**R**) recorded decreasing in surface leveling from 91.72% to 87.29%, 83.86% and 82.1%, with increasing of standard deviation of different points at seed-bed surface from 1.21 to 1.34, 1.45 and 1.51 cm, respectively. The seedbed surface slope decreased from 0.0323% to 0.0127% and 0.0032% after first and second seasons. Whereas, it decreased into 0.0095% at opposite direction before forth season. Treatment (**Ch-R**) recorded decreasing of surface leveling from 91% to 86.65%, 82.97% and 81.25%, with increasing of standard deviation of different points at seedbed, surface from 1.21 to 1.36, 1.48 and 1.54 cm respectively. The seedbed surface slope decreased from 0.0323% to 0.0137% and 0.0055% after first and second seasons. Whereas, it decreased into 0.0034% at opposite direction after three season. While, Treatment (**2Ch-L**) showed decreasing of surface leveling from 91% to 85.7%, 80.69%, and 78.52%, with increasing of standard deviation of different points at seed-bed surface from 1.21 to 1.39, 1.56 and 1.64 cm respectively.

The seedbed surface slope decreased from 0.0323% to 0.0277% and 0.006% after first and second seasons. Whereas, it decreased into 0.0003 % at the opposite direction after three season. According to the above results, it may be noted that the longest leveling duration with using (**Ch-R**) and (**2Ch-L**) treatments are not more than four seasons after leveling. On the other hand, the soil surface after accurate leveling using **LASER** equipment with slope 0.00%, had actual surface slope 0.005%, 89.28% leveling and 1.28cm standard deviation of different points at soil surface.

Table 1: Effect of seedbed preparation systems on soil surface properties at three seasons under three different land leveling methods.

Treatments	Seasons	Leveling method	Actual surface slope, %	Standard deviation, cm	Surface leveling, %
Rotary tiller (R)	Season (1) Wheat	Laser 0.03%	0.01270	1.340	87.29
		Laser 0.00%	0.00140	1.381	86.00
		Traditional	- 0.0028	1.440	84.16
	Season (2) Corn	Laser 0.03%	0.00320	1.450	83.86
		Laser 0.00%	- 0.0052	1.549	81.00
		Traditional	- 0.0030	1.600	79.59
	Season (3) Clover	Laser 0.03%	- 0.0095	1.510	82.10
		Laser 0.00%	- 0.0124	1.738	76.00
		Traditional	- 0.0050	1.780	74.96
otary tiller fter chisel ough (Ch-R)	Season (1) Wheat	Laser 0.03%	0.1370	1.360	86.65
		Laser 0.00%	0.0021	1.387	85.80
		Traditional	0.0027	1.480	82.97
	Season (2) Corn	Laser 0.03%	0.0055	1.480	82.97
		Laser 0.00%	0.0001	1.585	80.00
		Traditional	0.0001	1.630	78.78
	Season	Laser 0.03%	- 0.0034	1.540	81.25

The obtained results showed that the longest leveling duration is recorded with using (**Ch-R**) and (**2Ch-L**) treatments. It existed not more than two seasons after leveling. At the same time, the soil surface after traditional leveling had actual surface slope of 0.0072%, 86% leveling and 1.38cm standard deviation for different points at soil surface. The longest leveling duration was obtained with using treatments (**Ch-R**) and (**2Ch-L**). It extended not more than three seasons after leveling.

The results in table (2) showed that the effect of tillage systems on water application efficiency and water use efficiency under three different leveling methods.

Table 2: Effect of seedbed preparation systems on irrigation efficiency at three seasons under three different land leveling methods.

Treatments	Seasons	Leveling method	Water available on root zone after 48 h from irrigation depth, cm	Water applied depth, cm	Water losses outside root zone depth, cm	Water application Efficiency, %	Water use Efficiency kg/m^3
Rotary tiller (R)	Season	Laser 0.03%	12.00	13.69	1.69	87.66	1.037
	(1)	Laser 0.00%	11.87	16.56	4.69	71.68	0.984
	Wheat	Traditional	11.62	17.95	6.33	64.74	0.962
	Season	Laser 0.03%	12.08	16.34	4.26	73.93	0.688
	(2)	Laser 0.00%	11.91	18.67	6.76	63.79	0.643
	Corn	Traditional	11.65	18.51	6.86	62.94	0.591
	Season	Laser 0.03%	12.10	18.63	6.53	64.95	8.024
	(3)	Laser 0.00%	11.94	19.17	7.23	62.29	7.945
	Clover	Traditional	11.68	18.78	7.10	62.19	7.650
iller isel Ch-R)	Season	Laser 0.03%	11.94	13.48	1.54	87.92	1.140
	(1)	Laser 0.00%	11.86	16.13	4.27	73.53	1.010
	Wheat	Traditional	11.57	16.07	4.50	72.00	0.977
	Season	Laser 0.03%	11.98	16.03	4.05	74.73	0.748

Surface irregularity may be harmful and will hamper the efficiency of water application, water storage, and water distribution. This makes surface irrigation wasteful and expensive; it may also accelerate soil erosion, hamper the drainage, and interfere with machinery operation, thus reducing the quality, quantity of yield, and at the same time increasing production costs **(Jensen 1983)**. Decreasing soil surface slope and roughness produced a high increase on depth of water applied. Therefore, the results in table 2 show that the depth of water available for root zone after 48 h from irrigation is increased with longest leveling systems duration.

Rotary tiller treatment (R) recorded the lowest water application efficiency in comparison with the other treatments. The reason due to the fact that, the rotary tiller produced small aggregates, which have low stability in comparison with the other one produced from the other treatments. During the irrigation, the aggregates were broken into many particles. The fine particles are removed with irrigation water from the upper to lowest layers and in the same time from place to another at soil surface. Therefore, the soil surface slope decreased and consequently, water application efficiency decreased after three sequence seasons. Rotary tiller treatment (**R**) recorded average of water application efficiency about 87.66, 73.93 and 64.95%. Whereas (**Ch-R**) treatment recorded 87.92, 74.73 and 64.88%, but the highest efficiency (88.63, 74.84 and 66.8%) was accomplished (**2Ch-L**) treatment through three following sequence respectively.

In addition fig. 4 shows the influence of tillage systems on water use efficiency at different leveling methods. The results indicate that water use efficiency is decreased with longest different leveling systems duration.

Using (Ch-R) treatment at all leveling methods recorded the highest water use efficiency in comparison with other treatments. The average of water use efficiency for (Ch-R.) treatment are 0.977, 0.682 and 8.14 kg/m^3, While, the corresponding values for treatments (2Ch.-L. and R.) are 0.971, 0.653, 7.88 kg/m^3 and 0.962, 0.591, 7.65 kg/m^3 at wheat, corn and clover, respectively.

CONCLUSION

Land leveling duration is highly affected by land leveling methods. The results obtained from the present study showed that, the accurate leveling 0.03% and traditional method recorded the longest land leveling duration in comparison with the accurate leveling 0.00%. In addition seedbed preparation system (Ch-R) recorded the longest land leveling duration and highest water use efficiency in comparison with other treatments at all land leveling methods.

It may be concluded that the tillage system using chisel plough followed by rotary tiller may be considered the suitable system for land leveling and seed-bed preparation simultaneously.

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الملخص العربي

تأثير بعض نظم إعداد مرقد البذرة على عمر عملية التسوية

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تعتبر عملية تسوية سطح مرقد البذرة من أهم العمليات التي تؤثر بشكل مباشر في إنتاجية المحصول وتوفير مياه الري . لذا أجريت هذه الدراسة بغرض تحديد أنسب نظم

إعداد مرقد البذرة التي تحافظ علي درجة التسوية لأطول فترة ممكنة وتأثيرها علي كفاءة استخدام مياه الري.

أظهرت النتائج المتحصل عليها أن نظام الحرث باستخدام المحراث الحفار يعقبه محراث دوراني يعتبر أنسب نظام لإعداد وتجهيز مرقد البذرة وخاصة في الأراضي الثقيلة (تربة طينية) لما حققه من زيادة في عمر عملية التسوية (أربع مواسم زراعية) بالإضافة إلى ارتفاع كفاءة استخدام مياه الري.