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Effects of Rice Straw Incorporation on Some Physical Characteristics of Paddy Soils

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ABSTRACT

The prevalent method of irrigation in paddy fields in Iran is continuous ponding, which changes to intermittent method at the time of water shortage. Soil cracks are the main problem in intermittent irrigation. In this study, effects of adding rice straw on some soil physical characteristics and cracks were studied in paddy soils of the Guilan Province of Iran. The experiment was performed as split-split plots based on a complete randomized blocks design. Treatments included four soil textures (silty clay, silty clay loam, clay loam, and sandy loam), seven rates of rice straw (0, 2, 3, 4, 5, 6 and 7% by weight), and three soil moisture stages of drying conditions [primary stage (T_1), initial crack stage (T_2), final crack stage (T_3)]. Results revealed that soil texture, rice straw rate, crack treatments, and their interactions had significant ($P< 0.01$) effects on soil moisture content, bulk density, and time to crack formation. During the drying stage (from T_1 to T_3), moisture content decreased, however, bulk density and time to crack formation increased. In silty clay soil, addition of 2-3% rice straw expedited crack formation, and an addition of 4-7% straw delayed crack formation. In silty clay loam soil, addition of 3-5% straw enhanced crack formation, and addition of 6-7% delayed crack formation. The addition of rice straw in clay loam and sandy loam delayed crack formation. In general, addition of rice straw increased soil moisture content, decreased bulk density, and delayed crack formation.

Keywords: Bulk density, Crop residue, Paddy field, Soil moisture.

INTRODUCTION

Over 90% of the world's rice is produced and consumed in Asia-Pacific Region (Papademetriou *et al.,* 2000). In Asia, almost 84% of the water withdrawal is used for agricultural purposes, compared to 71% for the world. Rice represents about 45% of all irrigated crop areas in Asia and 59% of rice is irrigated (Facon, 2003).

More than 75% of rice cultivation in Iran is in the Guilan and Mazandaran Provinces. In Guilan, 230,000 ha of land are used for rice cultivation. Water is the main limiting factor in paddy fields. Two methods are practiced for irrigation of paddy fields: continuous flow of water (ponding) and intermittent method. In the intermittent method, after saturating the soil, irrigation is stopped and the next irrigation is applied when the water depth on the soil surface is close to zero. At this stage, soil starts to crack. In Iran, the prevalent irrigation method of the paddies is ponding. However, intermittent method is frequently applied when water is deficient.

After formation of the cracks in a paddy soil, far more water is needed to irrigate the filed than a field without cracks. Moreover, cracks can damage plant roots and reduce the yield, while high soil organic matter content can prevent cracking or reduce its intensity. Therefore, water management in cracked paddy fields is important.

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According to Islam *et al.* (2003), water management in cracked soil is the foremost problem in these soils. Soil management during irrigation is very important in order to reduce water losses from the cracking field, especially in areas with limited water resources.

A study of cracking soils was conducted to investigate soil management practices on infiltration rate (Islam *et al.,* 2004). It was observed that management of cracking soils has an enormous influence on infiltration rate. Among the management practices, the hand hoe operation was found to be better than trampling to reduce cracking.

Soil bulk density depends on many factors including texture, organic matter content, and root depth. It has been shown that the addition of organic amendments to soil has improved soil structure and reduced bulk density (Tester, 1990). Adams (1973) and Rawls *et al.* (1998) showed a negative correlation between organic matter content and bulk density of soil.

In an experiment by Gupta *et al.* (1977), soil-water retention was increased by incorporation of sewage sludge into a sandy soil. Most of this increase resulted from water adsorbed by organic matter. Bulk density decreased as the rate of sludge addition increased.

In order to improve aeration and water infiltration in the Middle Awash area of Ethiopia, green manure (dolicus lab-lab), farm manure, and bagasse were incorporated in the soil (Girma and Endale, 1995). The infiltration rate increased slightly after incorporation of dolicus lab-lab. In contrast, lower bulk density and greater total soil porosity were obtained after the incorporation of farmyard manure.

Hudson (1994) stated that organic matter could absorb water up to 20 times its weight, preventing dryness, shrinkage, and cracking of the soil.

In a research by Bandyopadhyay *et al.* (2003) it was found that all the cracking parameters were significantly negatively correlated with the water content of the 0–15 cm soil layer while crack width and volume were positively correlated with bulk density of the same layer. Application of manure reduced the magnitude of different cracking parameters.

The effect of straw mulching on crack formation during the fallow period was investigated on an Epiaqualf and a Pellustert in the Philippines (Cabangon and Tuong, 2000). Cracks did not close completely after rewetting, resulting in high losses of water (152-235 mm) during land preparation of the control plots, i.e. no soil management treatment. Straw mulching helped conserve moisture in the soil profile and reduced the mean crack width by 32% of the control. Mulching did not significantly reduce crack depth and the amount of water used in land preparation.

Straw mulching minimizes soil shrinkage by reducing evaporation from soil surface (Hundal and Tomar, 1985). According to Bhushan and Sharma (2002), crack volume and surface area decreased by 36-76% and 19-37%, respectively, by long-term addition of biomass.

One way of disposing of rice straw after rice harvest is burning the crop residues. According to Chan *et al.* (2002), burning the crop residue reduces the amount of organic substances. Burning wheat straw reduced water stability of entire soil and number of earthworms (Wuest *et al.,* 2005). It also reduced dry aggregates of 0.5–2.0 mm size, but didn't affect total C, total N, or ponded infiltration rate.

An on-farm experiment was conducted for two years in the northern Guinea savanna of Nigeria to evaluate the fertilizer effect of rice mill waste (RMW) on a degraded Alfisol (Schulz *et al.,* 2003). The RMW was applied at rates of 0, 5, 10, and 15 Mg ha^{-1} and was applied either unburnt or burnt (farmers' practice). In both years, compound fertilizer was broadcasted at rates of 40 kg N ha^{-1}, 17 kg P ha^{-1}, and 33 kg K ha^{-1}. The results showed that, compared to the control treatment (0 Mg ha^{-1} RMW), which yielded 0.55 Mg ha^{-1}, maize grain yields increased by 95% when 10 Mg ha^{-1} of unburnt RMW was applied, and by 147% with 15 Mg ha^{-1}.

In contrast, burnt RMW did not result in significant yield increases. The results indicated that unburnt RMW was a valuable organic input if applied at rates of 10-15 Mg ha^{-1} in combination with inorganic fertilizer.

In the present study, the effects of adding different levels of rice straw to four paddy soils on moisture content, bulk density, and time to crack formation were investigated.

MATERIALS AND METHODS

Experimental Site

Guilan Province, with an area of 14,711 km^2 is located in the northern part of Iran between 48° 25′ to 50° 34′ east longitude and 36° 36′ to 38° 37′ north latitude. This experiment was carried out in the Rice Research Institute, 10 km from city of Rasht, the capital of Guilan Province. This area has an average annual precipitation of 1,369 mm, air temperature of 15.9°C, and relative humidity of 81%.

Experimental Design and Treatments

The pot experiment was performed as split-split plots based on complete randomized blocks design and three replicates. Treatments included four soil textures as the main factor, seven rice straw rates as sub-factor (0, 2, 3, 4, 5, 6 and 7% by weight), and three soil moisture contents as sub-sub factor: primary stage (T_1, saturated soil with no water standing on the surface), initial crack stage (T_2, Area of cracks on soil in each pot= 13-17 cm^2), final crack stage (T_3, Area of cracks on soil in each pot= 55-59 cm^2). Treatments T_1 to T_3 resembled paddy fields with a shortage of irrigation water. It should be noted that when a saturated paddy soil is left to dry, first, water disappears from the soil surface, and then the drying soil starts to crack. In this experiment, treatment T_1 was the stage when standing water disappeared from the soil surface in the pot; treatment T_2 was the stage when the cracked area on soil surface in the pot was 13-17 cm^2; and T_3 was the stage when the cracked area on soil surface in the pot was approximately 55-59 cm^2. These cracks are mainly related to a separation of dried soil from the pot rim, even if some small cracks form on the soil surface.

Rice straw (as crop residue) was collected from paddy fields and cut into approximately 2 cm pieces. The soil samples from four paddy fields with textures of silty clay, silty clay loam, clay loam, and sandy loam were air dried and crushed. Each soil was mixed with the above percentages of rice straw and placed in large plastic containers and then saturated. The containers had some small holes at the bottom so that they could be wetted or drained. This action facilitated the decomposition of organic matter. The containers were kept in open out-door space to be under normal conditions of sunshine and rain for six months. Then, the soil of each container was mixed with enough water to be saturated and ready for proper puddling. The puddled soil was transferred to smaller pots of 16 cm diameter and 10.5 cm height. These pots had several drain holes at the bottom. Crack formation was monitored by measuring surface cracks or the separation of soil from the pot rim. At each cracking stage, the topsoil of each pot was photographed and then the AutoCad software was used for calculating the cracked-soil surface (Montes, 2005).

Characteristics of Rice Straw and Soils

Organic carbon, potassium, phosphorus, and nitrogen contents, C/N ratio of rice straw, particle-size analysis, texture, and organic matter content of the studied paddy soils were determined by standard methods in the laboratory (Black *et al.*, 1965; Blake and Hartge, 1986; Gee and Bauder, 1986; Page *et al.*, 1982; Walkley and Black, 1934).

Soil Water Content

Soil samples were taken with cores at each cracking stage. Samples were weighed and then oven-dried for 48 hours at 105°C. Dried soil samples were weighed again. Soil water content was computed as:

$$\theta = (\frac{W - W_d}{W_d - W_c}) \times 100 \qquad (1)$$

Where, θ is soil water content on weight basis (%), W is weight of wet soil sample and cylinder (g), W_d is weight of dry soil sample and cylinder (g), and W_c is weight of cylinder (g).

Dry Bulk Density

Soil samples were taken with cylinders of known volume at each cracking stage. Samples were weighed and then oven-dried for 48 hours at 105°C. Dried soil samples were weighed again. Dry bulk density was calculated as:

$$\rho_b = \frac{W_s}{V_t} \qquad (2)$$

Where, ρ_b is dry bulk density of soil (g cm^{-3}), W_s is weight of dry soil sample (g), and V_t is volume of cylinder (cm^3).

Data Analysis

Data were analyzed by ANOVA and then LSD techniques using SAS software. The significance level was 5% in all statistical analyses.

RESULTS AND DISCUSSION

Characteristics of Rice Straw and Paddy Soils

Tables 1 and 2 show some chemical and physical properties of the rice straw and the studied paddy soils.

Soil Water Content

Results showed that the effect of soil texture on soil moisture content was significant ($P< 0.01$). The highest amount of moisture content (49.4%) occurred in silty clay loam and the lowest moisture content was measured in sandy loam soil (Figure 1).

The effect of rice straw rate on soil moisture content was significant ($P< 0.01$). The highest and lowest amounts of moisture content (44.7 and 35.0%) were measured in 7 and 0% rice straw treatments, respectively

Table 1. Chemical composition of rice straw.

N^a (%)	K^b (%)	P^c (%)	Organic matter (%)	C^d/N
0.629	1.96	0.2	1.5	24

[a] Nitrogen; [b]= Potassium; [c] Phosphorus, [d] Carbon.

Table 2. Particle size, texture, organic matter content, FC and PWP of the studied soils.

Soil texture	Sand (%)	Silt (%)	Clay (%)	Organic matter (%)	FC (%W)	PWP (%W)
Silty clay	7	43	50	1.44	45.0	29.3
Silty clay loam	15	45	40	1.95	39.0	24.1
Clay loam	39	28	33	1.05	32.8	20.2
Sandy loam	78	12	10	0.33	12.0	5.9

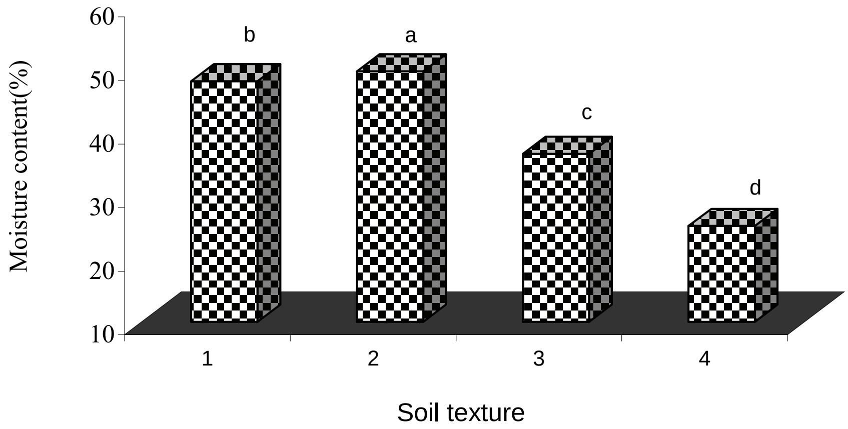

Figure 1. The effect of soil texture on soil moisture content (% by weight).

(Figure 2). In general, the addition of rice residues increased soil moisture content. Rice residues are important natural resources and recycling of these residues improves physical, chemical, and biological properties of paddy soils. Residue incorporation results in more microbial activity than residue removal or burning. Thus, if residues are managed properly, it can warrant improvements in soil properties and sustainability in crop productivity (Mandal *et al.*, 2004).

The effect of crack formation on soil moisture content was significant (P< 0.01). Moisture content in T_1, T_2 and T_3 treatments was 56.2, 43.6, and 11.1%, respectively. The formation and widening of cracks increased water loss from paddy soils.

The interaction effect of soil texture and rice straw rate on soil moisture was significant (P< 0.01). The highest moisture content (53.1%) was observed in silty clay loam and 6% straw treatment, and it was not different from 7% treatment in silty clay texture (Table 3). In general, sandy loam had the lowest and silty clay loam had the highest moisture content. Nevertheless, in almost all soil textures, the lowest and highest values of moisture content were measured in the control (0% straw) and 7%

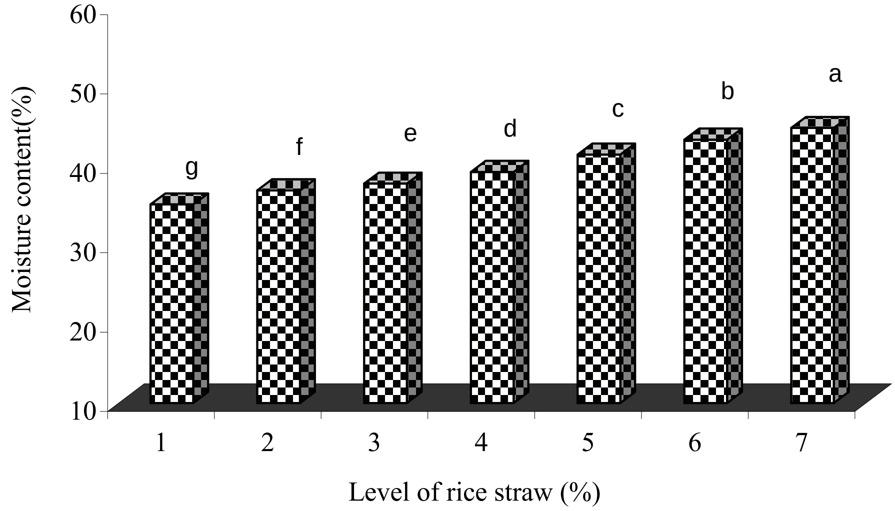

Figure 2. The effect of rice straw rate on soil moisture content (% by weight).

Table 3. Interaction of soil texture and rice straw rate on soil moisture content (%).

Rate of rice straw (%)	Soil texture			
	Silty clay	Silty clay loam	Clay loam	Sandy loam
0 (Control)	42.97^{h}	48.04^{d}	29.76^{o}	19.35^{s}
2	43.99^{g}	48.04^{d}	31.6^{m}	23.63^{r}
3	45.6^{f}	46.64^{e}	34.3^{l}	24.13^{r}
4	47.83^{d}	47.62^{d}	37.24^{k}	23.84^{r}
5	50.08^{c}	49.79^{c}	39.69^{j}	25.70^{q}
6	51.57^{b}	53.10^{a}	40.18^{j}	28.00^{p}
7	52.83^{a}	52.74^{a}	42.22^{i}	30.91^{n}

Values with the same letter are not different significantly (P< 0.05).

straw treatment, respectively. This is an important result, because in case of water shortages, treating the paddy fields with rice straw (instead of burning the straw, which is farmers' common practice) preserves water in the soil. It is well known that incorporation of organic matter into soils increases their water holding capacity (Plaster, 2008). Soil texture is the main determinant of soil water holding capacity. However, the level of organic matter also determines water holding capacity of a soil. Arkansas soil scientists have reported that for every 1% of organic matter content, the soil can hold 16,500 gallons of plant-available water per acre of soil down to 30 cm depth (Sullivan, 2002). Clay content of the studied soils (Table 2) may influence moisture content, too.

The effect of rice straw incorporation on changes in soil moisture retention behavior may be explained from capillary pore size and porosity expansion point of view. The porosity expansion is more evident for fine-textured silty clay and silty clay loam soils, when high moisture contents are measured at higher levels of rice straw incorporation (Table 3).

The interaction effect of soil texture and crack formation stage on soil moisture was significant (P< 0.01). The highest moisture content (68.8%) was observed in silty clay loam and crack treatment T_1 and the lowest moisture content (2.6%) was measured in sandy loam and crack treatment T_3 (Table 4). In general, in each soil texture, crack treatment T_1 had the highest and crack treatment T_3 had the lowest moisture content. This was because more soil moisture had been lost through wide and deep cracks developed in T_3 treatment.

The interaction effect of rates of rice straw and crack treatment on soil moisture was significant (P< 0.01). The highest moisture content (62.8%) was observed in crack treatment T_1 and 7% straw treatment, and the lowest moisture content (9.7%) was measured in crack treatment T_3 and 7% straw treatment (Table 5). This table shows that in all rice straw rates, the highest and lowest moisture contents occurred in crack treatments T_1 and T_3, respectively. Also, there is a descending trend in moisture content in crack treatments. The reason for a descending order of moisture content with increasing rice straw rate in T_3 is probably due to tighter sorption of moisture by the straw pieces in higher straw rates.

Table 4. Combined effect of soil texture and crack treatment on soil moisture content (%).

Crack treatment	Soil texture			
	Silty clay	Silty clay loam	Clay loam	Sandy loam
T1	67.73^{a}	68.85^{a}	51.76^{d}	36.36^{f}
T2	54.02^{c}	56.62^{b}	40.89^{e}	20.69^{g}
T3	21.52^{g}	14.86^{h}	5.46^{i}	2.63^{j}

Values followed by the same letter are not different significantly (P< 0.05).

Table 5. Combined effect of rice straw rate and crack treatment on soil moisture content (%).

Rate of rice straw (%)	Crack treatment		
	T_1	T_2	T_3
0 (Control)	51.11^{e}	41.31^{i}	12.65^{j}
2	53.03^{d}	42.08^{hi}	12.86^{j}
3	53.9^{d}	42.12^{hi}	10.24^{kl}
4	54.27^{d}	41.35^{i}	10.29^{kl}
5	58.23^{c}	42.84^{h}	10.98^{kl}
6	59.94^{b}	44.79^{g}	11.06^{k}
7	62.76^{a}	46.92^{f}	9.73^{l}

Values followed by the same letter are not different significantly ($P< 0.05$).

Soil Bulk Density

Results showed that effect of soil texture on bulk density was significant ($P< 0.01$). The highest and lowest bulk densities (1.32 and 1.07 g cm^{-3}) were measured in sandy loam and silty clay loam soils, respectively (Figure 3).

Effect of rice straw rate on bulk density was significant ($P< 0.01$). The highest and lowest bulk densities (1.38 and 1.03 g cm^{-3}) were measured in rice straw treatments 0 and 7%, respectively (Figure 4). In general, the addition of crop residues decreases soil bulk density. Adesodun *et al.* (2001) emphasized the role of organic matter on improvement of soil aggregates and bulk density.

Comparison of Figures 2 and 4 shows that there is a tight relationship between bulk density and moisture content in rice straw treatments. In general, in a clay soil, incorporation of organic matter causes clay particles to stick together and form aggregates; hence, bulk density is reduced. According to Martens and Frankenberger (1992), although addition of poultry manure and sewage sludge contributes to a higher soil organic matter, but the straw amendment is more effective in increasing infiltration rates and decreasing bulk density in the tillage zone.

The effect of crack formation on bulk density was significant ($P< 0.01$). Bulk densities of treatments T_3, T_2 and T_1 were 1.41, 1.12 and 1.02 g cm^{-3}, respectively. Formation of cracks increased bulk density, resulting in less downward movement of water.

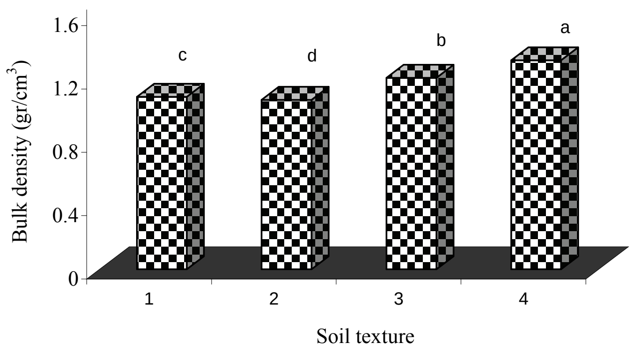

Figure 3. The effect of soil texture on bulk density of soil.

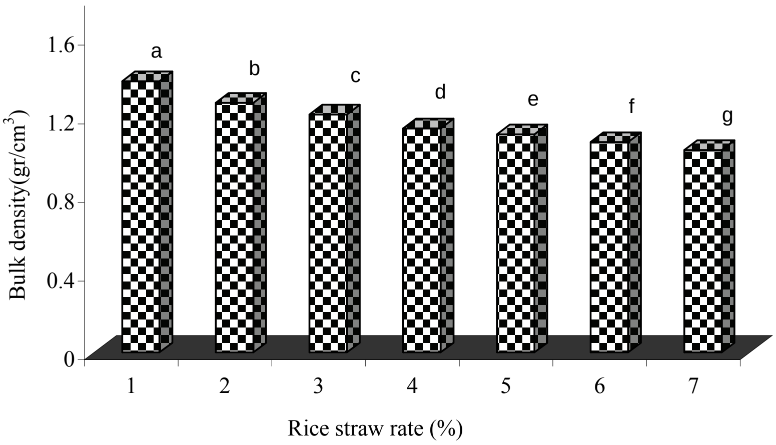

Figure 4. The effect of rice straw rate on bulk density of soil.

Time Needed for Crack Formation

The effect of rice straw rate and soil texture on time needed (i.e. number of days) for crack formation was significant ($P< 0.01$). The greatest time needed for crack formation (31.3 days) was observed in silty clay loam soil and 7% straw treatment, and the least time to crack formation (18.3 days) was in silty clay soil and the control treatment (Table 6). To delay crack formation when irrigation water is deficient, addition of more than 4% rice straw in silty clay soil and 6-7% straw in silty clay loam is recommended. In clay loam and sandy loam soils, all rice straw levels delayed crack formation.

The effect of crack treatment and soil texture on the time needed for crack formation was significant ($P< 0.01$). The greatest and the smallest time to crack formation (52.6 days and 6.6 days) was observed in sandy loam and crack treatments T_3 and T_1, respectively (Table 7). Therefore, considering the effect of incorporating rice straw on delaying cracks in paddy soils, it is possible to schedule the irrigation practices in case of water shortage. In general, Table 7 shows that in all the studied soils, the time needed for crack formation increased from treatment T_1 to T_3.

The effect of rice straw treatments and levels of crack treatments on time needed for crack formation was significant ($P< 0.01$). The greatest time to crack formation (56.2

Table 6. Combined effect of soil texture and rice straw rate on time needed (days) for crack formation.

Rate of rice straw (%)	Soil texture			
	Silty clay	Silty clay loam	Clay loam	Sandy loam
0 (Control)	18.33^{p}	21.00^{n}	21.67^{m}	22.00^{l}
2	20.67^{o}	21.00^{n}	22.00^{l}	22.33^{k}
3	21.67^{m}	23.00^{j}	22.00^{l}	22.33^{k}
4	21.67^{m}	23.67^{i}	24.00^{h}	26.33^{e}
5	23.67^{i}	23.67^{i}	26.00^{f}	26.33^{e}
6	26.67^{d}	24.37^{g}	27.00^{c}	27.00^{c}
7	28.33^{b}	31.33^{a}	27.00^{c}	27.00^{c}

Values with the same letter are not different significantly ($P< 0.05$).

Table 7. Combined effect of soil texture and crack treatment on time needed (days) for crack formation.

Crack treatment	Soil texture			
	Silty clay	Silty clay loam	Clay loam	Sandy loam
T1	8.43[i]	8.14[j]	7.57[k]	6.57[l]
T2	14.86[g]	17.00[e]	14.00[h]	15.14[f]
T3	45.71[c]	47.00[c]	51.14[b]	52.57[a]

Values with the same letter are not different significantly (P< 0.05).

Table 8. Combined effect of rice straw rate and crack treatment on time needed (days) for crack formation.

Rate of rice straw (%)	Crack treatment		
	T_1	T_2	T_3
0 (Control)	5.5[t]	11.75[m]	45.00[f]
2	6.25[s]	13.25[l]	45.00[f]
3	6.5[r]	13.75[k]	46.5[e]
4	8.0[q]	15.25[j]	48.5[d]
5	8.5[p]	15.5[i]	50.75[c]
6	9.25[o]	18.00[h]	51.75[b]
7	9.75[n]	19.25[g]	56.25[a]

Values with the same letter are not different significantly (P< 0.05).

days) was observed in 7% straw treatment and T_3, and the least time (5.5 days) was in T_1 and control treatments (Table 8). In general, Table 8 shows that in all the straw treatments, time needed for crack formation increased from treatment T_1 to T_3. As far as the literature was searched, no report was found on the time needed for crack formation after stopping the irrigation practice.

CONCLUSIONS

The effect of seven rice straw rates on moisture content, bulk density, and amount and intensity of cracks in four paddy soils was studied. The results were promising. The conclusions drawn from this study are summarized as:

1- Soil texture, incorporation of rice straw (as crop residue and organic manure), cracks, and their mutual effects caused significant differences (P< 0.01) in soil moisture content, bulk density, and time needed for crack formation.

2- Adding 2-7% of rice straw increased soil moisture content as compared to the control treatment. Silty clay soil with 7% straw had the highest and sandy loam soil with no straw had the lowest soil moisture content.

3- In all studied soil textures and straw treatments, the soil moisture content decreased from crack formation stages of T_1 to T_3.

4- Addition of rice straw decreased soil bulk density. Control treatment in sandy loam soil had the highest and 7% straw treatment in silty clay soil had the lowest bulk density.

5- Formation of cracks increased bulk density.

6- The greatest time needed for crack formation was observed in 7% straw treatment with silty clay soil, and the least was in the control treatment of sandy loam soil.

7- To delay crack formation and to conserve water, adding 4% of rice straw in silty clay soil, and 6-7% of rice straw in silty clay loam is recommended to the farmers in this region. In clay loam and sandy loam soils, addition of all rice straw rates resulted in delayed crack formation.

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اثر افزودن کاه برنج بر برخی ویژگی‌های فیزیکی خاک‌های شالیزاری

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چکیده

روش غالب آبیاری در مزارع شالیزاری ایران غرقاب دائم است، که در مواقع کمبود آب به آبیاری نوبتی تغییر داده می‌شود. در آبیاری نوبتی، ترک‌های خاک مشکل بزرگی می‌باشند. در این مطالعه، اثر افزودن مقادیر مختلف کاه برنج بر برخی ویژگی‌های فیزیکی خاک و ترک‌ها در خاک‌های شالیزاری استان گیلان بررسی شده است. طرح آزمایشی کرت‌های دوبار خرد شده در قالب بلوک‌های کامل تصادفی اجرا شد. بافت خاک در چهار سطح (رس سیلتی، لوم رسی سیلتی، لوم رسی و لوم شنی)، کاه برنج در هفت سطح (صفر، ۲، ۳، ۴، ۵، ۶ و ۷ درصد وزنی) و مراحل رطوبتی خاک در سه سطح (مرحله قوام (T_1)، مرحله ترک اولیه (T_2) و مرحله ترک نهایی (T_3)) در نظر گرفته شدند. نتایج نشان داد که بافت خاک، سطوح افزودن کاه، تیمارهای ترک و برهمکنش آنها اثر معنی‌داری (در سطح ۱٪) بر میزان رطوبت خاک، چگالی ظاهری و زمان تا تشکیل ترک دارند. در تغییر از تیمار T_1 به T_3 ، رطوبت خاک کاهش یافت، ولی چگالی ظاهری و زمان تا تشکیل ترک افزایش یافتند. در خاک رس سیلتی، افزودن ۲ تا ۳ درصد کاه برنج موجب تسریع در ظهور ترک و اضافه کردن ۴ تا ۷ درصد کاه برنج موجب تأخیر در تشکیل ترک نسبت به شاهد شد. در بافت لوم رسی سیلتی، اضافه کردن سطوح ۳ تا ۵ درصد کاه برنج موجب تسریع در ظهور ترک و افزودن ۶ تا ۷ درصد کاه برنج باعث تأخیر در تشکیل ترک نسبت به شاهد گردید. در بافت‌های سبک لوم رسی و لوم شنی، اضافه کردن کلیه سطوح کاه برنج، زمان تا تشکیل ترک را نسبت به شاهد کاهش داد. به طور کلی، افزودن کاه برنج به خاک-های شالیزاری باعث افزایش رطوبت خاک، کاهش چگالی ظاهری و تأخیر در تشکیل ترک گردید.