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Impact of LEISA based system of rice intensification (SRI) practices on rice grain yield and soil properties in rice – rice - rice cropping system in Puducherry region

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ABSTRACT

A field experiment was conducted on farmers' fields in the Southeastern region of Puducherry, India during *kharif* and *rabi* seasons of 2002 to 2005 to study the effect of LEISA based system of rice intensification practices on rice grain yield and soil properties. The field experiment was laid out in Randomized Block Design with twelve treatments replicated thrice. The treatments include incorporation of farmyard manure @ 12.5 t ha^{-1} and *Sesbania rostrata* @ 6.25 t ha^{-1}, applied alone and in combination with organic mixtures prepared from cow products into plots of a rice–rice–rice system. The results revealed that soils amended with organic manures consistently registered significantly improved organic C, mineral, total N and grain yield compared to the unamended soil.

Key words : LEISA, System of rice intensification (SRI), Soil characters, Rice grain yield.

INTRODUCTION

It is well known that intensive cultivation has led to a rapid decline in organic matter and nutrient levels besides affecting soil physical properties. Conversely, crop residue management practices influence agricultural sustainability by improving physical, chemical and biological properties of soils. However, a better understanding of nutrient cycling and the factors governing their decomposition in soil is imperative for implementing sustainable management practices (Babou *et al*., 2001).

Therefore, the present study was conducted with the primary objective of determining the effect of successive additions of organic manures and system of rice intensification (SRI) on grain yield and soil properties like pH, organic C and total N content in rice–rice– rice cropping system.

MATERIALS AND METHODS

Panchakavya (organic mixture-I):

In Sanskrit, Panchakavya means a combination of five products obtained from cow – dung, urine, milk, curd and ghee, fermented for 21 days. When suitably mixed and used as foliar nutrient spray or soil application along with irrigation water or seed or seedling treatment etc., it has positive influence on all living organisms (Somasundaram *et al.*, 2003). It has pesticidal / biocidal and manurial properties, besides serving as a growth regulator. The properties of Panchakavya are given in the Table 1. Foliar spray of Panchakavya @ 3% during four stages of rice *viz.*, active tillering, panicle initiation, flowering and heading have been given. There are no comprehensive publications on the impact of Panchakavya on grain yield and soil quality.

Table 1 : Physico-chemical and biological properties of Panchakavya

pH	5.12	Actinomycetes	21 x 10^1
EC (dsm^{-1})	8.20	Sodium	1600 ppm
Available N	492 ppm	Calcium	1000 ppm
Available P	915 ppm	Magnesium	840 ppm
Available K	1635 ppm	Chlorides	248.50 ppm
Organic carbon	0.60%	Boron	0.442 ppm
IAA	13.50 ppm	Manganese	0.500 ppm
GA	5.60 ppm	Iron	3.150 ppm
Total sugar	575 ppm	Zinc	12.00 ppm
Bacteria	92 x10^6	Copper	0.050 ppm
Fungi	48 x 10^4	Total dissolved solids	3.40 ppt

Amuthakaraisal (organic mixture-II):

It is a mixture of cow – dung, urine, Jaggery and water. It is kept overnight and used the next day for soil application along with irrigation water. It has beneficial effects similar to Panchakavya, besides improving soil quality. The properties of Amuthakaraisal are given in the Table 2. Applications of Amuthakaraisal @ 1% through

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Table 2: Nutrient status of organic manures

Organics	N (%)	P_2O_5 (%)	K_2O (%)
Farm Yard Manure (FYM)	0.80	0.45	0.74
Sesbania rostrata	3.00	0.85	1.60
Amuthakaraisal	1.60	0.20	1.30

irrigation water were done during active tillering stage, panicle initiation, flowering and heading stages of rice. Though there are no publications on the use of Amuthakaraisal for paddy cultivation, it appeared to be more promising for getting sustainable yield and improved the soil quality.

System of rice intensification (SRI):

SRI involves planting of fewer seedlings per hill (2 to 3 fold yield increase) and per square meter and with reduced water (by intermittent irrigation) and chemical fertilizer inputs. This SRI has been successfully used in more than a dozen countries (Uphoff, 2004). Under SRI practices deeper and stronger root systems are developed due to intermittent irrigation practiced on soils without physical barriers to root growth, planting of young, single seedlings at wide spacing, and application of slowly-releasing nutrient sources such as compost (Uphoff, 2003 and 2004). Soil fertility is being enhanced by the combination of plant-soil-water-nutrient-microbial interactions supported by SRI practices, making otherwise unavailable nutrients available through microbiological process (Uphoff, 2003). Hence, it is ideally suitable for resource poor farmers.

The field experiment was laid out in Randomized Block Design (RBD) with twelve treatments replicated thrice, at farmers' fields in the Southeastern region of Puducherry, India. The treatments include incorporation of farmyard manure @ 12.5 t ha^{-1} and *Sesbania rostrata* @ 6.25 t ha^{-1}, applied alone and in combination with organic mixtures like Panchakavya and Amuthakaraisal prepared from cow products into plots of a rice– rice–rice system. In a year, rice crops are grown in succession (December-March, March-June and August-November). The organic manures are incorporated into the soil 10 days before transplantation of each rice crop. Soils exclusively amended with farmyard manure (FYM), Sesbania and organic mixtures prepared from cow products (Panchakavya and Amuthakaraisal) for four successive rice–rice–rice cropping systems were incubated as such or after fresh addition of the respective organic manure under sub- mergence. The treatments also included fresh incorporation of these organic manures into soils with no amendment history. Soil organic C, mineral and total N was determined.

The details of the treatments and selected properties of the initial soil samples are given in Table 3. Mineral N, total N and organic carbon were determined by using standard methods (Page *et al.*, 1982). Soil pH was measured with a glass electrode using 1:2.5 soils: water ratio. The data were analyzed with the ANOVA procedure (Gomez and Gomez, 1984) using an F-test to determine if there were any significant differences (0.05 % level).

RESULTS AND DISCUSSION

Rice grain yield:

The results revealed that among the different nutrient management practices, incorporation of FYM @ 12.5 t ha^{-1} along with Panchakavya and Amuthakaraisal remarkably influenced and increased rice grain yield (7245 kg ha^{-1}), which was at par with application of *Sesbania rostrata* @ 6.25 t ha^{-1} along with Panchakavya and Amuthakaraisal (7120 kg ha^{-1}) (Table 3). This improvement in rice grain yield might be improved enzyme activities and microbial respiration and total biomass (Dinesh *et al*., 2000 and Uphoff, 2004), it is obvious that greater rice grain yield has been established in the amended soils.

Soil properties:

The application of organic manure and organic mixtures prepared from cow significantly improved the soil properties like pH, EC, mineral N, total N and organic carbon. Particularly, in the present study, the results revealed that incorporation of FYM @ 2.5 t ha^{-1} or *Sesbania rostrata* @ 6.25 t ha^{-1} along with Panchakavya and Amuthakaraisal exhibited positive residual effect in succeeding rice crops and improved soil properties after the harvest of six successive rice crops. The improved soil properties *viz*., pH (7.46), EC (3.82), mineral N (26.33 $\mu g\ g^{-1}$), organic carbon (11257 $\mu g\ g^{-1}$) and total N (1157 $\mu g\ g^{-1}$) were observed in the treatment which received FYM @12.5 t ha^{-1} + Panchakavya @ 3% + Amuthakaraisal @ 1% (T_9) and these soil properties were at par with the treatment received *Sesbania rostrata* @ 6.25t ha^{-1} + Panchakavya @ 3% + Amuthakaraisal @ 1% (T_{12}) (Table 3). This improvement might be the positive relationship between total N content and enzyme activity indicates higher C turnover in soils amended with organic manures compared to control (Babou *et al*., 2001 and Somasundaram *et al*., 2003). Though the available publication on the use of organic for improving soil quality indicate three to five years, the present study conducted on farmer's fields indicated that

Table 3: Impact of LEISA based SRI practices on rice grain yield and soil properties

Treatments	Rice grain yield (Kg ha^{-1})	Relevant soil properties				
		pH	EC	Mineral N ($\mu g\ g^{-1}$)	Organic C ($\mu g\ g^{-1}$)	Total N ($\mu g\ g^{-1}$)
Initial sample	2453	8.20	4.25	11.23	7325	517
T_1-Control	2756	8.22	4.36	9.21	7215	481
T_2-100 % RDF	4223	8.28	4.29	15.92	8553	753
T_3-FYM @12.5 t ha^{-1}	6280	8.13	4.19	20.08	9754	929
T_4-*Sesbania rostrata* @6.25 t ha^{-1}	6140	8.12	4.18	19.66	9630	896
T_5-Panchakavya@3%	5884	8.15	4.19	16.23	9145	830
T_6-Amuthakaraisal@1%	5530	8.14	4.18	16.01	8900	753
T_7- FYM @12.5 t ha^{-1}+ Panchakavya@3%	6942	7.88	3.94	24.13	10779	1086
T_8- FYM @12.5 t ha^{-1}+ Amuthakaraisal@1%	6838	7.89	3.96	23.26	10638	1067
T_9- FYM @12.5 t ha^{-1}+ Panchakavya@3% + Amuthakaraisal@1%	7245	7.46	3.82	26.33	11257	1157
T_{10}- *Sesbania rostrata* @ 6.25 t ha^{-1}+ Panchakavya@3%	6640	8.13	4.06	21.99	10291	1008
Sesbania rostrata @6.25 t ha^{-1}+ Amuthakaraisal@1%	6528	8.13	4.05	21.42	10179	991
Sesbania rostrata @6.25 t ha^{-1}+ Panchakavya@3% + Amuthakaraisal @1%	7120	7.64	3.82	25.36	11103	1143
LSD (0.05 %)	145	0.23	0.12	1.18	317	44

soil quality was improved with in three years with sustainable rice grain yield.

The addition of organic manure to soils enhances soil organic C status, mineral N, organic C and total N, which subsequently enhance rice grain yield. This in turn would improve the soil's capability to cycle and provide nutrients for crop growth. It can thus, indicate that LEISA based SRI will be instrumental in evolving sustainable cultivation practices in rice – rice – rice cropping system in Puducherry. The present study appears to be the first attempt to investigate the impact of LEISA based SRI on rice grain yield and soil properties in rice – rice – rice cropping system in Puducherry.

REFERENCES

Babou, C., Vijayasarangan, K. and Subramanian, P. (2001). In : Abstracts of International conference on nature farming and ecological balance, Hisar, India, pp. 49.

Dinesh, R., Dubey,R.P. and Shyam Prasad,G. (2000). Short term effect of organic manures on soil properties and rice grain yield. *Current Sci.*, **79** (12) : 25.

Gomez, K.A. and Gomez, A.A. (1984). *Statistical Procedures for Agricultural Research*, John Wiley & Sons, New York.

Page, A.L., Miller, R.H. and Keeney, D.R. (1982). *Methods of Soil Analysis*, Part 2, Agron. 9, ASA-SSSA, Madison, WI, 1982, 2nd Ed.

Somasundaram, N., Sankaran, N. and Thiyagarajan, T.M. (2003). Response of green gram to varied concentration of Panchakavya (organic nutrition) foliar application. *Madras Agric. J.*, **90** (1-3) : 169-172.

Uphoff, N. (2003). Transitions in agriculture for enhancing water productivity. In International symposium, Tamil Nadu Agricultural University, September 22-25, 2003

Uphoff, N. (2004). The system of rice intensification: An opportunity for raising productivity in the 21st century, Cornell International Institute for Food, Agriculture and Development, Paper for the International Year of Rice Conference, FAO, Rome, February 12-13.

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