

EFFECT OF PRECISION LAND LEVELING AND BIOFERTILIZERS ON RICE WATER USE EFFICIENCY IN SANDY SOILS

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ABSTRACT

This study was carried out in Kalabsho Region, El-Dakhlia Governorate, during 2007 summer season to identify the rice water use efficiency in the sandy soils, as affected by the precision land leveling and the application of the biofertilizers. The experiment was designed statistically as a split plots with three replicates. The main plots were located for the precision land leveling levels, and the sub plots were devoted for the biofertilization types. The obtained results could be summarized as follows:

- 1. The precision land leveling with slope of 0.02% which was accompanied with the biofertilizers Blue Green Algae and Bacillus megatherium var. phosphaticum achieved the lower values of soil bulk density (1.28 g/m^3) and soil infiltration rate (20 mm/h).*
- 2. the precision land leveling saved the total applied irrigation water amount by about 44.68, 43.85, 41.82 and 18.47% for 0, 0.01, 0.02 and 0.03% slopes, respectively from that required using the traditional leveling.*
- 3. The precision land leveling with slope of 0.02% which was accompanied with the biofertilizers Blue Green Algae and Bacillus megatherium var. phosphaticum achieved higher grain yield of 3.96 ton/fed. and higher water use efficiency of 0.39 kg/m^3 .*

Generally, it is recommended to use the precision land leveling and apply the biofertilizers to achieve higher rice grain yield accompanied with saving more irrigation water under the sandy soils conditions.

INTRODUCTION

Egypt has adopted a strategy for future planning based upon some factors. One of them is rationalization of water use. This could be done through reducing the cultivated area with high irrigation

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demand crops such as rice which is the most important staple food after wheat and a second major export agricultural commodity (**Helmy et al., 2000**). On the other hand, Egypt faces a growing imbalance between agriculture production and population increase. Both the vertical and the horizontal expansionism should be taken into consideration to achieve a balance between the population food consumption and agricultural production. About 2.38 million feddans of sandy desert soil close to Nile Delta and Nile Valley could be added to the cultivated area. Improving fertility of the new reclaimed sandy soils may share in this respect (**Khader et al., 2004**).

Ministry of Agriculture and Land Reclamation (2006) stated that rice cultivated area in the newly reclaimed soils is about 0.04 million fed., producing 0.14 million tons approximately of paddy rice with average of 3.50 ton/fed. Rice unlike other cereals, has a remarkable adaptation to a wide range of hydrological conditions. It is the most common crop in the newly reclaimed lands where the high salinity prevents the successful growth of many other crops (**Mourad et al., 2003**). Furthermore, **El-Refae (2007)** pointed out that the developed short duration rice cultivars maintain higher and increase productivity, as well as saving irrigation water by reducing losses of evaporation, seepage and percolation and \or surface runoff, as well as reusing or recycling water.

In Egypt, rice is cultivated as a fully surface irrigated crop with standing water. The irrigation water is relatively limited (55.50 mlrd m³ a year) and insufficient for both reclamation and irrigation purposes. So, it is essentially to apply water saving irrigation methods, as well as by improving management of available water resources. So, it is an important issue to depend on the laser land leveling as a wise method to manage the available water. It was concluded by El-Behery and El-Khatib, (2001); El-Raie at al. (2003) and El-Raie at al. (2004) that the laser land leveling saves farm inputs like water and fertilizers, improves crop stand, encourages uniform germination and consequently, enhances yield.

On the other hand, the sandy reclaimed land of the coarsest texture is hard to be productive because of the lower water holding capacity, the higher aeration, the rapid drain, the lower content of the organic matter and the

higher fertilizer leaching (**El-Banna, 1998** and **El-Serafy and El-Ghamry, 2006**).

Recently, the agricultural technology introduced the biofertilizers as soil conditioners, which could improve the soil structure, the water holding capacity, the hydraulic conductivity and the water retention, reducing leaching, water losses due to percolation and evaporation protecting the plant against the hydric stress and increasing both the nutrients and the water supply to the roots (**Singh et al., 1992** and **Yanni, 1992**). Bacterial inoculation and nitrogen fixation in the rice rhizosphere have shown that in most cases, yield increases after inoculation with nitrogen fixing bacteria. Microaerophilic azospirilla were found to enhance yield of both lowland and upland rice. Nitrogen-fixing bacteria, living in association with roots of plants were investigated to establish their effects on plant growth and yield (**Hammad, 1994; Sharief et al., 1998** and **El-Kholy and Omar (2004)**).

This study aimed to identify the effect of precision land leveling and the biofertilizer applications on rice water use efficiency in the sandy soils.

MATERIAL AND METHODS

Experimental Procedure:

1. Experimental site and soil characteristics:

To fulfill the objective of this study, a field experiment of 1.50 fed. (105 x 60 m) was conducted at Kalabsho Region, El-Dakhliya Governorate, during 2007 summer season. As shown in Tables (1) and (2), the soil was analyzed mechanically and chemically according to the standard procedures as cited by **El-Serafy and El-Ghamry (2006)**. Also, the soil field capacity, available water, wilting point and soil infiltration rate were determined using pressure extractor with regulated air pressure, according to **El-Banna, (1998)**.

Table (1): Soil mechanical analysis of Kalabsho region.

Sand, %			Silt, %	Clay, %	Soil texture class
Coarse, %	Fine, %	Total, %			
70.48	3.72	74.20	9.85	15.95	Sandy

TABLE (2): Some soil properties of Kalabsho Region.

Bulk density, g/cm ³	pH, 1:2.5 (susp.)	Available nutrients, ppm			Field capacity, Wt/wt%	Wilting point, Wt/wt%	Available water, mm	Infiltration rate, mm/h
		N	P	K				
1.60	7.33	19.31	8.50	291.40	14.00	6.70	23.36	45

2. Irrigation water characteristics:

The irrigation water was characterized as a treated agricultural drainage water. As indicated in Table (3), it was analyzed chemically according to **El-Serafy and El-Ghamry (2006)**.

Table (3): The chemical analysis of irrigation water.

Ph, 1:2.5 (susp)	EC _w , dS/m	Total soluble salts, ppm	SOLUBLE anions, ppm				Soluble cations, ppm				SAR
			CO ₃	HCO ₃	Cl	SO ₄	Ca	Mg	Na	K	
7.40	3.05	1715.20	0.02	443.25	600.66	126.27	88.00	80.83	355.40	8.16	2.41

3. Agricultural tractors:

The following agricultural tractors were used:

1. A general purpose agricultural tractor of 90 kW was used as a mobile power for the laser control leveling equipment.
2. A general purpose agricultural tractor of 60 kW was used as a mobile power for the chisel plough, the tandem disc harrow, the hydraulic scraper and the seed drill.

The characteristics of the used agricultural tractors are shown in Table (4).

Table (4): The characteristics of the used agricultural tractors.

Source of manufacture	Engine	Source of drive	Engine power, kW.	RPM at max. power	Cooling system	Traveling speed, km/h.
Italy	Diesel fuel, 4 strokes, 6 cylinders	4 WD	90	2500	Water	1.10 to 32.90
U.S.A.	Diesel fuel, 4 strokes, 4 cylinders	2 WD	60	1000	Water	2.17 to 30

4. Agricultural practices:

The following agricultural practices were applied:

- 1) Tillage:

The seed bed was prepared using a chisel plough in two perpendicular directions at 0.20 m depth. Table (5) shows the specifications of the used chisel plough.

Table (5): The specifications of the used chisel plough.

Source of manufacture	Type	No. of tines	Type of blades	Total width, m	Mass, kg
Egypt	Mounted	Seven	Painted	1.75	380

The secondary tillage was conducted using a tandem disc harrow. Table (6) indicates the specifications of the used tandem disc harrow.

Table (6): The specifications of the used tandem disc harrow.

Source of manufacture	Type	No. of gangs	No. of discs\gang	Disc type	Disc diameter, m	Disc spacing, m	Mass, kg
U.S.A.	Trailed	Two	Eight	Notched	0.65	0.26	1360

3) Land leveling:

Both the precision land leveling and traditional leveling were performed using a hydraulic land leveler. Table (7) indicates the specifications of the used hydraulic land leveler.

Table (7): The specifications of the used hydraulic land leveler.

Source of manufacture	Type	Cutting depth, m	Dimensions (length, width and height), m	Capacity, m ³	Control depth	Mass, kg
Egypt	Mounted	0.10	0.60, 3.00 and 0.70	1.26	Tractor hydraulic	770

The unit of laser control equipment consists of the following parts:

a- Transmitter:

The transmitter Spectra-physics laserplane has the following specifications:

Model: 1145 laserplane

Out put: Infrared laser. The reference plane of laser light can be tilted from 0% to 9.99% grade in two axes that are perpendicular to each other. The beam of light rotates at 600 rpm.

Power requirement: Internal battery powered gallium arsenide diode.

b- Control box:

CB2MTD control box is used in land leveling on the tractor to display the signals to indicate the blade relative position to grade and the

elevation of the mast to the operator. The control box has the following specifications:

Size: 0.17 x 0.24 x 0.14 m.

Mass: 1.50 kgs.

Elevation display graduation: 0.5 cm.

Operating temperature: - 28 to + 71 °C.

Electrical input: 12 or 24V DC, 10 amp. Max.

Electrical output: 12 or 24 V DC, 4.5 amp./valve output.

Electrical connector: Standard military type.

(Mil spec C-5015)

Control valve fine correction adjustment range: 50 to 180 m/s.

c- Receiver mast:

Receiver mast is an electro-mechanical device that can search for and perceive the presence of a laser light plane. This reception of the laser light plane is indicated to the operator visually (with lights). In control applications, the receiver (reads) the laser signal and automatically maintains the earthmoving equipment on grade. The Receiver mast has the following specifications:

Retracted height: 1.58 m.

Extended: 2.77 m.

Mass: 19.00 kg.

Operating temperature (ambient): -28 to + 71 °C.

d- Receiver unit:

The receiver unit is a 360° omni-directional receiver that detects the position of the laser reference plane and transmits these signals to the control box. These signals are processed to indicate the relative position of the receiver to the laser reference plane. The receiver unit has the following specifications:

Vertical sensing range: 18.59 cm.

On-grade dead band: ± 0.45 cm.

Mass: 1.30 kg.

Size: 0.29 x 0.11 x 0.14 m.

Electrical input: 12 or 24 V DC.

Electrical connector: Standard military type (mil spec C-5015).

Operating temperature: -28 to + 71 °C.

Beam acceptance angle: 360°.

e- Telescoping grade rod:

The telescoping grade rod is used with the transmitter to measure the different points levels during execution of net leveling. The telescoping grade rod has the following specifications:

Model: 1084 English.

Size: Extended 180 H x 1.7 W x 4.2 D inches.

Retracted 54 H x 1.7 W x 4.2 D inches.

Mass; 2.27 kg.

4) Sowing:

The seeds of Giza 178 short duration rice variety (135 days) were selected by Rice Dep., Field Crops Inst., Ag. Res. Center. They were sown with a rate of 60 kh/fed. using a seed drill. Table (8) shows the specifications of the used seed drill.

TABLE (8): The specifications of the used seed drill..

Source of manufacture	Type	Drive system	No. of rows	Row spacing,m	Furrow opener	Mass, kg
French	Mounted	Rubber wheels	21	0.15	Choe	725

5) Fertilization:

1- Mineral N fertilizer in the form of Urea (46% N) with a rate of 69 kg N/fed. was applied in four equal doses. The first one was applied before sowing and the others were applied 20, 40 and 60 days after sowing.

2- Biofertilizers: The used biofertilizers are produced and distributed commercially by the General Organization for Agricultural Equalization Fund (GOAEF), Ministry of Agriculture and Land Reclamation. The following biofertilizers are used:

a- Biofertilizer₁ (bf1): Blue Green Algae.

b- Biofertilizer₂ (bf2): A combination of Azospirillum sp., Azotobacter sp., Bacillus mega-theruim var. phosphaticum, Pseudomonas sp. And Mycorriza sp.

c- Biofertilizer₃ (bf3): Bacillus megatherium var. phosphaticum

At the tenth day after sowing, the biofertilizer in the form of Blue Green Algae powder with the rate of 0.50 kg/fed. was mixed with a suitable

quantity of softy soil, then, the mixture was broadcasted above the irrigation water surface.

The other biofertilizers in the form of powder with the rate of 0.30 kg/fed. were applied and mixed with the soil before sowing.

6) Irrigation:

As indicated in Fig. (1): the border surface irrigation system was applied using an electric archimedean screw of 252 m³/h discharge. During the period from the sowing to 60 days after soing, the irrigation water was applied daily to achieve and maintain a standing water of 0.03-0.05 m. While, during the period of 60-120 days from sowing, it was applied with a rate of one irrigation/two days to achieve and maintain a standing water of 0.05-0.06 m.

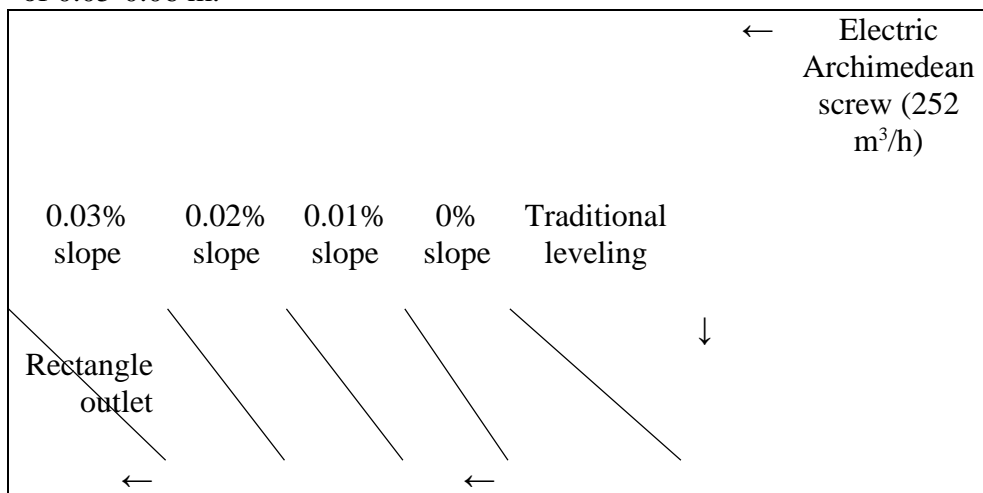


Fig. (1): Sketch diagram of the applied border surface irrigation system.

5. Statistical design and treatments:

The experiment was designed statistically as a split plots with three replicates. During the experiment, the following treatments were tested:

1. Precision land leveling: This treatment included the Precision land leveling slope levels of 0, 0.01, 0.02 and 0.03%, which were compared with the traditional land leveling.
2. Biofertilization: This treatment included the biofertilizers bf_1 , bf_2 , bf_3 , $bf_1 + bf_2$ and $bf_1 + bf_3$, comparing with the bereaved of biofertilization. The main plots involved the precision land leveling levels, and the sub plots involved the biofertilization types.

Measurements:

1. Soil conditions:

a) Soil bulk density (ρ_b):

At harvest, across each experimental unit, three soil samples were extracted from layer of 0-0.30 m using a core sampler. Then, the average soil bulk density was determined as follows:

$$\rho_b = \frac{\text{soil dry mass}}{\text{core volume}} \text{ g/cm}^3 \quad (1)$$

b) Soil infiltration rate:

At harvest, across each experimental unit, the soil infiltration rate was determined using the cylinder (ring) infiltrometer method.

2. Applied irrigation water amount (Q):

The applied amount of irrigation water was measured using a rectangular shape crested weir according to El-Banna, (1998) as follows:

$$Q = \frac{CLH^3}{2} \text{ m}^3/\text{s} \quad (2)$$

Where

L is the length of the crest, m.

H is the head, m.

C is the coefficient of discharge (0.6).

3. Rice grain yield:

At harvest, for each experimental unit, an area of 1 m² was taken randomly to determine the rice grain yield. Then, it was calculated on basis of 14% moisture content (d.b.).

4. Water use efficiency (WUE):

$$WUE = \frac{\text{grain yield, kg/fed.}}{\text{applied irrigation water amount, m}^3/\text{fed.}} \text{ kg/m}^3 \quad (3)$$

Statistical Analysis:

Microsoft Office Excel 2007 computer program was used to employ the analysis of variance and the LSD tests for rice grain yield data.

Regression and Correlation Analysis:

Microsoft Excel 2007 computer program was used to carry out the simple regression and correlation analysis to represent the effect of the precision land leveling slope on the rice grain yield.

RESULTS AND DISCUSSIONS

1. Effect Of Precision Land Leveling Slope On Soil Conditions:

a) Soil bulk density:

Figure (2) showed that the precision leveling achieved lower values of soil bulk density by about 4% than that was obtained by the traditional leveling. This result could be explained that the traditional leveling achieved the soil particles of higher pore spaces, leading to the increased mechanical connections between particles, reducing the soil free pore spaces per unit volume, then, the soil bulk density increased.

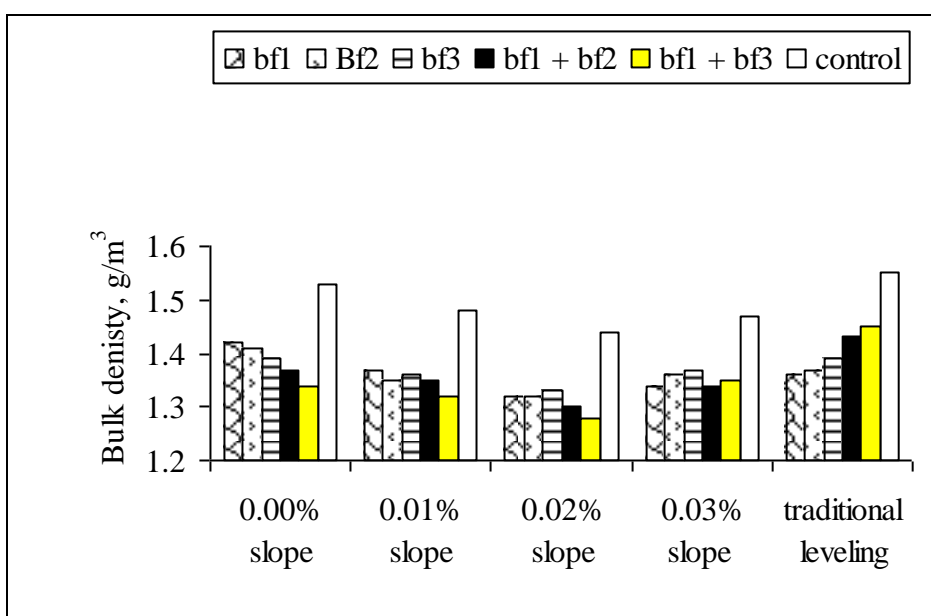


Fig. (2): Effect of precision land leveling on soil bulk density under application of biofertilizers.

On the other hand, the soil bulk density decreased by about 5% as the leveling slope increased from 0 to 0.02%, then, it increased by about 4% at leveling slope of 0.03% due to the enclosed soil pore spaces that create an aggregated structure of the a higher soil bulk density.

In addition, the application of biofertilizers in case of the precision leveling diminished the soil bulk density by 3-12%, comparing with the traditional leveling. The lower soil bulk density values were obtained in case of using Blue Green Algae and *Bacillus megatherium* var.

phosphaticum. It is attributed to the beneficial effect of the microorganisms which were retained in the soil in voids between the particles, sticking one to another, increasing the free pore spaces per soil volume unit, consequently, the soil bulk density improved.

b) Soil infiltration rate:

Results presented in Figure (3) indicate that there is a significant effect for the precision land leveling on the soil infiltration rate, comparing with the traditional leveling.

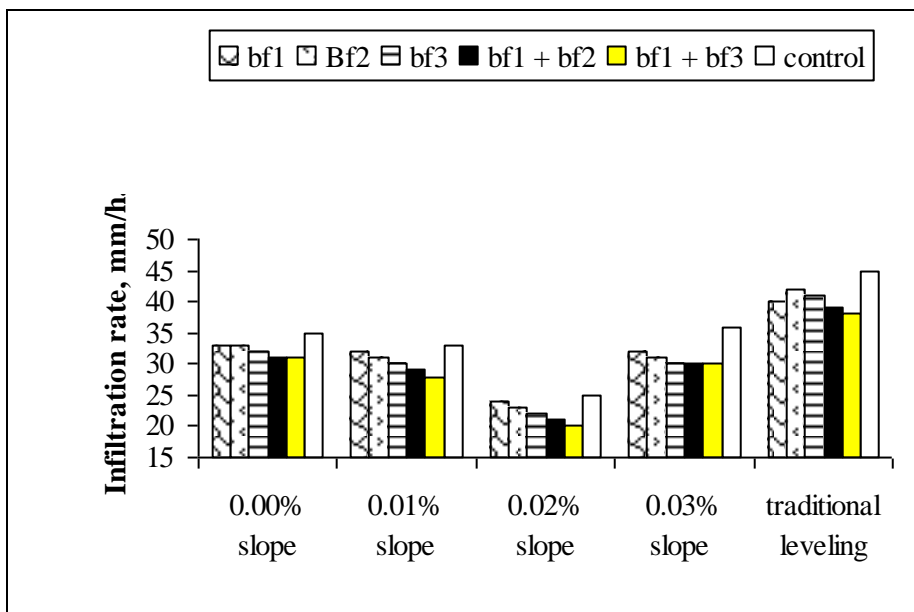


Fig. (3): Effect of precision land leveling on soil infiltration rate under application of biofertilizers.

The soil infiltration rate values may be arranged in the following descending order: the traditional leveling, 0.03% slope, 0% slope, 0.01% slope and 0.02% slope. These results could be illustrated that the traditional leveling achieved soil particles of higher pore spaces values, which having larger surface connected pores, allowing water to infiltrate quickly. On the other hand, at 0.03% slope, the higher relative infiltration rate values may be attributed to smoothing the soil surface, the very small pores pull water through capillary action in addition to and even against the force of gravity. Meanwhile, at 0.02% slope, the soil is occupied by

medium pore spaces, then, the irrigation water streamed, detach soil particles from the surface and wash fine particles into surface pores, creating smaller pores offer greater resistance to gravity, where they can impede the infiltration process.

The application of biofertilizers occurs a significant reduction in the soil infiltration rate. This finding is explained that applying the biofertilizers created more porous soil by both protecting the soil from pounding, which can close natural gaps between soil particles, and loosening soil through the biological reactions. Consequently, the soil infiltration rate decreased.

2. Applied Irrigation Water amount:

Figure (4) revealed that during the growing period of 1-60 days after sowing, to maintain standing water or to keep the soil saturated, the irrigation water amounts of 3326.40, 4989.60, 4989.60, 6652.80 and 8316.00 m³/fed. were received for precision leveling with 0, 0.01, 0.02, and 0.03% slope and the traditional leveling, respectively. While, at the growing period of 61-120 days after sowing, the corresponding irrigation water amounts were 8632.80, 7151.10, 7590, 10975.80 and 13305.60 m³/fed. for the previous land leveling treatment levels with the same respect. On the other hand, the total water amounts to irrigate one fed were 11959.20, 12140.70, 12579.60, 17628.60 and 21628.20 m³ for the previous land leveling treatment levels with the same respect. Then, the precision leveling of 0, 0.01, 0.02 and 0.03% slope saved the applied irrigation water amounts by 44.68, 43.85, 41.82 and 18.47% , respectively, comparing with that applied irrigation water amount in case of the traditional leveling.

3. Rice Grain Yield:

figure (5) demonstrates that applying the biofertilizers increased the rice grain yield by about 83.07, 6.17, 17.67 and 4.58% using the precision land leveling with 0, 0.01, 0.02 and 0.03% slope, respectively, comparing with the traditional leveling. This finding means that, the rice grain yield was affected significantly by the precision land leveling which improves the soil conditions, enhancing the releasing of the available soil nutrients, resulting in more NPK uptake by rice plants, consequently, the rice grain yield increases. Moreover, the rice grain yield was affected significantly by the biofertilization, which improve the soil conditions and encouraged

both the biological fixation of the atmospheric Nitrogen and the Phosphate volatilizing by the soil microorganisms.

The analysis of variance test indicates that there is a high significant difference in rice grain yield due to the precision land leveling slope and the biofertilization.

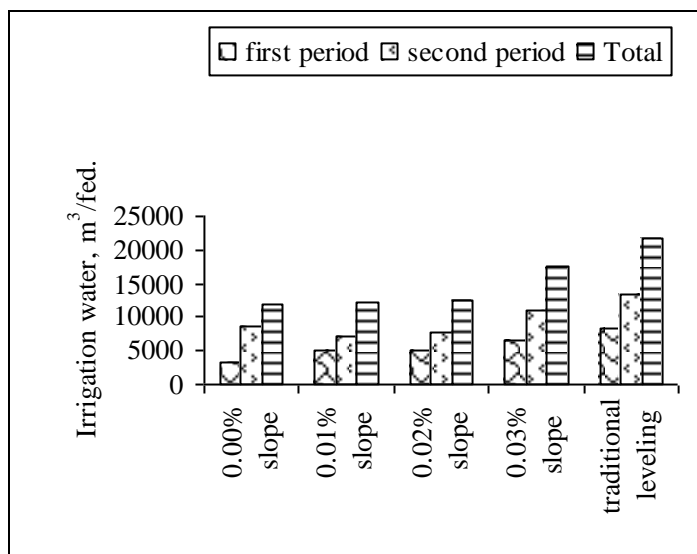


Fig. (4): Effect of precision land leveling slope on the applied irrigation water amount.

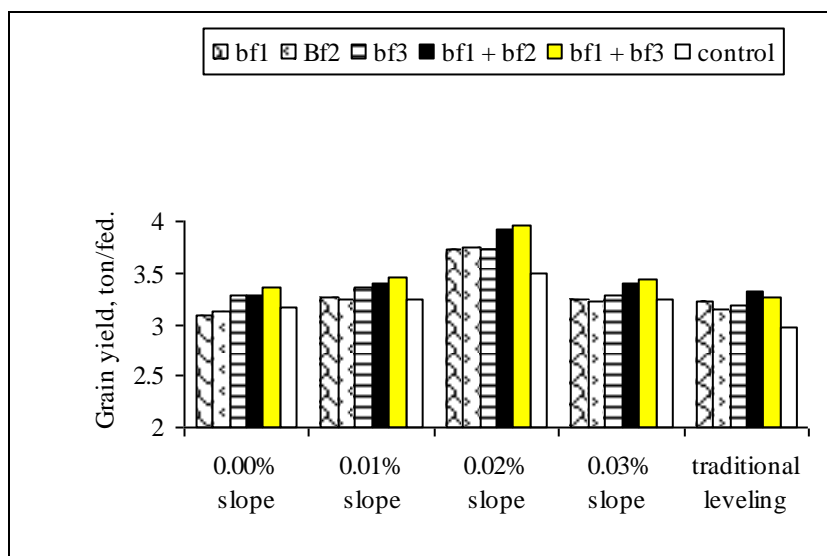


Fig. (5): Effect of precision land leveling on rice grain yield under application of biofertilizers.

The L.S.D. test at 0.05 level shows that the highest rice grain yield of 3.96 ton/fed. Was obtained in case of using the precision land leveling slope of 0.02% which was accompanied with Blue Green Algae + Bacillus megatherium var. phosphaticum among the other treatments.

The regression and correlation analysis reveals that the rice grain yield (y) correlates positively with the precision leveling slope (x) as follows:

$$y = - 0.2025 x^2 + 1.1135 x + 3.602 \quad (R^2 = 0.5896)$$

4. Rice Water Use Efficiency:

Figure (6) reveals that applying the biofertilizers increased the rice water use efficiency by about 86.67, 86.67, 153.33 and 26.33% using the precision land leveling with 0, 0.01, 0.02 and 0.03% slope, respectively, comparing with the traditional leveling. The higher rice water use efficiency value of 0.39 kg/m³ was obtained at precision leveling slope of 0.02% which, was accompanied with Blue Green Algae + Bacillus megatherium var. phosphaticum.

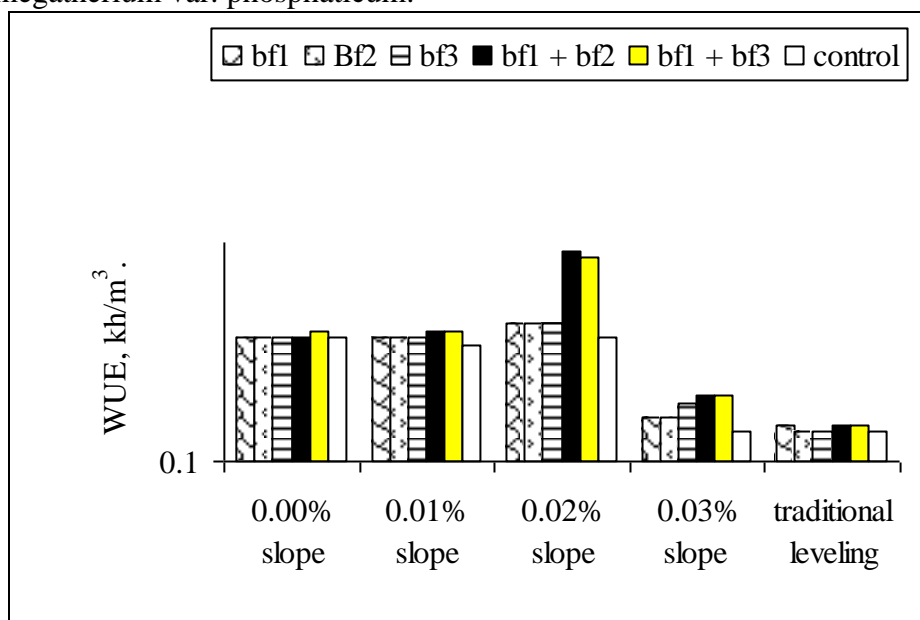


Fig. (6): Effect of precision land leveling on rice water use efficiency under application of biofertilizers.

CONCLUSION

The obtained results of this study could be concluded as follows:

1. *The precision land leveling under the biofertilization application achieved the lower values of soil bulk density (1.28 g/m^3) and soil infiltration rate (20 mm/h).*
2. *The precision land leveling saved the total applied irrigation water amount by about 44.68, 43.85, 41.82 and 18.47% for 0, 0.01, 0.02 and 0.03% slopes, respectively, comparing with the traditional leveling.*
3. *The precision land leveling under the biofertilization application produced 3.96 ton rice grain/fed. and used one m^3 irrigation water to produce 0.39 kg of rice grains.*

It is recommended to use the precision land leveling under the biofertilization application due to the desirable soil conditions, the higher rice grain yield and the higher water use efficiency, comparing with the traditional land leveling.

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REFERENCES

- El-Banna, E.B. (1998).** Soil mechanics and water, 1st Ed., El-Bardi Press, Mansoura, 444 p.
- El-Behery, A.A. and S.E. El-Khatib (2001),** The effect of precision land leveling on water use efficiency and performance for some farm machinery. J. Ag. Res. Review , 79 (4): 1513-1523.
- El-Kholy, M.H. and M.A. Omar (2004),** A two –year field trial on evaluating Rhizobacteria inoculation on growth and yield of rice plants, J. Ag. Res. 82 (3): 1047-1057.
- El-Refae, I.S. (2007),** The interaction effect between water regimes and Potassium levels on growth, grain yield and water productivity in rice, J. Ag. Res., 85 (4): 1399-1421.
- El-Raie, A.S.; A.M. El-Nozahy and R.K. Ibrahim (2003).** Laser land leveling impact on water use efficiency, soil properties and machine

- performance under agricultural intensification conditions. *Misr. J. Ag. En.*, 20 (4): 757-775.
- El-Raie, A.S.; A.T.Imbabi; M.F. Hassan and K.A. Gabber (2004)**, Precision land leveling by using laser technology under the conditions of Fayoum Governorate. *Misr J. Ag. Eng.*, 21 (2): 321-340.
- El-Serafy, Z.M. and A.M. El-Ghamry (2006)**, Methods of soil and water analysis (Practices), Soils Dep., Fac, Ag., Mansoura Univ., 253 p.
- Hammad, S.A. (1994)**, Evaluation of Azolla and Ammonium Sulfate as a source of Nitrogen for rice production. *J. Ag. Sci. Mansoura Univ.* 19 (1): 375-385.
- Helmy, M.A.; A.M. El-Serfy; S.Gomma; W. Abo El-Hassan; G. Fawzy and A. Nassar (2000)**, Effect of seed bed preparation and water management on yield and water requirement for rice. *Misr J. Ag. Eng.* 17 (4): 83-96.
- Khadr, M.S.; R. Abou-El-Enein, A. Abd El-Shafy, F.A. Zahran and A.A. Zohry (2004)**, Sustainability of soil fertility status after 3-year crop rotation in sandy soils in Egypt. *J.Ag. Res.* 82 (2): 475-485.
- Ministry of Agriculture and Land Reclamation (2006)**, Statistical Year Book, Central administration for agricultural economics. Study of important indicators of the agricultural statics. (2): 61.
- Mourad, S.A.; M.A. Ali; S.M. El-Awady and KH.A. Mowafy (2003)**, The role of certain environmental factors on the population activity of rice leaf miner *hydrellia prosternalis*; deeming and leafhopper *balclutha hortensis* lindb, at the northern parts of Delta. *J. Ag. Res.*, 81 (4): 1619-1629.
- Sharief, A.E.; M.H. El-Hinidi; A.T. El- Kassaby and F.I. Yossef (1998)**, Response of rice productivity to Biofertilization type and Nitrogen fertilizer level. *J. Ag. Sci. Mansoura Unvi.* 23 (12):5817-5825.
- Singh, A.L.; P.K. Singh; V.P. Pandey, A.K. Dubey and D.C. Veemd (1992)**, Effect of blue-green Algae inoculation on yield of paddy in different districts of U. P. *News. Agriculture.* 3 (2): 189-192.
- Yanni, Y.G. (1992)**, The effect of Cyanobacteria and Azolla on the performance of rice under different levels of fertilizer Nitrogen. *Biotechnology* 8 (2): 132-136.

الملخص العربي

تأثير التسوية الدقيقة بالليزر والمخصبات الحيوية على كفاءة إسفاده الأرة من مياه الري في الأراضي الرملية

د/ أسامة طه بهنس** د/ محمد يسري بندق*

أجريت هذه الدراسة بمنطقة قلابشو بمحافظة الدقهلية خلال الموسم الصيفي ٢٠٠٧، وذلك للوقوف على تأثير التسوية الدقيقة للتربة والمخصبات الحيوية على كفاءة إسفاده الأرز من مياه الري في الأراضي الرملية، وقد تم تنفيذ وتصميم التجربة إحصائياً في قطع منشقة، وقد تضمنت القطع الرئيسية مستويات التسوية الدقيقة، بينما إشملت القطع الشقية على أنواع المخصبات الحيوية، ويمكن تلخيص أهم النتائج كما يلي:

١. حققت التسوية الدقيقة للتربة عند إنحدار ٠,٠٢٪ مع إستخدام التخصيب الحيوي للتربة بكل من *Blue Green Algae* و *Bacillus megatherium var. phosphaticum* أقل قيمة للكثافة الظاهرية للتربة (١,٢٨ جم/س^٣) أقل قيمة لمعدل رشح التربة (٢٠ مم/س).
٢. حققت التسوية الدقيقة للتربة وفراداً في الكمية الكلية المستخدمة من مياه الري بمقدار ٤٤,٦٨, ٤٣,٨٥, ٤١,٨٢, ٤٧,١٨٪ عند إنحدار ٠,٠١, ٠,٠٢, ٠,٠٣٪ على الترتيب بالمقارنة بالتسوية التقليدية للتربة.
 ٣. حققت التسوية الدقيقة للتربة عند إنحدار ٠,٠٢٪ مع إستخدام التخصيب الحيوي للتربة بكل من *Blue Green Algae* و *Bacillus megatherium var. phosphaticum* أعلى إنتاج لحبوب الأرز بمقدار ٣,٩٦ طن/فدان وأعلى كفاءة إسفاده مياه الري بمقدار ٣٩.٠ كجم/م^٢.
- وبصفة عامة، فإنه يوصى باستخدام التسوية الدقيقة للتربة مع المخصبات الحيوية وذلك لتحقيق أعلى إنتاج لحبوب الأرز مع توفير أكبر قدر ممكن من مياه الري.

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