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EFFECT OF RICE STRAW ON SOME SOIL PROPERTIES

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ABSTRACT

The main objective of this study is to investigate the influence of adding different rice straw quantity and mixing depth in soil on improving some soil properties. The experiments were carried out during two successive seasons (winter 2011-2012 and summer 2012) on a silty clay loam soil at the research farm of the Faculty of Agriculture - Mansoura University.

The obtained results indicated that increasing the quantity of rice straw increases the soil's ability to retain soil moisture content, decreases the soil penetration resistance and increases the soil organic matter in comparison with the soil without adding of rice straw. The results also showed that increasing the depth of the mixing soil layer from (0-10 cm) to (0-20 and 0-30 cm) lead to a reduction in soil's ability to retain soil moisture content as well as high soil penetration resistance and reduce the proportion of the organic matter in soil.

INTRODUCTION

The effect of crop residual on soil properties depends on the quality of crop residues and the degree of its decomposition; it depends largely on the tillage system and the degree of biological activity in soil.

Tebrügge (1989) reported that the tillage systems can play an important role for increasing the decomposition of organic matter, biological activity, erosion protection and stability of soil fertility.

Helmy, *et al*, (1994) reported that the conventional tillage systems changed the vertical distribution of soil arthropod communities at the two tested soil layers (0-20 & 20-40 cm). On other hand, ploughing, harrowing by the popular ordinary wooden plough were changed to some extent the vertical distribution of both soil and fauna. Ali and Abo-Habaga (1995) reported that the highest population number of soil fauna recorded after using conservation tillage (Chisel plough + Rotary plough) and minimum tillage (Rotary plough) in comparison with traditional tillage (chisel plough twice + wooden leveler), which were about 85 and 80% more than the number of soil fauna at the traditional tillage treatment, respectively.

Abo-Habaga *et al* (1999) indicated that utilization of the rotary tiller system led to an increase in soil microbial activity and microbial numbers of about 57% in comparison to the traditional system.

Abdel-Khalik (2001) indicated that the reduced tillage system recorded the highest decomposed percentage (94%) from the total residual stalk cotton and using conservation tillage system recorded (92%), whereas using conventional tillage system recorded the minimum decomposed percentage (68.5%) from the total residual stalk cotton after vegetation period.

Abo-Habaga (2008) observed that the rate of decomposition of the rice straw (without addition of enzymes and microorganisms) after one month

of the seedbed preparation and sowing was 51 and 59%, while the percentage to 85 and 93%, then 94 and 97% after two and three months for each of the surface layer (0-10 cm) and the next layer (10-20 cm) depths, respectively. While, all straw traces disappeared in the last sample after four months in both layers. Whereas the samples after the addition of enzymes and microorganisms recorded increasing in the proportion of decomposed straw after one month of the seedbed preparation and sowing, this recorded 79 and 82% of the total amount of straw in the surface (0-10 cm) and followed layers (10-20 cm) depths, respectively. Khider (2010) reported that the conservation tillage treatment achieve increase in the proportion of decomposed straw after 45 days of the seedbed preparation and sowing about 60 % from the total amount of straw in comparison with intensive and conventional tillage, which recorded about 48 and 28.3%, respectively. Karami *et al*. (2012) showed that application of organic matters (OM) sources had positive effects on the soil mean weight diameter (MWD), geometric mean diameter (GMD). The (GMD) and soil aggregate percents (SAP) > 0.84 mm increased following application of sheep and cow manure. The SAP > 0.84 mm, MWD, and GMD showed increasing trend from the beginning of the sowing stage to the end of the growing season.

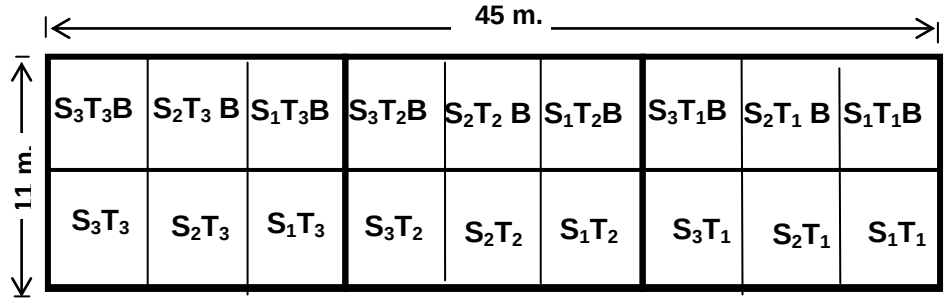
The aim of this study is investigating the effect of residual quantity and mixing depth in soil on improving the soil properties.

MATERIALS AND METHODS

The experiment was carried out during two successive seasons (winter 2011-2012 and summer 2012) on a silty clay loam soil at the research farm of the Faculty of Agriculture - Mansoura University. The experimental area was about 495 m^2. It is divided into three parts according to the mixing depth of residual. Each part was subdivided into two plots depending on the crop residual type and addition of biological activator. Each plot was divided into three subplots, in accordance with the amount of crop residual (Fig. 1). Experimental area was prepared by using conservation tillage system (one pass chisel plough followed by one pass of rotary plough) according to (Abdel-Khalik, 2001, Khidr, 2010 and Atwa, 2012).

The biological activator was prepared in Microbiology Dept. Fac. of agric. It consists of Trichoderma viridae and Bacillus megaterium.

The experiment treatments were prepared through excavation area (200×75 cm) at the center of each subplots with defined depths (10, 20 and 30 cm.) by using metal frame (200×75×35 cm) for mixing the cutting rice straw with soil. The frame pushes into the desired soil depth. Then, the soil was lifted from the frame and mixed well with the residual and return within the frame.



S (Rice straw): S_1(275 g/m^2), S_2 (550 g/m^2), S_3 (1100 g/m^2) – B- Biological activator
T (Layer depth): T_1(0-10 cm), T_2 (0-20 cm), T_3 (0-30 cm)

Fig. 1: Layout of experimental area.

Soil Penetration Resistance (P_r):

The soil penetration resistance was measured with a penetrograph according to Eijkelkamp catalogue (1979).

Soil Moisture Content (Ɵ):

The soil moisture content was determined using an oven drier at 105 °C for 24 hours according to Black *et al*. (1965).

Total Counts of Bacteria:

Plate count technique was used to determine total bacterial count using soil extract agar media according to Allen (1959).

Organic Matter:

The organic matter was determined using muffle furnace at 350 to 400 °C for 7-8 hours according to Jackson (1967).

RESULTS AND DISCUSSION

Soil Moisture Content:

The results in figure (2) showed that increase the quantity of crop residues in the soil increases the soil's ability to retain soil moisture content during the irrigation interval. The treatments with addition crop rice residues (275, 550 and 1100 g/m^2) at (0-10 cm depth) recorded soil moisture content at field capacity about 43.2, 43.4 and 43.8% and 28.1, 28.5 and 28.7% after 22 days from irrigation, whereas, the treatment without crop residual recorded soil moisture content about 42.9 and 27.7%, respectively.

The results in figure (3) showed that addition of biological activator for the previous treatments with crop residual increases the soil's ability to retain soil moisture content about 0.4, 0.5 and 1.1% at field capacity and 0.7, 1.05 and 3.4%, respectively.

The results in figures (4 and 5) showed that the increasing of the soil layer depth of mixing crop residual leads to reduced the capacity of the soil to retain moisture content. Taking into consideration, the addition of biological

activator for treatments with crop residual increase its ability to retain soil moisture content.

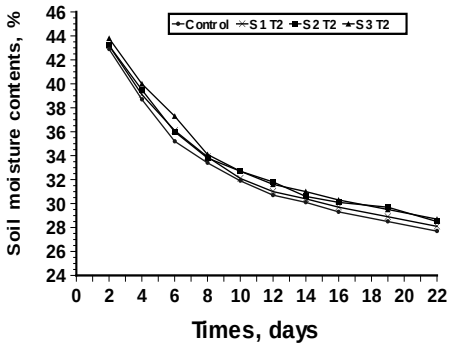


Fig. 2: Effect of the quantity of rice straw without biological activator on the soil moisture content.

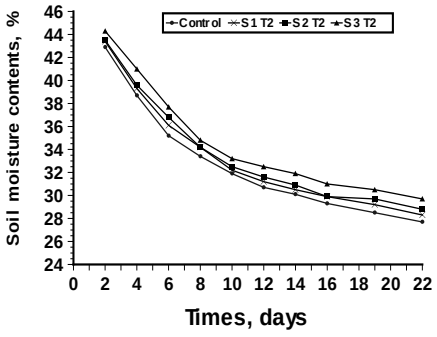


Fig. 3: Effect of the quantity of rice straw with biological activator on the soil moisture content.

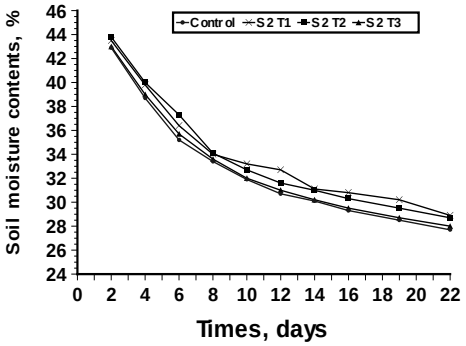


Fig. 4: Effect of the depth of mixing rice straw without biological activator on the soil moisture content.

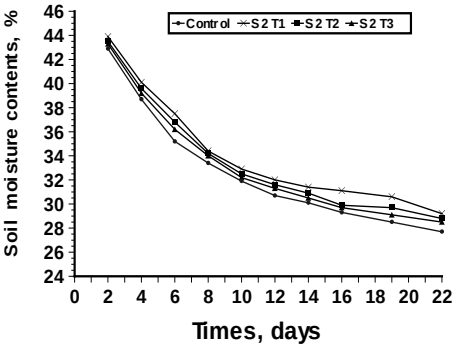


Fig. 5: Effect of the depth of mixing rice straw without biological activator on the soil moisture content.

Soil Penetration Resistance:

The experimental results in figure (6) showed a decrease in the soil penetration resistance with increase the addition of quantity of crop residue at all soil layer depths. Addition of (275, 550 and 1100 g/m^2) crop residue decreased the soil penetration resistance about 10.2%, 14.2 and 18% in comparison with the soil without crop residues. Whereas, addition of biological activator for the treatments with crop residual decreases the soil penetration resistance about 13.5%, 17.5 and 21.5% in comparison with the soil without crop residues as shown in figure (7).

Results in figures (8 and 9) showed that the decreasing of the soil layer depth of mixing crop residual leads to reduced the soil penetration resistance.

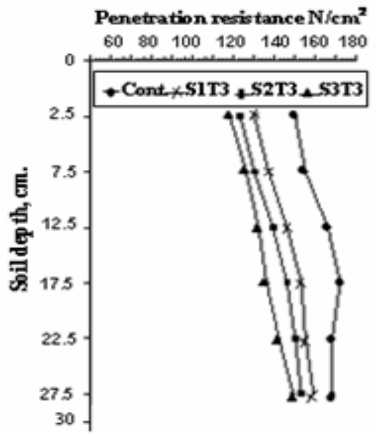


Fig. 6: Effect of the depth of mixing rice straw without biological activator on the soil penetration resistance.

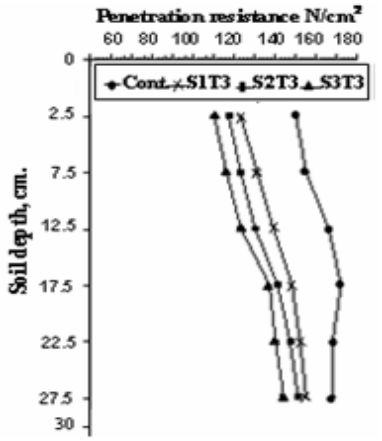


Fig. 7: Effect of the quantity of rice straw with biological activator on the soil penetration resistance.

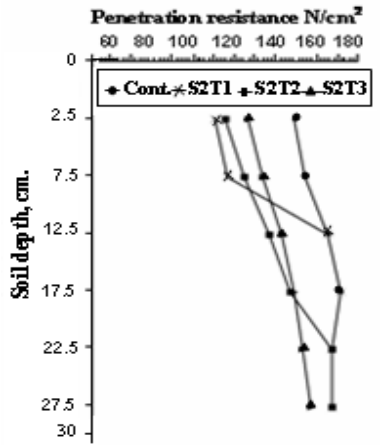


Fig. 8: Effect of the quantity of rice straw without biological activator on the soil penetration resistance.

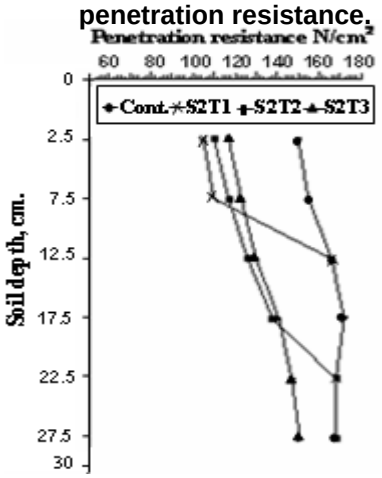


Fig. 9:Effect of the depth of mixing rice straw with biological activator on the soil penetration resistance.

Treatments, which have been mixed with amount of 550 g/m^2 from the crop residual in soil layer (0-10 cm) depth, recorded decreasing of soil penetration resistance about 27.2%, while the treatments with the same amount of crop residual in soil layers (0-20 and 0-30 cm) depth recorded decreasing of soil

penetration resistance about 21.5 and 14.2 %, respectively. Addition of biological activator for the treatments with crop residual decreases the soil penetration resistance about 29.5%, 23.8 and 17.5% at soil layer depths (0-10, 0-20 and 0-30 cm) in comparison with the soil without crop residues, respectively.

Organic Matter:

Results in figure (10) indicated that the field experiment contain about 1.3% organic matter. The addition of rice straw (275 g/m^2) recorded increasing of soil organic matter about 0.114, 0.057 and 0.038% in soil layers (0-10, 0-20 and 0-30 cm) depths, in comparison with treatment without rice straw, respectively. Increasing the quantity of rice straw from 275 to 550 g/m^2, increase the percentage of organic matter about 0.227, 0.114 and 0.077%, whereas, increasing the quantity of rice straw from 275 to 1100 g/m^2, increase the percentage of organic matter about 0.454, 0.227 and 0.151%, in soil layers (0-10, 0-20 and 0-30 cm) depths, in comparison with treatment without rice straw, respectively.

The addition of biological activator to the treatments with rice straw increased the percentage of organic matter at all treatments between 0.08 and 0.63% in comparison with treatment without rice straw.

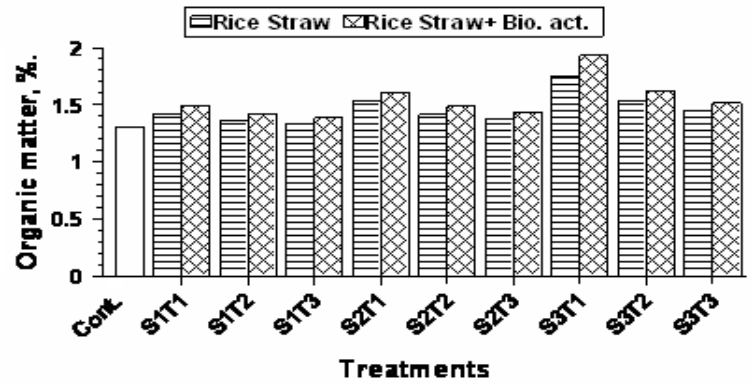


Fig. 10: Effect of quantity of rice straw on the soil organic matter at different soil layer depths.

Biological activity:

Results in figure (11) indicated that increase the quantity of rice straw in soil leads to increased the total count of bacteria as evidence of soil biological activity. Increase the addition rice straw from 275 g/m^2 to 550 and 1100 g/m^2 increase the soil biological activity from 15.7% to 25.7 and 35.7% in comparison with treatment without rice straw at mixing soil layer (0-10 cm), respectively. Also, the results showed that the increasing of the soil layer depth of mixing rice straw leads to reduce the soil biological activity. The results also showed that increasing mixing layer for 550 g/m^2 rice straw from

(0-10 cm) to (0-20 and 0-30 cm) decrease soil biological activity from 25.7% to 17.1 and 7.1%, respectively.

Addition of bio. activator to the treatments with rice straw increased the soil biological activity

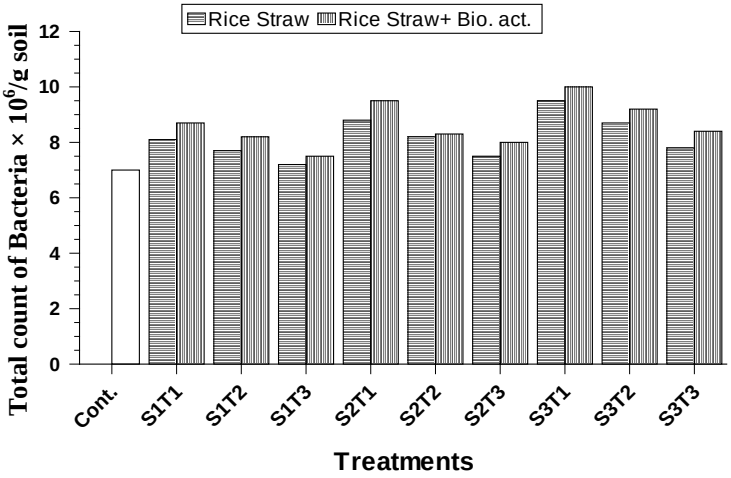


Fig. 11: Effect of quantity of rice straw on the biological activity at different soil layer depths.

CONCLUSION

From this study, it may be concluded that to benefit the rice straw by mixing it with soil during seedbed preparation, as the consequent low soil penetration resistance, increase the proportion of organic matter in soil and increase the soil biological activity as well as increase the ability of soil to retain moisture content for longer period of time, which helps to provide water and exploitation of irrigation in the cultivation of new areas.

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تأثير بقايا قش الارزعلى بعض خواص التربة

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أهتمت الدولة في الآونة الآخيرة بالتخلص الآمن للمخلفات الزراعية والعمل على تعظيم الأستفادة منها بطرق عديدة ومتنوعة يراعى فيها المحافظة على البيئة من التلوث وعلى صحة الأنسان ومصادر ثرواته. أجريت هذه الدراسة بهدف الأستفادة من المخلفات الزراعية الحقلية. تم اختيار مخلف قش الأرز وتقدير مدى تأثير كمية المخلف وعمق خلطة في التربة على تحسين بعض خواص التربة. أجريت التجارب الحقلية لهذه الدراسة في تربة سلتية طينية طميية بمزرعة كلية الزراعة ـ جامعة المنصورة لمدة موسمين زراعيين متتاليين (الموسم الشتوي 2012/2011 والموسم الصيفي 2012م).

تم استخدام ثلاث كميات من قش الأرز(275، 550، 1100 جم/ م^2)، وتم خلط كل كمية من المخلف في ثلاث طبقات بالتربة وهي (0-10 سم)، (0-20 سم)، (0-30 سم). وتم تكرار كل معاملة مرتين. مع إضافة منشط بيولوجي لإحدى هاتين المكررتين.

تم أخذ مجموعة من القياسات التالية يمكن تلخيصها فيما يلي:

- نسبة المادة العضوية بالتربة.
- النشاط البيولوجي بالتربة.
- المحتوي الرطوبي للتربة.
- مقاومة التربة للإختراق.

تم التوصل لمجموعة من النتائج يمكن تلخيصها فيما يلي:

- أدى زيادة كمية قش الأرز المخلوط بالتربة عند عمق (0-10 سم) إلى ارتفاع نسبة المادة العضوية بها، في حين تقل هذه النسبة كلما زاد عمق طبقة التربة المخلوط بها نفس الكمية من قش الأرز.
- ترتفع قدرة التربة على الاحتفاظ بالرطوبة كلما زادت كمية قش الأرز المخلوطة بها عند عمق (0-10 سم)، بينما تقل هذه القدرة كلما زاد عمق طبقة التربة المخلوط بها نفس الكمية من قش الأرز.
- أدى إضافة قش الأرز إلى تقليل مقاومة التربة للاختراق وتنخفض قيمة هذه المقاومة كلما زادت كمية قش الأرز المضافة للتربة عند عمق (0-10 سم)، في حين ترتفع هذه القيمة كلما زاد عمق الطبقة المخلوط بها قش الأرز.
- أدى إضافة قش الأرز إلى زيادة نسبة النشاط الحيوي بالتربة وترتفع هذه النسبة كلما زادت كمية قش الأرز المضافة للتربة عند عمق (0-10 سم)، في حين تنخفض هذه النسبة كلما زاد عمق الطبقة المخلوط بها قش الأرز.

لذا توصي هذه الدراسة بالاستفادة من قش الأرز من خلال خلطه بالتربة أثناء عملية إعداد وتجهيز مرقد البذرة للزراعة، لما يترتب على ذلك من انخفاض مقاومة التربة للاختراق وزيادة نسبة المادة العضوية بالتربة بالإضافة إلى زيادة مقدرة التربة على الاحتفاظ بالرطوبة لفترة زمنية أطول مما يساعد على توفير مياه الري واستغلالها في زراعة مساحات جديدة.

قام بتحكيم البحث

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