



## Brown manuring effects on soil and yield of rice (*Oryza sativa*) under rainfed midland farming system

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### ABSTRACT

The present study conducted in the year of 2015, 2016 and 2017 aiming to determine the effect of brown manuring on rice (*Oryza sativa* L.) in inceptisol under midland farming of southern Chhattisgarh. Six treatment combinations with the objective of reducing chemical fertilizers, which were line sowing of rice and broadcasting *dhaincha*, line sowing of rice and *dhaincha* together in same row, incorporation of *dhaincha* in line sown rice at 30 DAS, broadcasting of rice and *dhaincha*, line sowing of rice and broadcasting of rice, all *dhaincha* crops were smothered by spraying 2,4-D at 25 DAS. The higher grain yield was with Line sowing of rice and *dhaincha* together in same row followed by line sowing of rice and broadcasting *dhaincha* and 30.95% higher grain yield in Line sowing of rice and *dhaincha* together in same row over broadcasting of rice. Soil organic carbon showed an overall increase over the initial SOC of 0.28%. The mean SOC (%) was 0.62, 0.45 and 0.41 % higher under line sowing of rice and *dhaincha* together in same row, line sowing of rice and broadcasting *dhaincha* and incorporation of *dhaincha* in line sown rice at 30 DAS treatments respectively over the broadcasting of rice. The highest B:C was under Line sowing of rice and *dhaincha* together in same row (4.26) then incorporation of *dhaincha* in line sown rice at 30 DAS (2.37) followed by broadcasting of rice and *dhaincha* line sowing of rice 2.39, 2.86 and 2.46, respectively.

**Key words:** Brown manuring, Dry seeding, Dhaincha, Yield of rice

Rice (*Oryza sativa* L.) has largest contribution to sustained self-sufficiency in food grain production to feed ever increasing population of the country. Development of input-responsive varietal introduction capable of achieving high yield potential particularly under irrigated ecology is responsible to this attainment (Zaman 2012). The agricultural production system of Bastar region is constrained by low organic carbon, low clay, and uneven distribution of rainfall which induces soil erosion with steep slope. Rainfed system of cultivation sprawling fastly in India because of erratic nature of rainfall which governs the cultivation practices and cultural operations to be performed depends on rain frequency and quantum, moisture stress is a regular phenomenon in rice cultivation till harvest. Green manuring is done with sowing of rice in same furrow and germinate after receiving rain and also grows simultaneously in staggered manner makes the system sustainable and easy operation as when mixes with rice and *dhaincha* seeds together. Rainfed cultivation of rice is being done in sloppy to flat land with intensive tillage. After harvesting, biological residuals are not returned to soil with further consequences

of the process of soil degradation (Sharma *et al.* 2012). The post-emergence herbicide spray on green manure leaves resulting in loss of chlorophyll in leaves showing brown in colour is referred to as brown manuring (Tanwar *et al.* 2010). Generally, brown manuring practice is introduced in the fields where *Sesbania* spp @ 20 kg ha<sup>-1</sup> is broadcast three days after rice sowing and allowed to grow for 30 days and was dried by spraying 2,4-D ethyle-easter which supplied up to 35 kg/ha<sup>-1</sup> N, dry matter, control of broad leaf weeds, higher yield by 4-5 q ha<sup>-1</sup> due to addition of organic matter in low fertile soils. This may also be a preferred option on lighter soils prone to erosion and reduce weeds (Sharma *et al.* 2014; Singh *et al.* 2014).

Conservation Agriculture (CA) is the concept for resource conservation and mitigation of adverse climatic impacts that has higher profitability (Acharya *et al.* 1998). Reduced tillage is defined as any tillage that leaves at least 30% of the soil surface covered by residue after planting (Lal 2003). Minimum and zero tillage are a practice for soil and water conservation owing to reduced cost of cultivation expanding benefits to retention of soil water and physical protection of soil organic carbon (Anitha and Mathew 2010). Brown manuring is a version of incorporation of green manures using abroad leaf killing herbicide in mix flora (rice + *dhaincha*). In 'Brown manuring' practice, both the main crop and intercrops are seeded together and allowed

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to grow upto 35 days then green manuring crop is knocked down by applying herbicide (Singh *et al.* 2007). In case of rice, a loss in productivity to the extent of 8.0-10.3 kg/ha for loss of each mm of top soil has been reported (Ghosh *et al.* 2012). Information regarding effect of conservation tillage (CT) on crop yield in the Shivalik region is meagre. The farmers' adoption of conservation tillage in India has been limited due to the lack of sufficient field level research.

Keeping the view of green manuring in rice, a combination of green manuring methods were designed with objectives were to determine impact of green manuring on grain yield in rice (*Oryza sativa* L.) cropping system, to determine soil organic carbon and moisture storage, and to evaluate economics of various resource conservation practices.

#### MATERIALS AND METHODS

The experiment was conducted at the Instructional cum Research Farm, S G College of Agriculture & Research Station, IGKV, Raipur located at Jagdalpur, Chhattisgarh, India (82°01' N latitude, 19°5'E longitude and 547 m above msl). The soil is inceptisol with low organic carbon. The average soil pH (1:2) is 6.5; EC 0.31dS/m organic carbon 0.28%; available N 238 kg/ha, P<sub>2</sub>O<sub>5</sub> 21.2 kg/ha, K<sub>2</sub>O 421 kg/ha, Zn 1.12 mg/kg, Cu 0.53 mg/kg, Fe 2.75 mg/kg and Mn 5.37 mg/kg. The area receives 1408.40 mm mean annual rainfall, of which more than 70% occurs in 3-4 months (June to September).

The study was conducted in the year of 2015, 2016 and 2017; an experimental trial was taken in Randomized Block Design (RBD) with four replications. Twenty four plots of size 5 m × 5 m were prepared with a uniformly leveled field. Treatment comprised Line sowing of rice and broadcasting *dhaincha* (T<sub>1</sub>); line sowing of rice and *dhaincha* together in same row (T<sub>2</sub>); incorporation of *dhaincha* in line sown rice at 30 DAS (T<sub>3</sub>); broadcasting of rice and *dhaincha* (T<sub>4</sub>); line sowing of rice (T<sub>5</sub>) and broadcasting of rice (T<sub>6</sub>). Fertilizer was applied at the rate of 100 kg N/ha, 60 kg P/ha and 40 kg/K ha and nitrogen was applied in two splits, i.e, at sowing and 35 days after sowing, rice variety MTU 1010 was grown as rainfed crop. After harvesting, plot-wise soil samples in triplicate were collected from the surface (0-30 cm) layer. The soil samples were air dried, ground and passed through a 0.2 mm sieve for determination of soil

organic carbon (OC) by Walkley and Black (1934) method. Observation on growth and yield parameters were recorded and the average rate of return per rupee investment was calculated as per prevailing rate of market.

#### RESULTS AND DISCUSSION

*Yield attributes under different treatments:* The highest plant height was noted with line sowing of rice and *dhaincha* together in same row (103.25 cm) to be significantly superior than remaining treatments except Incorporation of *dhaincha* in line sown rice at 30 DAS (102.45 cm) and line sowing of rice and broadcasting *dhaincha* (95.52 cm) which were found statistically similar to that of line sowing of rice and *dhaincha* together in same row. Similar trend was noticed in effective tillers m<sup>-2</sup>, panicle length, and number of grains panicle<sup>-1</sup>. In case of broadcasting of rice and *dhaincha*, line sowing of rice and broadcasting of rice which were found at par with each others as shown in Table 1.

*Yield of rice under different treatments:* Yield varied significantly between treatments. The higher grain yield was with line sowing of rice and *dhaincha* together in same row followed by line sowing of rice and broadcasting *dhaincha* and 30.95% higher grain yield in line sowing of rice and *dhaincha* together in same row over broadcasting of rice (Table 2). The treatments like line sowing of rice and *dhaincha* together in same row produced 57.79 and 65.67% higher over broadcasting of rice and *dhaincha* and line sowing of rice, respectively.

*Soil organic under different treatments:* Soil organic carbon showed an overall increase over the initial SOC of 0.28%. The mean SOC (%) was 0.62, 0.45 and 0.41 % higher under line sowing of rice and *dhaincha* together in same row, line sowing of rice and broadcasting *dhaincha* and incorporation of *dhaincha* in line sown rice at 30 DAS treatments respectively, over the broadcasting of rice (Table 2). The soil organic carbon followed a trend similar to the quantity of biomass added under various treatments. Soil chemical properties were found to be higher in line sowing of rice and *dhaincha* together in same row. Line sowing of rice and *dhaincha* together in same row favoured better organic carbon build up. Reduction of runoff and soil through bio-resources recycling is expected as carbon input from organic sources helps in formation of more water stable macro-aggregates (Anitha and Mathew 2010), thus

Table 1 Effect of brown manuring on growth and yield attributes of rice (Pooled data of three years)

Treatment	Plant height (cm)	Effective tillers/m <sup>2</sup>	Panicle length (cm)	1000 grain wt. (g)	No. of grains/panicle
Line sowing of rice and broadcasting <i>dhaincha</i>	95.52	128.94	19.84	25.36	53.31
Line sowing of rice and <i>dhaincha</i> together in same row	103.25	139.41	21.45	26.35	54.81
Incorporation of <i>dhaincha</i> in line sown rice at 30 DAS	102.45	138.27	21.28	25.14	52.75
Broadcasting of rice and <i>dhaincha</i>	85.62	115.56	17.79	25.63	50.23
Line sowing of rice	91.26	123.18	18.96	24.15	52.29
Broadcasting of rice	79.25	120.47	18.54	24.17	50.27
CD (P=0.05)	7.08	1.14	1.59	0.19	0.98

Table 2 Effect of brown manuring on yield, OC and economics of rice (Pooled data of three years)

Treatment	Rice yield (q/ha)	Organic carbon (%)	Net return/₹	B:C
Line sowing of rice and broadcasting <i>dhaincha</i>	27.15	0.45	47721	2.37
Line sowing of rice and <i>dhaincha</i> together in same row	32.08	0.62	64957	4.26
Incorporation of <i>dhaincha</i> in line sown rice at 30 DAS	25.12	0.41	44280	2.39
Broadcasting of rice and <i>dhaincha</i>	18.54	0.34	34338	2.86
Line sowing of rice	21.07	0.12	37432	2.46
Broadcasting of rice	13.89	0.19	22713	1.89
CD (P=0.05)	4.91	0.17	17232	1.35

providing more time for infiltration; and reduced soil water evaporation by shading and cooling the soil; and by reducing wind speed at the soil surface (Loch 1989).

*Economic analysis of different treatments:* The highest net return was recorded under line sowing of rice and *dhaincha* together in same row (₹ 47721) followed by line sowing of rice (₹ 64957) and broadcasting *dhaincha* and incorporation of *dhaincha* (₹ 44280) in line sown rice at 30 DAS and the lowest being in broadcasting of rice (Table 2). The highest B:C was under line sowing of rice and *dhaincha* together in same row (4.26) then incorporation of *dhaincha* in line sown rice at 30 DAS (2.37) followed by broadcasting of rice and *dhaincha* in line sowing of rice 2.39, 2.86 and 2.46, respectively. Earlier workers have also reported that the conservation tillage improves economic performance, reduces production risks, decreases soil disturbance, improves and benefits soil quality (Zentner *et al.* 2004).

It was concluded that the line sowing of rice and *dhaincha* together in same row followed by line sowing of rice and broadcasting *dhaincha* and 30.95% higher grain yield in line sowing of rice and *dhaincha* together in same row over broadcasting of rice. The mean SOC (%) was 0.62, 0.45 and 0.41 % higher under line sowing of rice and *dhaincha* together in same row, line sowing of rice and broadcasting *dhaincha* and incorporation of *dhaincha* in line sown rice at 30 DAS treatments respectively, over the broadcasting of rice (Rana *et al.* 2003). The highest B:C was under line sowing of rice and *dhaincha* together in same row (4.26) then incorporation of *dhaincha* in line sown rice at 30 DAS (2.37).

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