I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Soil properties as influenced by Alternate Cropping Systems to Rice-Rice (*Oryza sativa* L.) in Tunga Bhadra Project Area

Shridhara B. Nagoli[1]*., Basavanneppa. M. A[2]., Sawargaonkar, G. L[3]., Biradar. S. A[4]. Tevari P.[5] and Navyashree. M. R[6].

***ABSTRACT**: A field experiment was carried out in farmer's field near Agriculture Research Station, Siruguppa of Bellary district (Karnataka), during kharif and rabi 2014-15, the study was conducted to study the influence of cropping system on soil properties as influenced by alternate cropping systems to rice-rice (Oryza sativa L.) in Tunga Bhadra Project (TBP) Area. The soil was medium deep black with soil pH (8.01), EC (0.54 dS m^{-1}), available nitrogen (240.80 kg ha^{-1}), P_2O_5 (22.90 kg ha^{-1}) and K_2O (347.49 kg ha^{-1}). The experiment was laid out randomised block design which comprised of seven sequential cropping systems as treatment with three replications viz., T_1: Rice-maize, T_2: Rice-sorghum, T_3: Rice-chickpea, T_4: Rice-sesame, T_5: Maize-chickpea, T_6: Cotton-sesame and T_7: Rice-rice. Significantly higher rice equivalent yield (REY) was recorded in cotton-sesame cropping system (13117 kg ha^{-1}) compared to rest of the cropping systems. Significantly higher system productivity was recorded with maize-chickpea (35.94 REY kg ha^{-1} day^{-1}) cropping system and it was significantly superior over rice-sesame (22.85 REY kg ha^{-1} day^{-1}), rice-sesame (24.17 REY kg ha^{-1} day^{-1}) and existing rice-rice (26.89 REY kg ha^{-1} day^{-1}) cropping systems. Whereas rice-chickpea and maize-chickpea were performed better in terms of low pH (7.98 and 7.98, respectively), EC (0.51 and 0.52 dS m^{-1}, respectively) and bulk density of soil (1.31 g cc^{-1} each). The cotton-sesame and maize-chickpea crop sequences are more productive and sustainable as they improve fertility status of soil when compared to other cropping sequences and can be a better option for the farmers of the TBP area of Karnataka.*

***Key words**: Alternate sequential cropping system, Bulk Density, Electrical conductivity, Rice equivalent yield and system productivity.*

INTRODUCTION

Rice (*Oryza sativa* L.), occupies a pivotal place in Indian agriculture. It is the staple food for about 70 per cent of population and a source of livelihood for about 120-150 million rural households. It accounts for about 43 per cent of total food grain production and 55 per cent of cereal production in the country. In India, rice is cultivated over an area of 43.95 million hectares with a production of 106.54 million tonnes. In Karnataka, it is grown in an area of 1.42 million hectares with an annual production of 3.5 million tonnes [1]. Rice is a primary energy source or high calorie food and it contains less protein than wheat. The protein content of milled rice is usually 6-7 per cent. The by-products of rice milling are used for various purposes. Rice bran is used as cattle and poultry feed. Rice hulls can be used in manufacturing of insulation materials, cement, card board and as a litter in poultry keeping. Besides, rice straw is also used to feed cattle. Rice has been cultivated in four major ecosystems in India *viz*., irrigated, rainfed lowland, rainfed upland and flood prone system. More than half of rice growing area (55%) is under rainfed ecosystem. Crop diversification shows lot of promises in alleviating these problems besides, fulfilling basic needs for cereals, pulses, oilseeds, vegetables and also regulating farm income, withstanding weather aberrations, controlling price fluctuation, ensuring balanced food supply,

* University of Agricultural sciences, Raichur-584102, Karnataka
** University of Agricultural sciences, Dharwad-580005, Karnataka
*** International Crop Research Institute for Semi-arid Tropics, Hyderabad
E-mail: snagoli4858@gmail.com

conserving natural resources, reducing the chemical fertilizer and pesticide loads, ensuring environmental safety and creating employment opportunity [2]. In this context, efforts are being made to promote diversification of rice based cropping sequence or development of an alternate cropping systems to paddy-paddy in our country as well as TBP area with cereals, legumes and oil seed crops for sustaining the productivity and meet out demand for vegetables, pulses and oilseeds. Therefore, keeping all these points in view, the present investigation was carried out.

MATERIAL AND METHODS

A field experiment was carried out in farmer's field near Agriculture Research Station, Siruguppa of Bellary district (Karnataka), during *kharif* and *rabi* 2014-15, the study was conducted to study the influence of cropping system on soil properties as influenced by alternate cropping systems to rice-rice (Oryza sativa L.) in Tunga Bhadra Project (TBP) Area. The soil was medium deep black with soil pH (8.01), EC (0.54 dS m^{-1}), available nitrogen (240.80 kg ha^{-1}), P_2O_5 (22.90 kg ha^{-1}) and K_2O (347.49 kg ha^{-1}). The experiment was laid out randomised block design which comprised of seven sequential cropping systems as treatments in three replications, consisting five rice based cropping systems viz., rice-maize, rice-sorghum, rice-chickpea, rice-sesame and rice-rice. And two non-rice based cropping systems *viz*., maize-chickpea and cotton-sesame. All the crops under the above seven rice-based cropping sequences were chosen on the basis of their prevalence in the region. The rice–rice system is the major cropping sequence. Recommended dose of N, P and K (150:75:75 kg N, P_2O_5 K_2O ha^{-1}) were applied to the soil in the form of urea, di-ammonium phosphate and muriate of potash to all the crops at the time of sowing and subsequent N applications were done by following package of practice and the details of the treatments are shown in Table 1 All agronomical packages of practices were followed to raise the crops in different cropping sequences.

Yield and yield parameters of rice and other crops in the cropping system were recorded. Economic yields of component crops were converted into rice-equivalent yield (REY), taking into account the prevailing market prices of different crops in the cropping sequences. The REY values were computed as per the following formula given by [3].

$$REY\,(kg\,ha^{-1}) = \frac{(YCC\ X\ MPCC) + yield\ of\ main\ crop\,(kg\,ha^{-1})}{Price\ of\ main\ crop\,(₹\,ha^{-1})}$$

Whereas, YCC= Yield of component crop (kg ha^{-1}), MPCC=Market price of component crop (ha^{-1}). System productivity values in terms of kg REY $ha^{d1}day^{d1}$ were worked out for the total production by means of rice equivalent yield in a crop rotation divided by year duration. Bulk density [4], soil reaction[5] and electrical conductivity [6].

RESULTS AND DISCUSSION

Rice equivalent yield and System Productivity

Among different cropping systems cotton-sesame produced significantly higher rice equivalent yield (13117 kg ha^{-1}) compared to rest of the cropping systems (Table 2). The yield varied from 9.32 to 33.60 per cent over existing rice-rice (9816 REY kg ha^{-1}) cropping systems. Whereas, minimum rice equivalent yield was noticed with rice-sesame (8342 REY kg ha^{-1}) system. Significantly higher system productivity was recorded with maize-chickpea (35.94 REY kg $ha^{-1}day^{-1}$) cropping system and it was significantly superior existing rice-rice (26.89 REY kg $ha^{-1}day^{-1}$) cropping systems. These results are in conformity with finding of [7], who reported that inclusion of legume during summer/*rabi* in rice based cropping system resulted in an increased in productivity and profitability. The higher rice equivalent yield indicate that the residual advantage of a legume crop on the succeeding maize besides contribution in total system productivity. Similarly, rice-maize and rice-chickpea cropping systems which are ranked second and third respectively with system productivity. This might be due to higher production potential of maize along with the good market price of chickpea and rice that yielded better grain yield than rest other cropping systems. The chickpea in maize-chickpea and rice-chickpea cropping system also markedly contributed to the system productivity besides enhancing the productivity of succeeding crops and consequently resulted in higher crop equivalent yield and system productivity which was almost equal to the conventional rice-rice cropping system. Similar results are also reported by [8].

Influence of cropping systems on soil properties

In the present study observation on the soil reaction (pH), electrical conductivity (dS m^{-1}) and bulk density (g cc^{-1}) changes were not found any significant differences among the different cropping systems. Among different cropping systems, rice-chickpea and maize-chickpea were performed better in terms of low pH (7.98 each), EC (0.51 dS m^{-1} each) and bulk density

Table 1
Details of season, cultivar spacing and recommended dose of fertilizer used of the experiment

Sequence cropping system	*Season*	*Cultivar*	*Spacing (cm)*	*Recommended dose of fertilizers (N, P_2O_5, K_2O kg ha^{-1})*
Rice-maize	*Kharif*	BPT-5204	20 x 10	150:75 :75
	Rabi	NK-6240	60 x 20	150:75:37.5
Rice-sorghum	*Kharif*	BPT-5204	20 x 10	150:75 :75
	Rabi	NSH-18	45 x 15	100:75:40
Rice-chickpea	*Kharif*	BPT-5204	20 x 10	150:75 :75
	Rabi	JG-11	30 x 10	25:50:00
Rice-sesame	*Kharif*	BPT-5204	20 x 10	150:75 :75
	Rabi	DSS-9	30 x 15	25:50: 25
Maize-chickpea	*Kharif*	NK-6240	60 x 20	150 :75:37.5
	Rabi	JG-11	30 x 10	25: 50:00
Cotton-sesame	*Kharif*	AJITH-155	90 x 60	150:75:75
	Rabi	DSS-9	30 x 15	25:50: 25
Rice-rice	*Kharif*	BPT-5204	20 x 10	150:75 :75
	Rabi	Gangavathi sona	20 x 10	150:75 :75

Table 2
Crop yield, rice equivalent yield (REY), system productivity and soil properties as influenced by different cropping systems

Sequence cropping system	*Crop yield (kg ha^{-1})*		*REY (kg ha^{-1})*		*Total REY (kg ha^{-1})*	*System productivity (kg REY $ha^{-1}day^{-1}$)*	*Soil properties*		
	Kharif	*Rabi*	*Kharif*	*Rabi*			*Ph*	*EC(dS m^{-1})*	*BD(g cc^{-1})*
Rice-maize	5329	7372	-	6031	11361	31.13	8.04	0.55	1.32
Rice-sorghum	5291	3809	-	3532	8823	24.17	8.01	0.56	1.31
Rice-chickpea	5285	1975	-	5446	10731	29.40	7.98	0.51	1.31
Rice-sesame	5361	615	-	2981	8342	22.85	8.01	0.52	1.32
Maize-chickpea	7691	2075	6292	5723	12015	32.92	7.98	0.51	1.31
Cotton-sesame	4288	559	10405	2712	13117	35.94	8.02	0.53	1.32
Rice-rice	5395	5031	-	4421	9816	26.89	7.99	0.57	1.33
S.Em.±	114	81	-	-	216	0.60	0.02	0.05	0.07
CD (p=0.05)	352	250	-	-	668	1.80	NS	NS	NS

of soil (1.31 g cc^{-1} each). Rice based cropping systems including legume (chickpea) in the sequence, improved the soil chemical properties. Similar results were also reported by[8], who reported that electrical conductivity and pH of soil decreased due to the inclusion of vegetables, legumes and green-manure.

Based on findings of this experiment it can be concluded that under conditions of Tunga Bhadra Project area, rice-chickpea and maize-chickpea cropping systems proved to better in terms of soil properties (pH, EC and bulk density). And cotton-sesame in terms of system productivity. Hence these cropping systems were found to be better alternate cropping systems to existing rice-rice system of the Tunga-Bhadra project area.

ACKNOWLEDGEMENT

The authors wish to acknowledge the UAS, Raichur and ARS, Siruguppa for providing good facilities. We also appreciate greatly the financial support by the International Crop Research Institute for Semi Arid Tropics (ICRISAT), Patencheru, for carrying out this study.

REFERENCE

Anonymous, (2015), State wise Area, Production and yield of Rice 2014-15. Directorate of Economics and statistics, Ministry of Agriculture, Govt. of India. p. 151-152.

Gill, M. S. and Ahlawat, I., (2006), Crop diversification - its role towards sustainability and profitability. *Indian J. Ferti.* 2(9): 125-138.

Verma, S. P. and Mudgal, S. C., (1983), Production potential and economics of fertiliser application as a resource constraints in maize-wheat crop sequences, Himachal J. Agril. Res. 9(2): 89-92.

Black, C. A., (1965), *Methods of soil analysis*, Part 1 and 2. Agronomy Monograph no. 3 in the series "Agronomy". *American Soc. Agron., Inc.*, Madison, Wisconsin, U.S.A. p. 47-51.

Piper, C. S., (1966), *Soil and Plant Anaslysis*. Academic Press, New York, pp. 368.

Jackson, M. L., (1973), *Soil Chemical Analysis*. Prentice hall of India Private Limited, New Delhi, p. 214.

Sharma, R. P., Pathak, S. K., Haque, M. and Manser Lal, (2008), Productivity, profitability and nutrient balance as influenced by diversification of rice (*Oryza sativa*) - wheat (*Triticum aestivum*) cropping system. *Indian J. Agron*., **53**(2): 97-101.

Shrikant, K., Phajage and Upadhyay, V. B., (2014), Effect of rice (*Oryza sativa* L.) based cropping systems on soil properties and crop productivity. *Bioinfolet,* 11(3a): 811-813.