

Original Research Article

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Effects of Preceding Scented Rice Varieties in Combination with Organic Inputs on Soil Microbial Properties in Scented Rice (*Oryza sativa*)-Lathyrus (*Lathyrus sativus* L.) Relay Cropping under Organic System

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ABSTRACT

Keywords

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A field experiment was conducted during *Kharif* and *Rabi* seasons 2016-17 to evaluate the effects of preceding scented rice varieties and carry-over nutrients on soil microbial properties (microbial biomass carbon, microbial population and dehydrogenase activity) in scented rice-lathyrus relay cropping under organic system. The nine treatments included three scented rice varieties and five organic inputs and one control which were laid out in factorial RBD with 3 replications. Among the three preceding scented rice varieties, the highest microbial biomass carbon (912.91 μ g TPF/g/day) and dehydrogenase activity (58.11 μ g TPF/g/day) was found in CR-Dhan-909 and the highest microbial population was found in *kola joha* [soil bacteria (37.81log cfu/g) and fungi (4.32log cfu/g)]. In case of carry-over nutrients, enriched compost recorded highest microbial biomass carbon (935.24 μ g TPF/g/day), dehydrogenase activity (60.96 μ g TPF/g/day), soil bacteria (4.3log cfu/g) and fungi (4.54log cfu/g).

Introduction

Ensuring global food security with changing environment and shrinking natural resources are the major challenges in the present era (Hussain *et al.*, 2015). Sustainable use of natural resources in the fact of high population density is critically important and consequently food insecurity is overwhelming for specially developing countries (Munsinguzi *et al.*, 2015; Nyssen *et al.*, 2015; Tsozue *et al.*, 2015). The increasing population pressure on land and water resources leads to degradation of these

resources, which often results in loss of productive capacity and food insecurity as a consequence of soil degradation and the increase on soil erosion (Borrelli *et al.*, 2015; Gessesse *et al.*, 2015). This situation has led to the excessive exploitation of natural resources and increased soil losses (Novara *et al.*, 2015).

Relay cropping is a sustainable approach that optimizes system productivity and compensates yield of two crops at a time and can solve time contravene among sowing of different crops. It possesses the capability to

improve soil quality, to increase net return and land equivalent ratio and to control weed and pest infestation, thereby decreasing chemical pest control measures (Jabbar *et al.*, 2011; Bandyopadhyay *et al.*, 2016).

The fertility building in organic cropping system has consequences for soil biological properties (Robertson *et al.*, 2000; Madar *et al.*, 2002) and changes in organic inputs may affect crop yield and soil properties differently in different system depending on mineral nutrient supply to the crops. Hence, the present study was planned to evaluate effects of preceding scented rice varieties and carry-over nutrients on soil microbial properties (microbial biomass carbon, microbial population and dehydrogenase activity) in scented rice-lathyrus relay cropping under organic system.

Materials and Methods

The experiment was carried out at the Instructional-cum-research Farm, Assam Agricultural University, Jorhat during *khari* and *rabi* seasons, 2016-17. The experiment site was under five years of conversion period and behaved like organic ecosystem which justifies the credibility of organic practices followed. The organic inputs under study were also produced under strict organic guidelines of Assam Agricultural University. The plant protection measures and seeds collected for experiment were governed under organic guidelines.

Thus the control plot with no external organic inputs may be treated as organic with native fertility and biological makeup. The soil of the experimental field was acidic in reaction (pH 5.26). The experiment had eighteen treatment combinations viz., scented rice varieties were *Badshahbhog* (V₁), CR dhan-909 (V₂) and *Kolajoha* (V₃) and organic inputs were Control (I₁), Enriched compost (I₂),

Vermicompost (I₃), Green leaf manuring (I₄) and Azolla compost (I₅) as 100% RDN and microbial consortium (I₆) @ 3.5-4 kg/ha. Organically grown lathyrus (Variety *Ratan*) seeds were soaked in water the day before sowing and seeds were sown broadcasted @ 45kg seeds/ha in the standing rice crop. An overlapping period of 10 days was observed in CR Dhan-909 and 18 days was observed in *Badshahbhog* and *Kola joha* respectively. Organic manures were applied in standing rice crop and after harvest of rice soil microbial properties were recorded as MBC (934.99µg/g dry soil), DHA (60.57µg TPF/g/day) and Microbial population (43.66 and 3.87log cfu/g soil for bacteria & fungi respectively). The experiment was laid out in factorial randomized block design with three replications.

Results and Discussion

Though no significant effect was found in case of MBC from preceding rice varieties and carry-over nutrients, in case of carry-over nutrients highest MBC was found in enriched compost (935.24µg TPF/g/day) and lowest in control (885.69 µg TPF/g/day) and in preceding scented rice varieties, highest MBC was recorded in CR Dhan-909 (912.91 µg TPF/g/day) and lowest in *Badshahbhog* (891.91 µg TPF/g/day) when evaluated after harvest of relay lathyrus (Table 1).

Effects of carry-over nutrients for DH activity were found to increase over control. Significantly higher DH was recorded with application of enriched compost (60.96µg TPF/g/day), which was *at par* with azolla compost (58.90µg TPF/g/day), microbial consortium (60.25µg TPF/g/day), green leaf manuring (59.99µg TPF/g/day) and vermicompost (57.4182µg TPF/g/day). The lowest DH (50.82µg TPF/g/day) was recorded in the control. No significant difference was found in case of variety (Table 1).

It was observed that within the interaction effects, DH activity in *Badshahbhog* growing plots was found highest in green leaf manuring (63.74µg TPF/g/day) which was *at par* with all the other tested treatments except control. Similarly, CRDhan-909 growing plots with enriched compost recorded highest interaction (60.96µg TPF/g/day) which was *at par* with all the other treatments and *Kolajoha* growing plots with enriched compost (62.09µg TPF/g/day) and microbial consortium (62.09µg TPF/g/day) was recorded highest interaction in terms of DH activity which was *at par* with vermicompost, green leaf manure and azolla compost (Table 1a). Residual effect of carry-over nutrients from applied organic inputs on soil bacteria was found significant. Highest was found in

enriched compost (43.61 log cfu/g) which was *at par* with green leaf manuring (42.30 log cfu/g) and lowest was obtained in control (26.93log cfu/g). Residual effect on bacterial population on plots where different varieties were grown found non-significant. Highest was found in *kola joha* (37.81log cfu/g) and lowest on CR Dhan-909 (32.27log cfu/g). Residual effect of organic input, variety as well as interaction effect on fungal population was found non-significant. Highest value under organic input was recorded in enriched compost (4.54log cfu/g) and lowest was found in control (4.05log cfu/g). Among varieties highest was found in *kola joha* (4.32log cfu/g) and lowest in CR Dhan-909 (4.17log cfu/g) (Table 1).

Table.1 Effect of preceding rice varieties and carry-over nutrients from organic inputs on soil biological properties after harvest of lathyrus

Treatment	Dehydrogenase activity(µg/g dry soil)	Microbial biomass carbon (µg TPF/g/day)	Microbial population(log cfu/g)	
			Bacteria	Fungi
Varieties				
V ₁ : <i>Badshahbhog</i>	58.09	891.91	36.07	4.23
V ₂ : CR Dhan-909	58.11	912.91	32.27	4.17
V ₃ : <i>Kola joha</i>	57.97	903.26	37.81	4.32
SEd(±)	1.61	17.68	2.27	0.19
CD(P=0.05)	NS	NS	NS	NS
Organic inputs				
I ₁ : Control	50.82	885.69	26.93	4.05
I ₂ : Enriched compost	60.96	935.24	43.61	4.54
I ₃ : Vermicompost	57.41	886.19	38.42	4.20
I ₄ : Green leaf manuring	59.99	893.67	42.30	4.08
I ₅ : Azolla compost	58.90	900.79	29.37	4.11
I ₆ : Microbial consortium	60.25	914.55	31.69	4.46
SEd(±)	2.28	25.00	3.21	0.27
CD (P=0.05)	4.64	NS	4.61	NS
(V×I)	NS	NS	NS	NS

Table.1a Interaction effect of preceding rice varieties and carry-over nutrients on dehydrogenase activity

Treatments	<i>Badshahbhog</i> (V ₁)	CR Dhan-909 (V ₂)	<i>Kola joha</i> (V ₃)
I ₁ : Control	48.73	53.21	50.53
I ₂ : Enriched compost	59.82	60.96	62.09
I ₃ : Vermicompost	59.33	59.07	53.84
I ₄ : Green leaf manuring	63.74	58.20	58.03
I ₅ : Azolla compost	55.01	60.46	61.23
I ₆ : Microbial consortium	61.93	56.74	62.09
SEd(±)	3.95		
CD (P=0.05)	8.04		

Table.1b Interaction effect of preceding rice varieties and carry-over nutrients on bacterial population of soil

Treatments	<i>Badshahbhog</i> (V ₁)	CR Dhan-909 (V ₂)	<i>Kola joha</i> (V ₃)
I ₁ : Control	23.73	25.26	31.81
I ₂ : Enriched compost	46.75	37.46	46.63
I ₃ : Vermicompost	45.23	33.89	36.13
I ₄ : Green leaf manuring	46.22	30.84	49.84
I ₅ : Azolla compost	23.91	34.14	30.07
I ₆ : Microbial consortium	30.61	32.05	32.42
SEd(±)	5.56		
CD (P=0.05)	7.99		

Badshahbhog growing plots with enriched compost reported maximum interaction effect on bacterial population (46.75 log cfu/g) which was *at par* with vermicompost and green leaf manuring. Similarly, CRDhan-909 growing plots with enriched compost recorded highest interaction (37.46 log cfu/g) which was *at par* with all the other tested treatments except control and *Kolajoha* with green leaf manure interaction recorded highest on bacterial population (49.84 log cfu/g) which was *at par* with enriched compost (Table 1b). Similar observations on soil microbial properties were observed by Padmanabhan *et al.*, (2014), Yadav *et al.*, (2013) and Singh and Dhar (2011), who reported continuous enhancement in microbial population of actinomycetes, bacteria, fungi and BGA were recorded over the years due to the application of organic amendments with notable enhancement in dehydrogenase enzyme activity.

The enhanced microbial population upon application of different sources of organic matter is in close agreement with present studies (Kannan *et al.*, 2006; Aher *et al.*, 2018). With the results, it can be concluded that maximum residual effect from carry-over nutrients was observed in case of enriched compost irrespective of the scented rice varieties in scented rice – lathyrus relay cropping under organic system.

Abbreviations: MBC: Microbial Biomass Carbon, DHA: Dehydrogenase Activity.

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