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LONG-TERM EXPERIMENTS ON THE EFFECT OF RICE STRAW ADDITION ON SOIL PROPERTIES AND CROP PRODUCTIVITY

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ABSTRACT

Long-term experiment was carried out during the fall growing season in nineteen successive seasons. The experimental area with and without rice straw was tilled by using the conservation tillage system (one pass chiseling followed by rotary tiller). The experimental area was planted with wheat followed by rice crop during the whole experiments.

The obtained results indicated that the addition of rice straw, leading to lower soil penetration resistance during the growing season about 5.6, 5.9, 2.2 and 1.1% in comparison with the treatment without rice straw at depths of 5, 10, 15 and 20 cm, respectively. The crop yield increased about 28 and 23.4% more than the rice and wheat crop yields at treatment without rice straw, respectively.

INTRODUCTION

Given the desire to remove farm residues from the field quickly to catch up with the planting season, with the lack of manual laborer and suitable equipment, is a process of burning rice straw simpler, easier and cheaper way possible to get rid of this residues, helped by the belief among many Egyptian farmers low economic value of rice straw, resulting in a lot of environmental damage and which are reflected directly and indirectly to human health. The Egyptian farmer burn yearly about 3.9 million tons of rice straw and cotton stalk for vacating the field to prepare the seedbed for next crop.

Many scientific research have shown the nutritional value of rice straw. For example Hokka and Sawah (2002) explained the fertilizer elements of some field residual as shown in the Table (1).

Table 1: Percentage of fertilizer elements of some field residual.

Field residual	K	P	N	C/N Ratio
Rice straw	1.38	0.10	0.58	1:105
Wheat straw	1.06	0.11	0.49	1:105
Corn stalk	1.31	0.31	0.59	1:55

Percentage calculated on a dry weight basis.

This has led to the alert to the economic importance of rice straw and encouragement to take advantage of it in many different fields, especially the manufacturing of organic fertilizers.

Hegazi (2002) explained that the recent trends in agriculture support the use of organic agriculture systems so as to reduce or limit the use of mineral fertilizers, which performed under the systems of intensive

agriculture, as in greenhouses to contamination of soil and vegetation, water, and therefore, the amount of organic matter that must be added to the soil is of specific factors of production, and very briefly, the organic fertilizer made from rice straw and farm residual give back some of the nutrients taken from the soil through the stages of plant growth and crop production.

Morsi *et al*.(2006) used rice straw for manufacture of organic fertilizer (compost) with different treatments, the obtained results showed improved growth characteristics of all compost treatments in comparison with (without compost). The results also showed superiority compost rice straw, which treated with poultry manure comparison with which treated with organic manure.

Kessel and Horwath (2000) indicated that the cutting and mixing of rice straw in the soil affects the soil content of nitrogen, which leads to an increase in crop yield compared to the process of burning straw and leave it in the soil . Also, Khedr (2010) reported that the addition of rice straw due to increased the crop yield about 15-20٪ for the following wheat and rice crops, respectively, in comparison with un-treatments under different tillage systems.

Abo-Habaga *et al*. (2007) reported that the increasing of soil penetration resistance in treatments with rice straw before planting is very slight compared to the amount of the increase in treatments without straw under different tillage systems.

MATERIALS AND METHODS

The experiments were carried out in clay soil (61.8% clay, 11.2% silt and 27% sand) during nineteen growing seasons from summer 2002 untel summer 2011 in private farm at Koom-Elderby village, Dakahlia governorate.

The experimental area was divided into two plots (19×56m), in accordance with addition of rice straw and without rice straw. The experimental areas with and without rice straw were tilled by using the conservation tillage system (one pass chiseling followed by rotary tiller). The experimental area sowing wheat using hand sowing method and planting rice using hand transplanting method.

The soil penetration resistance was measured with a penetrograph according to Eijkelkamp`s catalogue (1979). The penetrograph is driven into the soil at a uniform speed; the resistance is measured and registered in N/cm^2 (Fig. 1).

The crop yield was evaluated by taking five randomly selected samples of one square meter area for each plot. The yield was expressed as dry matter weights. The samples were collected using a frame 1 m^2, which was put on the field carefully with a randomize way in each plot. Five samples were taken and shelled by hand and weighed and used to extrapolate the crop yield in related to the feddan.

The plants length was evaluated by taking five randomly selected samples for each plot. All plants in each sample were measured using a tape

measure length (2 m), and calculated the average length of plants, as well as the standard deviation for each treatment.

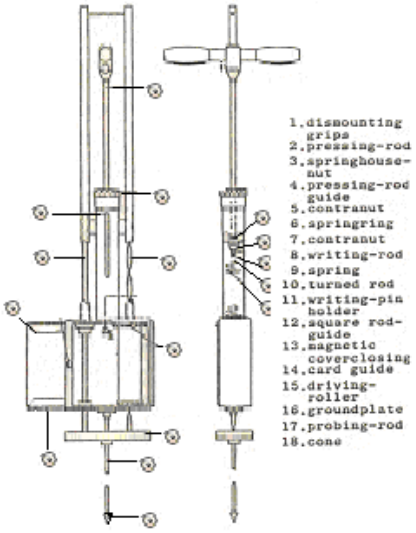

Fig. 1: Penetrograph.

RESULTS AND DISCUSSIONS

Soil penetration resistance:

The increase of soil penetration resistance makes it difficult to spread the roots in soil, which affect the vegetative growth and productivity of the crop cultivated, this comport with Dumbeck 1986. The obtained results (Figure 2) showed that the use of conservation tillage system leads to decrease soil penetration resistance after two weeks of planting and irrigation about 4.5, 6.4, 1.7 and 3.3% for the treatment without rice straw, and 6.7, 9.6, 3.3 and 3.9% for the treatment with rice straw at soil depth 5, 10, 15 and 20cm, respectively. After 3 months of planting and irrigation. The soil penetration resistance increased in all treatments at all depths to be much lower soil penetration resistance compared to the pre-tillage about 1.7, 1.6, 1.1 and 0.6% for the treatment without rice straw and 5.6, 5.9, 2.2 and 1.1% for the treatment with rice straw at depths of 5, 10, 15 and 20 cm, respectively. Thus clear that the addition of rice straw, leading to lower soil resistance during the growing season resulting in the further spread of the roots in soil and thereby increase the vegetative growth and productivity of the crop.

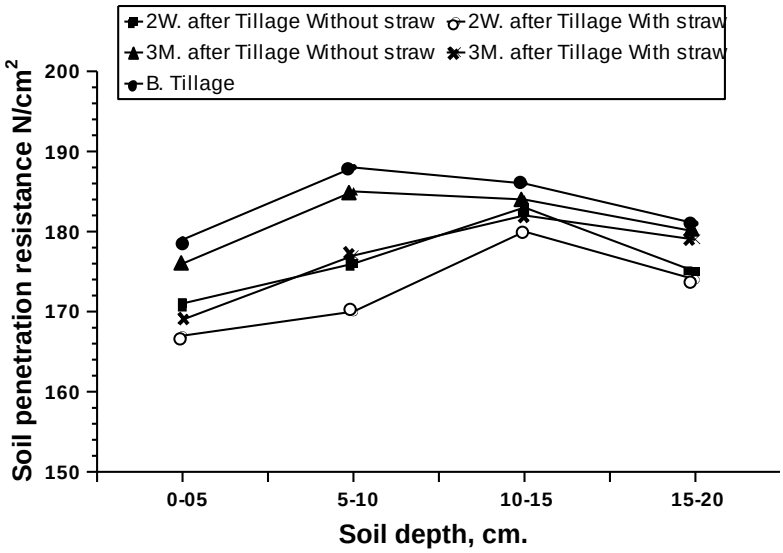

Fig. 2: Effect of rice straw on soil penetration resistance.

Specifics crop:

The obtained results (Figs. 3 and 4) showed the clear impact of the addition of rice straw on the specifics of the crop. Where the average length of ear and rice stalk in the treatment with rice straw were about 17 and 90 cm, while in the treatment without rice straw to reach about 14 and 81 cm, respectively. Whereas, the average weight of the ear and length of the stalk of wheat in the treatment with rice straw about 4.22 g, 112 cm, while in the treatment without rice straw were about 2.13 g, 91 cm. This results was agree with (Dumbeck, 1986) results.

Fig. 3: Effect of rice straw on length of rice and wheat stalk.

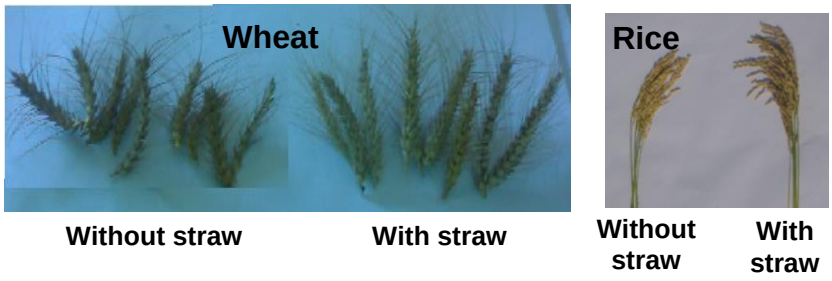

Fig. 4: Effect of rice straw on rice and wheat ears.

Crop yield

Data in Figure (5) showed the effect of rice straw on the crop yield. The results in Figure (5) were the average value of crop production in the last two seasons for each wheat and rice crops. The results indicated that the addition of rice straw increasing the crop yield about 28 and 23.4% for rice and wheat more than the crop yield at treatment without rice straw, respectively.

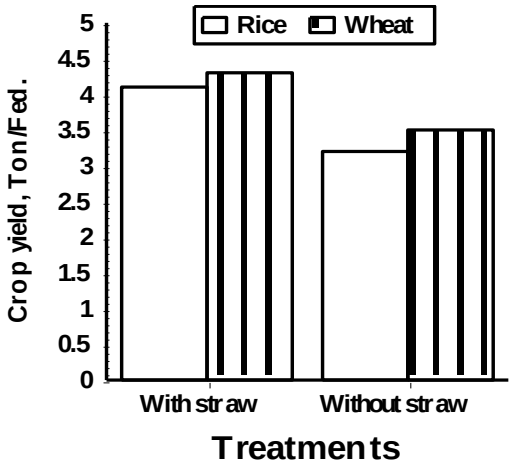

Fig. 5: Effect of rice straw on crop yield.

It may be noted that the addition of rice straw and mix it in the soil during nineteen seasons led to the improvement of soil properties in the form of soil penetration resistance as well as access to good specifics yield in terms of the lengths of the plants and the weight and length of ears. Thus increasing the productivity of wheat and rice, which were grown with successive seasons during throughout the experiment compared to cultivated crop in the treatment without rice straw.

REFERENCES

Abo-Habaga, M.; Salem, H. and M. Ghazy, 2007:" Effect of seed-bed preparation system and addition of rice straw on the following crop production" The third conference of sustainable agricultural development. Faculty of Agric. Fayoum Univ.: 55-62.

Dumbeck, G., 1986: “Bodenphysikalische und funktionelle Aspekte der Packungs-dichte von Böden”, Diss. Gießen, 1986.

Eijkelkamp, l979: "Catalogue for Penetrograph Stiboka". 3rd Ed-Lathu-mthe Netherlands: 1- 8.

Hegazi, A., 2002: " How to produce compost from rice straw and agricultural waste and use as fertilizer in the fruit and vegetables". Misr J. Agric. Eng. Special Issue for Symposium (Role of Agric. Eng. in the Profit of Agricultural Residue and Preservation of the Environment) Faculty of Agric., Mansoura Univ.: 24-28.

Hokka, F. and M. Al-Sawah, 2002:" Accumulation of agricultural waste in the environment - the problem and solution". Misr J. Agric. Eng. Special Issue for Symposium (Role of Agric. Eng. in the Profit of Agricultural Residue and Preservation of the Environment) Faculty of Agric., Mansoura Univ.: 82-98.

Kessel, Ch. and W. Horwath, 2000: "Research on alternative rice straw Management Practices in California". www.calrice.org/a5_ricestraw.htm

Khedr, M. O., 20102: " Development of adding machine unit for microbial materials to maximize utilization from rice straw" Ph. D. Thesis Mansoura univ.

Morsi, S.; Alkala, S.; Said, A.; Amiri, M. and H. Mustafa, 2006: "The use of some agricultural waste" rice straw " as organic fertilizer (compost)." Second Conference of Marketing Research Applied - Mansoura University - Research Summary: 6.

تجارب طويلة الأمد حول تأثير إضافة قش الأرز على خواص التربة وإنتاجية المحصول

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أجريت هذه الدراسة في مزرعة خاصة بقرية كوم الدربي – مركز المنصورة – محافظة الدقهلية في تربة طينية (61.8% طين، 11.2% سلت، 27% رمل) خلال تسع عشر موسم زراعي ابتداءاً من الموسم الصيفي 2002م حتى الموسم الصيفي 2011م.

قسمت أرض التجربة تبعاً لإضافة قش الأرز إلى جزئين أبعاد كل جزء (19×56م). تم تجهيز مرقد البذرة لأرض التجربة باستخدام نظام الحرث لحماية التربة (محراث حفار مرة واحدة يعقبه محراث دوراني)، وتم زراعة أرض التجربة بمحصول الأرز باستخدام طريقة الشتل اليدوي يعقبه زراعة محصول القمح باستخدام طريقة النثر طوال فترة التجربة.

تم التوصل لمجموعة من النتائج يمكن تلخيصها فيما يلي:

Penet. Resistance, N/ cm^2

- أظهرت النتائج انخفاض واضح في مقاومة التربة للإختراق في المعاملة المضاف إليها قش الأرز إلـــى مـــايقرب مـــن 5.6، 5.9، 2.2، 1.1% عنـــد الأعمـــاق (0-5)، (5-10)، (10-15)، (15-20) سم بالمقارنة إلى المعاملة بدون قش الأرز.
- أظهرت النتائج زيادة في طول النبات وسنبلة الأرز بمقدار 9، 3سم وطول نبات ووزن سنبلة القمح بمقدار 21سم، 2.09جم في المعاملة المضاف إليها قش الأرز بالمقارنة للمعاملة بدون قش أرز.
- أظهرت النتائج زيادة في متوسط انتاجية المحصول للموسمين الآخرين لكل من محصولي الأرز والقمح بمقدار 28%، 23.4% على التوالى في المعاملة المضاف إليها قش الأرز بالمقارنة للمعاملة بدون قش أرز.

تجدر الإشارة إلى أن إضافة قش الأرز وخلطه في التربة خلال المواسم التسعة عشر أدى إلى تحسين خواص التربة، من حيث انخفاض في مقاومة الاختراق للتربة فضلا عن الحصول على محصول جيد من حيث أطوال النباتات و وزن وطول السنابل، وبالتالي زيادة في إنتاجية محصولي القمح والأرز التي كانت تزرع في مواسم متتالية طوال فترة التجربة بالمقارنة إلى المحاصيل المزروعة في المعاملة دون قش الأرز.

قام بتحكيم البحث

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