Research article

Effects of Vermicompost and Rice Husk Ash on the Change of Soil Chemical Properties and the Growth of Rice in Salt Affected Area

CHAIPISIT PENGKAM
Department of Soil Sciences and Environment, Faculty of Agriculture / Integrated Water Resource Management Research and Development Center in Northeast Thailand, Khon Kaen University, Thailand

CHULEEMAS BOONTHAI IWAI*
Department of Soil Sciences and Environment, Faculty of Agriculture / Integrated Water Resource Management Research and Development Center in Northeast Thailand, Khon Kaen University, Thailand
Email: chuleemas1@gmail.com

TAKASHI KUME
Ehime University, Japan

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Abstract Soil rehabilitation is needed for salt affected area which is the problem of soil in wide world. Salt affected areas damage agriculture production and soil fertility. The objective of this research was to study the effects of vermicompost and rice husk ash on the change of soil electrical conductivity (EC) and the growth of rice in salt affected area in Khon Kaen, Thailand. The experiment plan was randomize complete block design 4 treatments with 3 replications 1) saline soil 2) saline soil + rice husk ash (rate 1000 kg per Rai) 3) saline soil + vermicompost (rate 1000 kg per Rai) 4) saline soil + vermicompost and rice husk ash (rate 1000 kg per Rai for both), and used two rice varieties (KMDL 105 and Rice berry). The results found that EC was lowest in the treatment mixed with vermicompost and rice husk ash followed by mixed with rice husk ash and mixed with vermicompost, respectively. The rice tillers number and height were found higher in the treatment mixed with vermicompost and rice husk ash followed by mixed with rice husk ash and mixed with vermicompost, respectively. The results of this study concluded that using vermicompost and rice husk ash helped reducing EC and increasing the rice's growth in salt affected area.

Keywords salt affected area, vermicompost, rice husk ash, rice production

INTRODUCTION

Soil degradation resulting from salinity is a major obstacle to the optimal utilization of land resources. Salt-affected soils are widely distributed thought the world, with around 20% of the world's cultivated land affected (Summer, 2000). In the Northeast of Thailand, an area of 17.81 million hectares or about 17 percent of the region faces this problem. The soil in the Northeast has a low fertility rate due to the dry weather. The nature of the soil in the area has been caused by salt bearing rock underground Due to the corrosion, decay, and disintegration of rocks, the salt is dissolved in groundwater and is extracted. When the water evaporates at a tremendous rate, salt dissolved in the groundwater moves up to the surface through a small gap. Concentration of salt increases on the surface)Topark-ngarm, 2006(resulting in the clay particles sticking together. The soil becomes dense, plant nutrient uptake is less thus needing more water. Soil salinity has become a serious threat to crop productivity, especially rice productivity.

At present, we have developed a solution by focusing on reducing salinity and increasing soil fertility. In order to increase the yield of crops and to increase the fertility of the soil, an effective

method has been discovered and that is the use of compost and vermicompost soil because the vermicompost contains nutrients and organic compounds that are useful for plants. The decomposition process of the earthworm itself possesses their ability to thrive which is used to condition the soil (Iwai et al., 2011(. In addition, Singh (2017) has reported using rice husk ash can absorbent sodium chloride in water.

Jatorongcakul et al. (1985), studied about using organic matter (rice husk) for recover saline soil found that using rice husk at the rate of 1,000 kg/rai mixed with chemical fertilizer could gain highest rice production and profit. Demonstrator was objective to study the effected of using vermicompost combine rice husk ash for rehabilitation saline soil and growing rice by experimental design in pot and field to find the way to used vermicompost and rice husk ash for sustainable developed.

Vermitechnology has been developed as a means of using earthworm changing wastes into value-added products which can be utilized for improving soil structure and fertility. Agro wastes could effectively be tapped for resource recovery through vermicomposting technology to produce a product for use in land rehabilitation. Adding compost or vermicompost to soils can help to replenish soil organic carbon which can help to improve soil health and promote further primary productivity (Iwai et al., 2010, 2011; Lal, 2004).

Earthworms are known to have beneficial effects on the physical, chemical and biological properties of soils, and thereby contribute to increased plant growth and crop yield in both natural and managed ecosystem (Edwards and Bohlen, 1996; Edwards, 1998). Their beneficial effects have been attributed to improvements in soil properties and structure, greater availability of mineral nutrients to plants (Gilot, 1997), and enhanced microbial populations and activity, thereby producing biologically active metabolites such as plant growth regulators (Doube et al., 1997).

Iwai and Kruapukdee (2017) had conducted the research on using vermitechnology in soil rehabilitation for rice production in plot experiment and rice (Pathumthani 1 variety), the result showed that vermitechnology could increase rice production. Therefore, this research aimed to study of using vermicompost combine rice husk ash in the field condition.

OBJECTIVE

To study the possibility of using vermicompost and rice husk ash in rehabilitation salt affected area for growing rice and the effect of vermicompost and rice husk ash amendment on changing soil quality (EC and pH) and the effect of vermicompost and rice husk ash amendment on the growth of two varieties of rice (KDML 105 and Rice berry).

METHODOLOGY

Study Area

The study area location was Hua-Bung village, Ban-Phai District, Khon Kaen province. Electrical conductivity (EC) and salt distribution in salt-affected area were surveyed by EM 38 machine, for collecting data and decision to experimental design.

Experimental Design

Field experiment: The experiment design was randomized complete block design (RCBD) include 8 treatments and 3 replications.

- Saline soil plot and growing KDML 105
- Saline soil mixed with rice husk ash plot and growing KDML 105
- Saline soil mixed with vermicompost plot and growing KDML 105
- Saline soil mixed with vermicompost and rice husk ash plot and growing KDML 105
- Saline soil control plot and growing Rice berry
- Saline soil mixed with rice husk ash plot and growing Rice berry

- Saline soil mixed with vermicompost plot and growing Rice berry
- Saline soil mixed with vermicompost and rice husk ash plot and growing Rice berry

Plant data collection: The growth and rice production were measured.

Soil analyses: Soil sample were collected at a depth 0-15 cm. from each pot and plot between 30 day and 60 day after growing rice. The soil samples were analyzed for soil physical and chemical properties at the laboratory of the Land Resources and Environment section, Faculty of Agriculture, Khon Kaen University. Soil texture was determined by a hydrometer (Bouyoucos, 1951). Soil pH was determined in a 1:2.5 soil to water solution by a pH meter. Electrical conductivity (ECe) in saturated paste extracts was measured following the method described by the United States Department of Agriculture (USDA, 1954).

Statistical Analysis

The data collected were analyzed statistically using analysis of variance (ANOVA) techniques. Treatment means were compared by the Least Significant Difference (LSD) method at the 5% level. All data analysis was done using Statistix 10 (Analytical Software, 2013).

RESULTS AND DISCUSSION

The result found that vermicompost and rice husk ash could reduce electrical conductivity after filled it in saline soil when compare with control, saline soil added vermicompost mixed with rice husk ash rate 1,000 kg per Rai can significantly reduce electrical conductivity in saline paddy soil. The rice growths of both varieties were increased by vermicompost and rice husk ash especially tillers per clump of Rice berry.

Table 1 Results of vermicompost and rice husk ash on electrical conductivity and KDML 105 growth in saline paddy soil

Treatment	EC (dS/m)	Tillers/clump	Height
Saline soil	2.93a	3.67c	88.55a
Saline soil add rice husk ash (RHA)	2.04b	6.00a	91.02a
Saline soil add vermicompost (VC)	2.06b	4.33bc	86.07a
Saline soil add VC + RHA	2.07b	5.67ab	88.97a
f-test	**	*	ns
CV %	4.66	13.98	7.72

Note: Values are mean ± standard deviation. Means with the same letter in the same column are not significantly different (P>0.05)

Table 2 Results of vermicompost and rice husk ash on electrical conductivity and Rice berry growth in saline paddy soil

Treatment	EC (dS/m)	Tillers/clump	Height
Saline soil	2.93a	3.33c	90.83b
Saline soil add rice husk ash (RHA)	1.99b	5.67ab	96.03a
Saline soil add vermicompost (VC)	2.00b	5.33b	93.33ab
Saline soil add VC + RHA	2.07b	6.67a	97.87a
f-test	**	**	ns
CV %	5.63	12.70	2.47

Note: Values are mean ± standard deviation. Means with the same letter in the same column are not significantly different (P>0.05)

However, the height of rice two varieties are non-significant that mean vermicompost and rice husk ash weren't enhance stalk stretching whereas could increase tillers of rice and the results were similar to Singh et al. (2017) that found rice husk ash can absorb Na^+. Accordingly, using vermicompost and rice husk ash could apply to beneficial to organic agriculture or sustainable agriculture for conservation ecosystem and fertility of soil.

CONCLUSION

The data of soil analysis showed the using vermicompost combined with rice husk ash could reduce electrical conductivity in saline paddy soil. Saline soil adds vermicompost combine rice husk ash significantly reduced electrical conductivity and increased tillers per clump of both rice varieties. The results showed saline soil add rice husk ash could reduce the most electrical conductivity and saline soil added with VC + RHA could increase the most tillers per clump and height. This research results were similar to Xu et. al. (2016) that found out vermicompost could improves the physiological and biochemical responses of blessed thistle and peppermint. Furthermore, vermicompost could increase exchangeable K^+, Ca^{2+} and Mg^{2+} in soil.

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