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TO STUDY THE EFFECT OF TILLAGE, MULCH AND FERTILITY LEVELS ON SYSTEM PRODUCTIVITY OF DIFFERENT RICE BASED CROPPING SYSTEM IN CHHATTISGARH PLAINS

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ABSTRACT

Field investigations were made at Research cum Instructional Farm Indira Gandhi Krishi Vishwa Vidyalaya, Raipur, Chhattisgarh during 2013-14 on silty clay loamsoils,to evaluate the effect of tillage, mulch and fertility levels on system productivity of different rice based cropping system.Two tillage operations (T_1 minimum and T_2 conventional) and four cropping systems (CS_1: rice-wheat, CS_2: rice-brinjal, CS_3: rice-maize and CS_4: rice-sunflower) were kept as main-plot treatments and two mulches (M_1: no mulch and M_2: crop residue mulch) and two fertility levels (F_1: RDF and F_2: RDF + 25% higher dose) were kept as sub-plot treatment. The total 32 treatments combinations were evaluated in a splitplot design under three replications.Maximum grain yield of rice (39.03 q ha^{-1}) was recorded under Con till X CS_3 i.e. conventional tillage X rice-maize cropping system.Among four crops taken during *rabi*, brinjal brought the highest rice equivalent yield (84.06 q/ha) irrespective of treatments. The yields of various *rabi* crops were also significantly higher in higher fertility level (125% RDF) as compared to recommended fertility level (100% RDF). Conventional tillage practices performed better as compared to minimum tillage practices in terms of yields of various *rabi* crops. Among all four cropping systems, rice-brinjal and rice-sunflower system produced higher productivity (122.18 and 84.84 q ha^{-1} respectively).

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INTRODUCTION

Lesser agricultural productivity, rural employment and economic status has been reported from Chhattisgarh, compared to other states of the country. Under wide range of farming situations and soil conditions, except upland light soil, rice is widely accepted and grown by the farmers depending upon their socio-economic conditions. During *kharif*, growing of rice is a tradition and is widely accepted depending upon farmers socio-economic conditions. While, in *rabi*, there are fewer options for the stakeholders to take profitable and suitable crops. Under these circumstances, they generally follow rice-wheat, rice-maize and rice-winter vegetables under partially or assured irrigation and rice-fallow, rice-utera (*Lathyrus*, chickpea and linseed) under rainfed situation. Oilseeds and pulses including vegetables and fodder are receiving more attention owing to higher prices. Diversification of existing cropping system through these crops of diverse nature can change the economics of the cropping sequences and may be a good proposition to break the monotony of the system. Hence, introduction of new high yielding and more profitable crop (s) in this area is vital. This will not only enhance the socio-economic conditions of the farmers by providing employment for longer duration but also enable them to exploit the upcoming marketing and processing infrastructure in this area. Besides, inclusion of vegetables, oilseeds or pulses could have effect on weed dynamics and sustaining the productivity and soil fertility. Minimum tillage farming has many benefits not only for energy saving through tillage reduction (Raper *et al.,* 2000), increased soil organic carbon (Higashi et al. 2014). This system has been widely developed in North and South America and adapted to soybean (Buah *et al.,* 2000) and sorghum production (Beare et al. 1994). However, in general, minimum tillage production relies completely on herbicide application for weed control, making organic farmers reluctant to adopt this system because of the difficulty of weed control.The objectiveof work, to design agronomically efficient and economically viable new cropping systems for resource conservation technologies.

MATERIALS AND METHODS

Field experiment was carried out during 2013-14 at Research cum Instructional Farm of Indira Gandhi KrishiVishwavidyalaya, Raipur (Chhattisgarh). The experimental site, Raipur comes under the seventh agro climatic region of India *i.e.* Eastern plateau and hills which is termed as sub humid with hot summer and cold winter. The soil of experiment field was '*Inceptisols*' (Silty clay loam) which is locally known as '*Matasi*' (pH 7.2, EC 0.27 dSm^{-1}OC 0.48%and available N, P & K were 254, 17 and 280 kg ha^{-1}respectivly). Two tillage operations (T_1 minimum and T_2conventional) and four cropping systems (CS_1: rice-wheat,CS_2: rice-brinjal, CS_3: rice-maizet and CS_4:rice-sunflower) were kept as main-plot treatments andtwo mulches (M_1: no mulch and M_2:crop residue mulch) and two fertility levels (F_1: RDF and F_2: RDF + 25% higher dose) were kept as sub-plot treatment. The total 32 treatments combinations were evaluated in a splitplot design under three replications. The recommended dose of fertilizer for rice 10:60:40 wheat and maize were 100:50:30 brinjal 125:75:60 and sunflower 80:50:30 kg N, P_2O_5 and K_2O/ha were applied. The crop variety Karma Mahsuri, GW-273, Pant Rituraj,Sugar-

75 and Jwalamukhi were used for rice, wheat, brinjal, maize (sweet corn), and sunflower, respectively. Soil samples were drawn from 0 to 15 cm depth in treatment plots after harvest of the *rabi* crops and analyzed for available nitrogen (Subbaiah and Asija, 1956), available phosphorus (Olsen's method, 1954) and available potassium flame photometric method, (Hanway and Heidel, 1952).

RESULTS AND DISCUSSION

Kharif crop

The result showed that in general, higher yield of rice was obtained under conventional tillage as compared to minimum tillage option irrespective of cropping systems (Table 1). Maximum grain yield of rice (39.03 q ha^{-1}) was recorded under Con till X CS_3 *i.e.* conventional tillage X rice-maize cropping system. It was considerable higher over all the combinations of minimum tillage X cropping system *viz.* rice- maize, rice-brinjal and rice–sunflower and rice-wheat. Other combinations of conventional tillage X cropping system i.e. rice-wheat, rice-maize and rice-sunflower have also produced comparable yield to that Con till X CS_2.Conventional tillage recorded significantly higher green fodder and dry fodder yield (Deva, 2015). As reported by Alam*et al.* (2014), conventional tillage practices have been shown to increase crop yield considerably.Different combination of mulching X fertilizer in subplot treatment had significantly affected the grain yield of rice. Treatment consisting of mulch X 125% RDF and no mulch X 125% RDFhas registered higher yields (39.67 and 38.89 q ha^{-1})as compared to mulch/no mulch X 100% RDF. Similar trend was observed for No. of panicles/m^2. However, straw yield and harvest index was not affected due to tillage X cropping systems and mulching X fertilizer combinations.

Rabi crops

Among four crops taken during *rabi*, brinjal brought the highest rice equivalent yield (84.06 q ha^{-1}) irrespective of treatments (Table 2). In terms of REY of various *rabi* crops. Brinjal and sunflower gave 3 and 2 times more net return to that of wheat respectively. The REY of various *rabi* crops were also higher in higher fertility level (125% RDF) as compared to recommended

Table 1: Grain yield, straw yield, harvest index and No. of panicles m^{-2} of rice as affected by tillage practices X cropping systems and Mulching X fertilizer dose

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest Index	No. of Panicle m^{-2}
Tillage X cropping system				
Min till X CS_1	35.05	69.22	38.94	322
Min till X CS_2	35.14	68.45	39.09	363
Min till X CS_3	34.98	67.12	39.68	317
Min till X CS_4	36.08	69.68	39.10	351
Con till X CS_1	38.36	79.27	38.44	337
Con till X CS_2	38.13	73.25	38.86	350
Con till X CS_3	39.03	77.55	39.03	322
Con till X CS_4	37.87	76.49	38.77	343
SEm ±	1.36	3.15	1.33	14
CD 0.05	NS	9.55	NS	42
Mulching X fertilizer dose				
No mulch X 100% RDF	34.29	69.25	38.81	305
No mulch X 125 % RDF	38.89	75.10	38.95	367
Mulch X 100% RDF	34.47	71.26	38.84	310
Mulch X 125% RDF	39.67	74.89	39.36	370
SEm ±	1.39	2.90	1.24	11
CD 0.05	3.96	NS	NS	33

Table 2: Rice equivalent yield (REY), net return of *rabi* crops and system productivity as affected by tillage practices X cropping systems and Mulching X fertilizer dose

Treatment	Rice yield (q ha^{-1})	REY of *rabi* crops (q ha^{-1})	Total productivity (q ha^{-1})
Tillage X cropping system			
T1CS1 Min Till rice-wheat	35.05	23.79	58.85
T2CS1 Con Till rice-wheat	38.36	23.86	62.21
T1CS2 Min Till rice-brinjal	35.14	82.55	117.69
T2CS2 Con Till rice-brinjal	38.13	84.06	122.18
T1CS3 Min Till rice-maize	34.98	39.38	74.36
T2CS3 Con Till rice-maize	39.03	45.25	84.28
T1CS4 Min Till rice-sunflower	36.08	44.24	80.32
T2CS4 Con Till rice-sunflower	37.87	46.97	84.84
CD 0.05	4.13	16.16	19.30
Mulching X fertilizer dose			
M1F1 No mulch 100% RDF	34.29	44.75	79.03
M1F2 No Mulch 125% RDF	38.89	52.43	91.32
M2F1 Mulch 100% RDF	34.47	45.28	79.76
M2F2 Mulch 125 % RDF	39.67	52.59	92.26
CD 0.05	3.96	NS	NS

Table 3: Physic-chemical properties of soil as affected by different Tillage, CS mulching and fertility levels

Treatment	pH	EC (dSm^{-1})	OC (%)	N	P	K
Tillage X cropping system						
T1CS1 Min Till rice-wheat	7.23	0.24	0.51	254	18.30	280
T2CS1 Con Till rice-wheat	7.25	0.22	0.50	242	15.00	274
T1CS2 Min Till rice-brinjal	7.28	0.25	0.49	248	18.15	287
T2CS2 Con Till rice-brinjal	7.25	0.24	0.51	238	17.50	283
T1CS3 Min Till rice-maize	7.25	0.25	0.54	263	19.78	295
T2CS3 Con Till rice-maize	7.24	0.24	0.52	261	16.33	285
T1CS4 Min Till rice-sunflower	7.25	0.24	0.51	264	19.98	300
T2CS4 Con Till rice-sunflower	7.23	0.24	0.53	244	19.13	289
SEm ±	0.32	0.01	0.03	16.8	1.20	18.4
CD 0.05	NS	NS	NS	NS	NS	NS
Mulching X fertilizer dose						
M1F1 No mulch 100% RDF	7.24	0.24	0.52	253	18.19	291
M1F2 No Mulch 125% RDF	7.23	0.24	0.53	256	18.76	295
M2F1 Mulch 100% RDF	7.25	0.24	0.50	248	17.12	278
M2F2 Mulch 125 % RDF	7.26	0.23	0.51	251	18.00	282
SEm ±	0.23	0.01	0.02	12.9	0.92	15
CD 0.05	NS	NS	NS	NS	NS	NS

fertility level (100% RDF). Conventional tillage practices performed better as compared to minimum tillage practices As reported by Liao *et al.* (2002) and Xue*et al.* (2005), conservation tillage practices have been shown to increase crop yield considerably.

System productivity

Among all four cropping systems, T2CS2 Con Till rice-brinjal and rice-sunflower system produced higher productivity (122.18 and 84.84 qha^{-1}respectively). Irrespective of treatments, maximum total productivity was obtained 92.26q ha^{-1} when conventional tillage and 125% of RDF was applied. T2CS3 Con Till rice-maize was also found to be better option as compared to the rice-wheat system and produced the higher total productivity of around 84.28 qha^{-1}(Table 2). Similar views were reported by Gupta *et al.* (2007).

Organic carbon and available major nutrients

Organic carbon and available major nutrients (N, P and K) content in soil was influenced by different tillage, cropping system, mulch and fertilizer doses. The data revealed that different tillage practices did not affect the organic carbon of soil and varied from 0.49 to 0.54% amongst various treatments. The tillage practices had slight influence in available N content in the soil. The conventional tillage had recorded lower N content as compared minimum tillage. Similar kind of pattern was also observed in case of available P and K content in soil amongst the different crops. Further, it was observed that no mulch and 100% RDF recorded the higher available N, P and K content in soil as compared to mulch and 125% RDF. However the difference was found non-significant (Table 3). The increases of available N and P in conservation tillage practices were also consistent with the findings of other researchers (Reyes *et al.,* 2002; Thomas *et al.*, 2007).

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