Environment & Ecology 29 (2A) : 856—859, 2011
 ISSN 0970-0420

Effect of Integrated Nutrient Management on Soil Microflora using System of Rice Intensification Practices

L. TZUDIR*, R. K. GHOSH AND S. MALLICK

Department of Agronomy, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya
Mohanpur 741252, India
E-mail : lanunola@gmail.com
**Correspondence*

Abstract

Field experiment was conducted during the *kharif* season of 2008 to investigate the effect of combination of organic manures and inorganic fertilizers on crop performance and soil microbial activities using the practices of system of rice intensification (SRI). With SRI practices, the best result was obtained with application of 75% N (enrich adhar) + 25% N (urea) + PK with an increase in grain yield by 27.63, 28.98 and 20.94% was observed over full NPK (60 : 30 : 30), 75% N (urea) + PK and farmers' practice treated plots respectively. The corresponding increases in straw yields were 23.38, 24.42 and 17.73%. Organic sources of plant nutrient also showed positive effect on LAI, CGR, tiller number and dry matter accumulation of the crops. The effect of different treatments on population of beneficial soil microflora also indicated that application of integrated approach of plant nutrients showed better results and application of 75% N (enrich adhar) + 25% N (urea) + PK resulted in highest microflora population while the lowest was from sole application of NPK through inorganic nutrient sources.

Key words : SRI, Integrated nutrient management, Microflora population.

Low agricultural production efficiency is closely related to a poor coordination of energy conversion which, in turn, is influenced by crop physiological factors, the environment, and other biological factors including soil microorganisms. The soil and rhizosphere microflora can accelerate the growth of plants and enhance their resistance to disease and harmful insects by producing bioactive substances. These microorganisms maintain the growth environment of plants, and may have secondary effects on crop quality. The application of beneficial microorganisms to soil can help to define the structure and establishment of natural ecosystems. Nevertheless, there is a growing consensus that it is possible to attain maximum economic crop yields of high quality, at higher net returns, without the application of chemical fertilizers and pesticides (1). The application of a wide range of different organic amendments to soils can also help to ensure a greater microbial diversity. The reason for this is that each of these organic materials has its own unique indigenous microflora which can greatly affect the resident soil microflora after they are applied, at least for a limited period. Until recently, this was not thought to be a very likely possibility using conventional paddy cultivation methods. However with the use of SRI practices in recent times, it is gaining importance as a promising system to attain higher productivity and profitability by conserving natural resources with reduced and efficient recycling of available nutrients and resources. SRI is an eco-friendly system of farming which can maintain the soil health in terms of soil biological fertility and productivity besides producing quality produce which can fetch high price in the market. SRI increases the productivity per unit area which manages the interactions between the plant, soil, water and nutrient. Building up of soil organic matter and microbial activity is part of SRI strategy for increased productivity. Hence supply, availability and uptake of nutrients, changes in the soil profile and the changes occurring in the soil and crop scenario in SRI under organic manure and inorganic fertilizer applications have been studied (2).

Methods

The field experiment was carried out during the *kharif* season of 2008 at Kalyani C Block Farm, BCKV,

Table 1. Performance of the crop under different nutrient management technique.

	Treatments	Tiller/ m^2	Panicle length (cm)	Test weight (g)	Filled grain/ panicle	Yield (t/ha) Grain	Straw
T_1	Full NPK (60 : 30 : 30)	442.11	23.17	20.35	80.30	3.80	4.79
T_2	75% N (urea) + PK	435.25	23.36	20.72	74.70	3.76	4.75
T_3	50% N (enrich adhar) + 50% N (urea) + PK	466.13	24.84	20.99	95.50	4.29	5.29
T_4	50% N (enrich adhar) + 40% N (urea) + PK	470.75	24.77	21.44	93.26	4.27	5.34
T_5	75% N (enrich adhar) + 25% N (urea) + PK	499.24	26.31	21.96	101.60	4.85	5.91
T_6	75% N (enrich adhar) + 20% N (urea) + PK	481.27	25.97	21.34	96.25	4.58	5.62
T_7	Farmers practice (60 : 30 : 30) neem cake 1 t/ha	452.50	24.50	20.92	88.42	4.01	5.02
	SE (±)	5.011	0.374	0.814	3.787	0.086	0.109
	CD (P=0.05)	14.886	1.112	NS	11.250	0.255	0.324

West Bengal. The experiment was carried in a randomized block design having seven treatments with four replications and the size of each plot was 4 m × 3 m. Treatment details were as follows : T_1 —Full NPK (60 : 30 : 30), T_2— 75% N (urea) + PK, T_3—50% N (enrich adhar) + 50% N (urea) + PK, T_4—50% N (enrich adhar) + 40% N (urea) + PK, T_5—75% N (enrich adhar)+ 25% N (urea) + PK, T_6—75% N (enrich adhar) + 20% N (urea) + PK, T_7—Farmers practice (60 : 30 : 30) + Neem cake 1 t/ha.

The rice variety Khitish (IET 4094) was used which were initially treated with *Trichoderma viride* at 4g/kg and then sown in a sand bed for germination. Single transplanting was done in puddled soil using 10 days old rice seedlings with a spacing of 20 cm × 20 cm in the first week of July. The organic manures were applied at the time of final land prepararion along with the full doses of 30 kg/ha phosphorus through single super phosphate and 30 kg/ha, potash through muriate of potash. The nitrogen at 60 kg/ha through urea was top dressed in four splits; at basal, 15, 40 and 70 DAT. For nitrogen application, urea was mixed with double dry soil and top dressing was done one day after irrigation. For the control of weeds, Pretilachlor 30.7 EC at 500 g/ha was applied at 1 DAT along with two hand weedings at 15 and 40 DAT respectively. Paddy weeder was further used at 25 DAT. The crop was harvested in the first week of November and thereafter compilation and statistical analyses of the collected data were done.

Results and Discussion

Effect of Different Treatments on the Performance of Crop

Table 1 reveals that the maximum yield of 4.85 t/ha was obtained from treatment T_5, i. e., 75% N (enrich adhar) + 25% N (urea) + PK which was significantly higher than all the other treatments. Treatments T_3, T_4 and T_6 also recorded higher grain yields of 4.29, 4.27 and 4.58 t/ha respectively. Treatment T_2 i.e., 75% N (urea) + PK recorded the lowest grain yield of 3.76 t/ha and was at par with T_1 i. e., full NPK (60 : 30 : 30). The prime factors for increased rice yield were attributed to improved yield attributing characters like increased panicle length, filled grains per panicle and increased number of productive tillers. There were also positive and significant effects of organic and inorganic combination of fertilizers on system of rice intensification (SRI). Application of enrich adhar with urea increase the yield of rice over the full inorganic fertilizer applied plots and farmers' practice plot and the best result was obtained with application of 75% N (enrich adhar) + 25% N (urea) + PK. This increased the grain yield to 27.63 , 28.98 and 20.94% over full NPK (60 : 30 : 30), 75% N (urea) + PK and farmers' practice (60 : 30 : 30) + neem cake 1 t/ha applied plots. The straw yield was also increased by 23.38, 24.42 and 17.73% over full NPK (60 : 30 : 30), 75% N (urea) + PK and farmers' practice (60 : 3 : 30) + neem cake 1 t/

Table 2. Effect of treatments on microbial population and available nutrients in rhizosphere soil after harvest of rice. * Initial samples were taken from composite soil sample.

Treatments	Total bacteria (CFU × 10^6/g soil)			Actinomycetes (CFU × 10^5/g soil)			Fungi (CFU × 10^4 /g soil)		
	*Initial	50DAT	Harvesting	*Initial	50DAT	Harvesting	*Initial	50 DAT	Harvesting
T_1	18	24.00	55.00	13	22.00	33.00	8	11.00	17.20
T_2		21.14	49.00		20.14	33.89		10.00	14.50
T_3		37.20	71.30		25.00	37.50		18.40	30.10
T_4		35.00	65.10		24.00	36.47		15.50	29.40
T_5		46.92	90.00		30.00	41.20		23.24	41.20
T_6		41.00	84.00		28.33	40.10		20.80	35.30
T_7		29.21	60.35		21.00	33.80		15.20	21.80
SE (±)		1.289	1.856		0.557	0.869		0.764	1.414
CD (P=0.05)		3.829	5.514		1.654	2.582		2.271	4.201

Table 2. Continuted.

Treatments	PSB (CFU × 10^6 / g soil)			Aerobic non-symbiotic N Fixing bacteria (CFU × 10^6 / g soil)		
	*Initial	50DAT	Harvesting	*Initial	50DAT	Harvesting
T_1	7	10.40	19.10	9.5	11.55	31.50
T_2		10.40	17.70		9.90	29.10
T_3		15.28	26.40		17.05	44.29
T_4		14.40	23.85		16.61	38.95
T_5		18.80	31.16		28.05	58.19
T_6		18.40	27.44		22.55	50.31
T_7		12.32	21.00		16.34	39.10
SE (±)		0.543	0.811		1.521	1.952
CD (P = 0.05)		1.614	2.408		4.518	5.798

ha applied plot.

Similar result was also observed by Thavaprakash et al. (3) from a field experiment during *rabi* 2007-08 and found that organic manure (poultry manure) recorded the highest growth parameters and yield attributes viz. productive tillers/hill (10.41), Filled grains/panicle (3,500 kg/ha) and straw yield (5,873 kg/ha) followed by FYM and vermicompost.

Effect of Different Treatments on Soil Microflora Population

Effect of Treatments on Population of Total Bacteria. Total soil bacteria counts were taken at three different stages i.e. initial, 50 DAT and at the time of harvesting. Table 2 shows that application of inorganic sources of plant nutrients has a detrimental effect on bacteria as compared to organic sources of plant nutrient. There was a progressive increase in the population of total bacteria in rhizosphere soil of *kharif* paddy by the application of 75% nitrogen through organic (enrich adhar) and 25% through inorganic (urea) sources of nitrogen along with phosphorus and potash in both 50 DAT and at harvesting.

At 50 DAT the populations of bacteria were increased for all treatments than initial-18 (CFU × 10^6 / g soil). Highest population (46.92 at CFU × 10^6 / g soil) was recorded in treatment T_5 i. e., 75% N (enrich adhar) + 25% N (urea) + PK and the treatment T_2 i.e., 75% N (urea) + PK produced the lowest number of bacterial colony (21.14 at CFU × 10^6 / g soil).

At harvesting also similar trend was observed, T_5 treatment gave the highest population which was significantly higher over other treatments.

Effect of Treatments on Population of Actinomycetes. Application of organic sources of plant nutrients also had an influence on actinomycetes population (Table 2).

Here also treatment T_5 gave the highest value both at 50 DAT and at harvesting, which was statis-

tically at par with T_6 treatment where 75% nitrogen was applied through organic (enrich adhar) and 20% through inorganic (urea) sources of nitrogen along with phosphorus and potash. As usual lowest population was obtained in T_2.

Effect of Treatments on Population of Fungi. Treatment T_5 resulted in a significant enhancement in the population of fungi in both 50 DAT and at harvesting in the rhizosphere soil of *kharif* paddy over other treatments (Table 2).

At 50DAT lowest populatin (10.00 at CFU × 10^4 / g soil) of fungi has been recorded in T_2 treatment. Treatment T_3 and T_4 were at par at this stage. At harvesting stage also similar trend was observed i. e. T_5 produced the highest (41.20 at CFU × 10^4/g soil) and T_2 produced the lowest (14.50 at CFU × 10^4 / g soil) population of fungi.

The results thus indicate that the significant increment in fungi population might be due to the influence of carbon, nitrogen and energy produced due to application of organic sources of plant nutrients.

Effect of Treatments on Population of Phosphate Solubilizing Bacteria. Significant increase in the population of phosphate solubilizing bacteria was seen due to application of plant nutrients through organic sources. The initial population of phosphate solubilizing bacteria in rhizosphere soil was 7 at CFU × 10^6 / g soil (Table 2).

At 50 DAT, the maximum population of phosphate solubilizing bacteria was observed in treatment T_5 i. e. 18.80 (CFU × 10^6 / g soil). Though with lower values of treatment T_6 the population of phosphate solubilizing bacteria was at par with T_5. Treatment T_3 and T_4 were not significantly different. Both T_1 and T_2 gave lowest population at this stage (10.40 at CFU × 10^6 / g soil) of the crop.

Effect of Treatments on Population of Aerobic Non-Symbiotic Nitrogen Fixing Bacteria. The initial population of aerobic non-symbiotic nitrogen fixing bacteria was 15 at CFU × 10^6 / g soil (Table 2). Treatment T_5 showed highest building of aerobic non-symbiotic nitrogen fixing bacterial colony at both 50DAT and at harvesting. T_6 treatment showed the next highest population. In both the stages the population of non-symbiotic nitrogen fixing bacteria T_3 and T_4 were at par. T_2 produced the lowest number of colonies (11.55 and 31.50 at 50DAT and at harvesting stages respectively).

So, it can be stated that the population of beneficial soil microorganisms were affected by the use of inorganic source of plant nutrients. At every stage of microbe counting inorganic nutrient treated plots showed the lowest population. But the plots where organic plant nutrients were applied produced greater building of population and it also helped to maintain better soil health.

The application of enrich adhar with urea increase the yield of rice over the full inorganic fertilizer and farmers practice applied plots and the best result was obtained with application of 75% N (enrich adhar) + 25% N (urea) + PK applied plot in improving all the growth parameters and also the highest microbial populations. Other treatments like 75% N (enrich adhar) + 20% N (urea) + PK and 50% N (enrich adhar) + 50% N (urea) + PK also showed positive results.

Thus paddy cultivation through system of rice intensification using organic sources of plant nutrients showed better result in respect of paddy production and enhancing soil microbial population along with the inorganic sources than that of only the NPK applied through inorganic sources.

References

1. Higa T. 1991. Effective microorganisms : A biotechnology for mankind. *Proc. Ist. Int. Conf. on Kyusei Nature Farming*. US Dep. Agric. Washington, DC, USA. 8—14 pp.
2. Lokanadhan S. 2008. Bio-input utilization in SRI cultivation organic vs inorganic. *Extended Summaries of 3rd Nat. Symp. System of Rice Inten. in India.* 7—8 pp.
3. Thavaprakash K., P. Baskar, K. Siddeswaran and P. Muthukrishnan. 2008. Effect of varied crop geometry levels under SRI on tillering behavior and yield of rice. *Extended Summaries of 3rd Nat. Symp. on System of Rice Inten. in India*. 92—94 pp.