Title
Organic farming practices for rice under diversified cropping systems in humid tropics.

Authors
Varughese, Kuruvilla, Dr
Rani, B, Dr
Abraham, Suja
et al.

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Introduction

World rice output is mainly confined to Asia and 90 percent of it is produce by small and marginal farmers who depend on it for their livelihood and food security. The smaller the farm, the greater the need for increasing productivity, so that the farm family gets a higher marketable surplus. Improvement of agricultural production through productivity pathway is essential for resource poor farmers and consumers. In India there is a steady increase in area and production of rice crop over the years. However, in the high rainfall humid tropical regions of Kerala there is a reduction in rice area due to lesser economic returns from rice cultivation. Scientific crop diversification specially suited to micro environmental variation is a practical means to enhance the total crop production and productivity and will curb the unbridled paddy land conversion to a great extent.

In the conventional rice cropping the usage of plant protection chemicals are very high to combat the high pest incidence in the humid tropics. The enhanced use of plant protection chemicals not only deteriorate the quality of the produce but also contaminates the water bodies and cause irreversible changes to the wetland ecosystem. In view of these facts an experiment was carried out to find the possibility of crop diversification under organic farming practices.

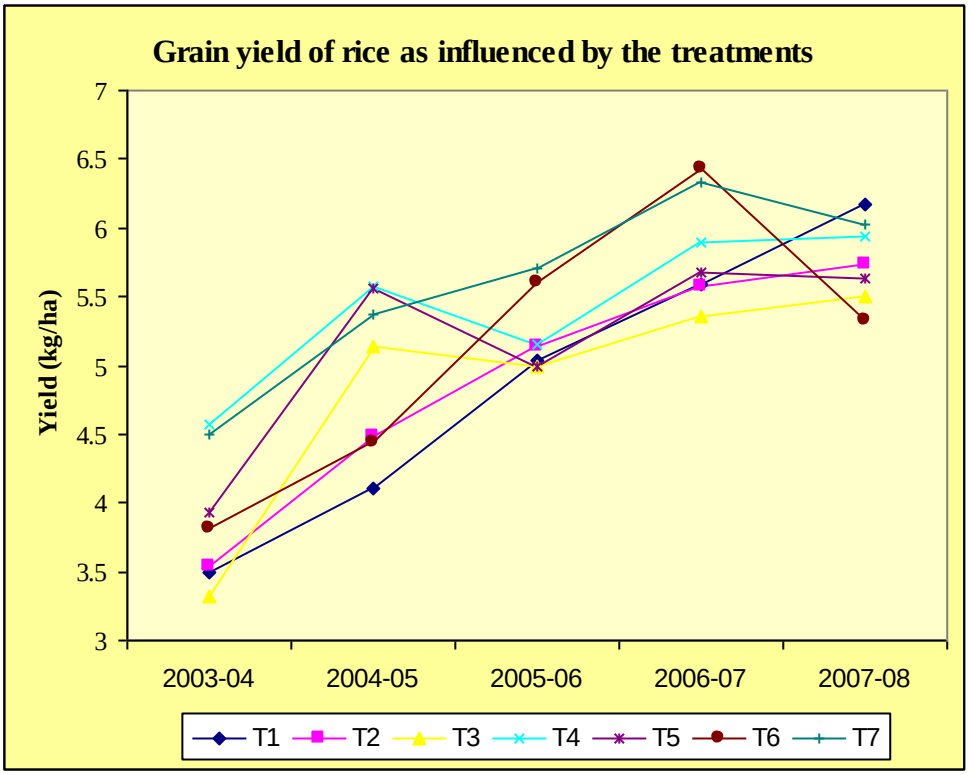
Materials and Methods

The study was conducted at the Cropping Systems Research Centre, Karamana of Kerala Agricultural University, India for a consecutive period of five years from 2003-04 to 2007-08. The soil of the experimental site was deep riverine alluvium with a pH of 5-6 low in available N and medium in available P and K contents. The conventional sequential cropping of rice-rice-fallow was modified as rice-cucumber (C*ucumis satives*)-okra (*Abelmoschus esculentus*). The sowing of cucumber crop commences after the cessation of intensive tropical monsoon and was cultivated with protective irrigation. In the same field a third crop was taken during summer months. The quantity of organic material was applied based on the equivalent nitrogen need of each crop as per package of practices recommendation of crops of Kerala Agricultural University (2002). The treatments of the experiment were T1, ½ N dose as fertilizers + ½ N as farm yard manure (FYM) ; T2, 1/3 N as FYM + 1/3N as vermicompost (VC) + 1/3 N as Neemcake (NC); T3-T2+intercrops of cowpea (*Vigna unguciculata*) in bunds and its incorporation ; T4-T2+Agronomic practices for pest control; T5- 1/2N as FYM +1/2 N as biofertilizers + P as rock phosphate with P solubilzing bacteria; T6-T2 + biofertilizers containing N and P solubilizing bacteria and T7- 100 per cent NPK as fertilizers + secondary and micronutrient)as per the requirements). The recommended dose of NPK for rice, cucumber and okra were 90:45:45, 70:25:25, 50:8:25 kg ha $^{-1}$ respectively. The average nutrient content of FYM, VC and NC were 1, 1.5 and 5 per cent respectively. The isolates of *Pseudomonas fluorescens* developed by KAU was used for disease management. Each treatment was tested in plots with 300 m^2. Yield data of five years was statistically analysed wherein each year data was considered as a replication. The second and third

crop yield was converted as rice equivalent yield (REY) (the ratio of economic out put from each crop to the current sale price of rice) and expressed as REY.

Results and Conclusion

The influence of treatments on individual crops in the cropping sequence is abridged in Fig.1 and Table 1. The rice yield recorded a quantum jump in the second year of study and almost stabilized from the third year onwards. Initially the treatments with full nutrient dose as chemical fertilizer showed an appreciable increase in grain and straw yield over other treatments. The five year cycle revealed that the organic farming treatments were on par with treatments that received the entire nutrients as chemical fertilizers indicating that this method is equally effective in sustaining rice productivity in humid tropics. The treatment which received half dose of nutrient as fertilizers and remaining as organics showed a positive increase in yield from the first to the fifth year of study indicating the better nutrient supplying capacity in the integrated nutrient management (INM) practices. Organic farming is often understood as a form of agriculture with the use of only organic inputs for the supply of nutrients and management of pests and diseases. Organic farming is a form of diversified agriculture wherein problems of farming are managed by using locally available resources and hence it can be considered as the best and sustainable production system for the region.



In the post monsoon crops of cucumber and okra, the treatment effects were not significant.

The REY presented in Table 1 shows no marked variation due to the influence of treatments. It varied from 16.2 to 18.8 t/ha per annum. In general sequential cropping of rice yielded between 8 to 10 t/ha per annum where as through crop diversification, more than 100 per cent yield increase could be obtained. Such a system based approach is the key for sustainability in agriculture.

Table 1. Rice Equivalent Yield (kg/ha) obtained from the treatments (mean of five years)

Treatments	First crop season (Rice) (Grain + Straw)	Second crop season (Cucumber)	Third crop season (Bhindi)	Total
T1	6292	6017	4728	17037
T2	6265	5273	4742	16280
T3	6234	6263	4861	17358
T4	6891	6431	5264	18586
T5	6585	6933	4928	18446
T6	6347	6573	4655	17575
T7	7142	6759	4990	18891

The soil nutrient status at the beginning and end of the study and microbial population are presented in Table 2. The N and P status of the soil was remarkably increased while the K status was slightly reduced at the end of the fifth year of study. The incorporation of crop residue in the system could not prevent the rapid depletion of K status in the soil. Soil organic carbon was profoundly increased by adopting organic farming practices.

Table 2. Change in soil properties as influenced by the treatments

Treatment	Initial			Final			
	OC %	Avail.P (kg/ha)	Exch.K (kg/ha)	OC %	Avail.N (kg/ha)	Avail.P (kg/ha)	Exch.K (kg/ha)
T_1	0.81	11.7	116.5	1.49	144.46	29.09	105.28
T_2	0.78	12.5	125.4	1.59	150.53	29.77	112.00
T_3	0.76	11.9	112.0	2.42	137.98	12.84	81.76
T_4	0.72	11.1	100.8	0.71	137.98	13.79	51.52
T_5	0.75	10.8	109.8	1.44	150.53	17.35	42.56
T_6	0.78	11.9	94.1	1.22	125.44	26.91	33.60
T_7	0.77	11.7	87.4	1.41	131.71	15.43	49.28

It may be concluded from the study that the organic farming practices under rice based crop diversification is a practical means to enhance productivity and soil health in

rice fields. The findings are in agreement with the views of FAO (2001) that it is a holistic production management system, which promotes and enhances agro-ecosystem health involving biodiversity, biological cycles and soil biological activity.

References

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