A STUDY ON EFFECT OF BROWN MANURING ON GROWTH, YIELD, ECONOMICS AND SOIL FERTILITY IN DIRECT SEEDED RICE (*Oryza sativa* L.)

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ABSTRACT

The study was carried out through front line demonstrations during *kharif* seasons of 2014 and 2015 to study the effect of brown manuring on growth, yield, economics and soil fertility in direct seeded rice. The demonstration results showed that the improved practice of brown manuring recorded 16.15 % higher grain yield (30.2 q ha^{-1}) , higher harvest index (47.34 %), production efficiency(28.8 kg ha^{-1} day^{-1}) and extension gap(4.2 q ha^{-1}) than farmer's practice . The same also produced higher plant height (89.97 cm), tillers plant^{-1}(18.95) , EBT plant^{-1} (15.5) and grains panicle^{-1}(125.6) with 0.14 % and 13.4 % higher increased in soil organic carbon and available nitrogen respectively. The improved practice also recorded the higher gross return of Rs.45146 ha^{-1}, B:C ratio(1.47) and profitability(Rs. 143.66 ha^{-1} day^{-1}) with additional net return of Rs.5271 ha^{-1} over local check and it can effectively replace the farmers practice in the existing farming situation for higher productivity, profitability and soil fertility.

Keywords: Brown manuring, Direct seeded rice, Extension gap, Sesbania, Yield

No: of Tables : 3 **No: of Figures: 1** **No: of References: 20**

INTRODUCTION

Rice(*Oryza sativa* L.) is the predominant crop of Odisha with a total coverage of 4.18 million hectare which is about 65 % of the total cultivable area of the state. Area under rice crop in Angul district of the state is 0.078 million hectare with a productivity of 19.29 q ha^{-1} which is 48 % less than that of state (Anonymus 2014). In future, there is no scope for further expansion in rice area and to achieve this goal, conventional breeding methods need to be supplemented with the innovative techniques. Achieving self-sufficiency in rice production and maintaining price stability are important political objectives in low-income countries because of the importance of this crop in providing national food security and generating employment and income for low-income people (Ghosh *et al.*, 2009). However due to death of irrigation water during summer, majority of rice farmers are not able to raise the green manure crop. Brown manuring is a new innovative approach where rice and Sesbania crops are seeded together and allowed to grow for 25-30 days. Application of 2,4-D is made to kill the co-cultured Sesbania. It reduces the weed population without any adverse effect on rice yield. Sesbania surface mulch decomposes very fast to supply Nitrogen (Pathak *et al*, 2011). Intensive agriculture, involving exhaustive high yielding varieties of rice and other crops, has led to heavy withdrawal of nutrients from soil, imbalanced and discriminate use of chemical fertilizers has resulted in deterioration of soil health (Porpavai *et al.*, 2011). Frontline demonstration were conducted to demonstrate the production potential of released proven technologies in farmers field under real farming situation and the available technologies should reach the farmers (Mitra *et al.*, 2014).

Keeping in view such problems and objectives farmers participatory field demonstrations were conducted to study the effect of brown manuring on growth, yield, economics and soil fertility in direct seeded rice.

MATERIALS AND METHODS

The study was carried out through front line demonstrations during *kharif* seasons of 2014 and 2015 in the adopted village *i.e. Ragudiapada* of Angul district in mid central table land zone of Odisha with the active participation of farmers after different extension approaches through regular field visit & interpersonal communication made by the scientists of Krishi Vigyan Kendra, Angul. The soil of the study area was slightly acidic in reaction (pH-5.5 to 6.0), loam in texture with medium organic carbon content(0.52 to 0.60 %), medium in nitrogen (284 to 290 kg ha^{-1}), low in phosphorus (10.0 to 11.5 kg ha^{-1}) and medium in potassium(176 to 182 kg ha^{-1}). Ten farmers were selected and they were supplied with input like Dhaincha seeds and herbicide (2,4-DEE). The rice crop was grown with recommended package of practices in 0.2 ha by each farmer during both the year. The farmers practices involved indiscrimate use of fertilizers. The improved practice included brown manuring practice involved sowing of dhaincha seed @15 kg/ha at 3 DAS rice and application of 2,4 D Ethyl Ester@1.0 kg/ha at 30 DAS for knocking down of dhaincha seedlings. This co-culture technology reduced annual sedges without any adverse effect on rice crop with increase soil health and grain yield. The plant population of dhaincha after knocked down was allowed for decomposition and absorption in the soil and increased organic carbon content and available nitrogen of initial soil status. Rice cv. *Sahabhagidhan* was sown 2nd week of June and harvested during 1st week of October in both the years of demonstrations. Observations on different yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Final crop yield (grain & straw) were recorded and the gross return were calculated on the basis of prevailing market price of the produce. Harvest index was the relationship between economic yield and biological yield (Gardner *et al.*,1985).

It was calculated by using the Following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Production efficiency value was calculated with using formula by Tomar and Tiwari, (1990). Extension gap as calculated by the formula suggested by Samui, *et al*.(2000) .

Extension gap = Demonstration yield- Farmers yield.

The soil was analysed for organic carbon (wet digestion method, Walkley and Black, 1934) and available nitrogen(Subbaiah and Asija, 2956) at the end of each year after harvest of rice. Tabular analysis involving simple statistical tools like mean was done by standard formula to analyses the data and draw conclusions and implications (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

1) Grain Yield, Straw yield and Harvest index:

Results of front line demonstrations (Table-1) indicated that the improved practice of brown manuring in direct seeded rice recorded grain yield 30.2 q ha^{-1} which was 16.15 % higher than that of farmers practice. The improved practice also produced higher straw yield 33.59 q ha^{-1} with higher harvest index (47.34 %). This might be owing to higher tillers and grain production. Similar results were also obtained by Maity and Mukherjee (2011).

2) Plant height, Tiller plant^{-1}, EBT plant^{-1}, Grains panicle^{-1}:

The brown manuring practice produced (Figure 1) higher plant height (89.97 cm), tiller plant^{-1}(18.95) , EBT plant^{-1} (15.5) and grains panicle^{-1}(125.6) in comparison to farmers practice. This was in agreement with the findings of Gill and Wallia (2014) and Sarangi *et.al*, (2016).

3) Production efficiency and Extension gap:

The production efficiency (Table 1) was higher in improved practice (28.8 kg ha^{-1} day^{-1}) in comparison to local check due to more grain yield. Higher extension gap (4.5 q ha^{-1}) was found during 2014 and lower(3.9 q ha^{-1}) was during 2015 . Latest production technologies will subsequently change this alarming trend of galloping extension gap (Samant, 2014). The new improved technologies will eventually lead to the farmers to discontinue the traditional method and to adopt new technology (Sharma *et al.*, 2011).

4) Fertility:

The organic carbon status of the soil (Table 3) increased after the harvest of rice at the end of each year. The brown manure practice contributed to an increase of 0.14 % organic carbon content after the harvest of rice. Such an increase in organic carbon content is attributed to the accumulation of root residues and shedding of leaves by the leguminous crops (Thakur and Sharma, 1988). The

initial available nitrogen status of the soil was 284.19 kg ha^{-1}. Progressive increase in available nitrogen status after each year was observed with incorporation of dhaincha through brown manuring practice which could sustain soil fertility. Thus the FLD might have a positive impact on farming community in the district over local check (Mondal *et al.*, 2005).

Table 1. Effect of brown manuring on yield, production efficiency and extension gap

Year	Yield (q ha^{-1})		Straw (q ha^{-1})		Harvest index(%)		% of increase in grain yield over local check	Production efficiency (kg ha^{-1} day^{-1})		Extension gap (q ha^{-1})	
	IP	FP	IP	FP	IP	FP		IP	FP	IP	FP
2014	31.8	27.3	34.0	28.7	48.33	48.75	16.48	30.2	26.0	4.5	-
2015	28.6	24.7	33.18	29.4	46.29	45.66	15.78	27.2	23.5	3.9	-
Mean	30.2	26.0	33.59	29.05	47.34	47.23	16.15	28.8	24.8	4.2	-

* *IP:* Improved technology (Brown manuring) ; *FP:* Farmer's practice (Indiscriminate use of chemical fertilisers)

Table 2. Effect of brown manuring on cost of cultivation, gross return, net return, B:C ratio and profitability

Year	Improved practice (Brown manuring)					Farmer's practice (indiscrimate use of chemical fertiliser)				
	Cost of cultivati	Gross return	Net return	B:C ratio	Profitability (Rs ha^{-1}	Cost of cultivation	Gross return	Net return	B:C ratio	Profitability (Rs ha^{-1}

	on (Rs ha-1)	(Rs ha-1)	(Rs ha-1)		day-1)	(Rs ha-1)	(Rs ha-1)	(Rs ha-1)		day-1)
2014	30430	46648	16218	1.53	162.18	29450	39998	10548	1.36	105.48
2015	31130	43644	12514	1.40	125.14	30125	37767	7642	1.25	76.42
Mean	30780	45146	14366	1.47	143.66	29787.5	38882.5	9095	1.31	90.95

**Sale price of rice seed Rs.1360/q and straw Rs.100/q for the year 2014-15 ; Sale price of rice seed Rs.1410/q and straw Rs.100/q for the year 2015-16*

Table 3. Effect of Brown manuring on soil organic carbon and post harvest available Nitrogen

Year	Initial organic carbon content of soil (%)	Organic carbon content after harvest (%)	% of increase in organic carbon	Initial soil available nitrogen content (kg/ha)	Soil available nitrogen content after harvest(kg/ha)	% of increase in soil available nitrogen content
2014	0.54	0.69	0.15	283.0	320.2	13.1
2015	0.58	0.71	0.13	285.38	324.6	13.7
Mean	0.56	0.70	0.14	284.19	322.4	13.4

* *IP:* Improved technology (Brown manuring) ; *FP:* Farmer's practice (Indiscriminate use of chemical fertilisers)

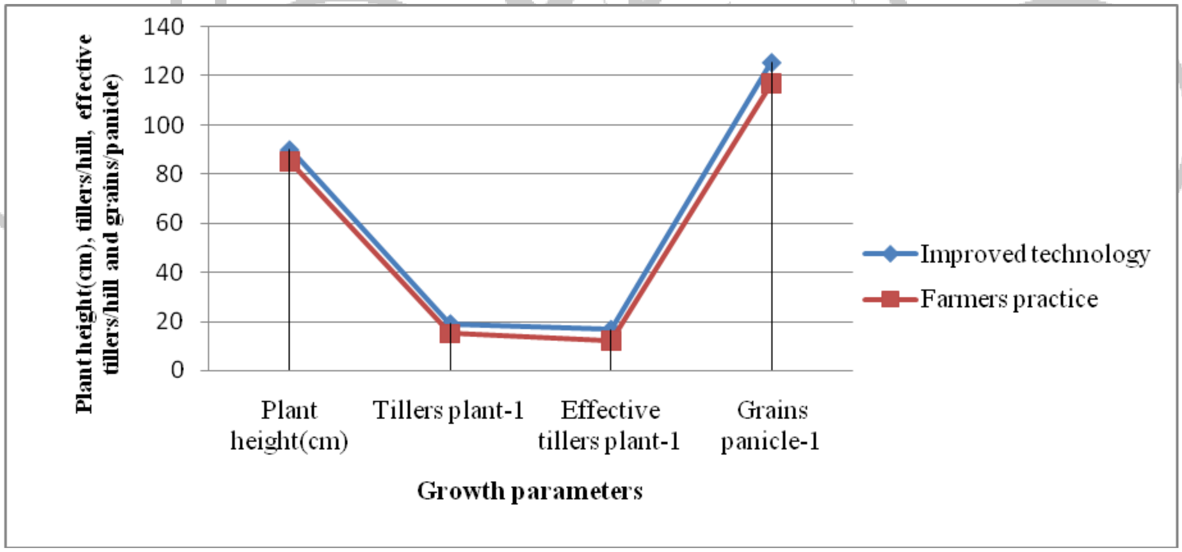

Figure 1: Effect of Brown manuring on growth parameters

5) Economics:

Brown manuring practice recorded (Table 2) the higher gross return of Rs.45146 ha^{-1} and profitability(Rs. 143.66 ha^{-1} day^{-1}) with additional net return of Rs.5271 ha^{-1} over farmers practice . Higher B:C ratio(1.47) was found in improved practice due to higher net return as compared to local check(1.31) attributed to more grain production. The variation in net return and benefit-cost ratio may be attributed to the variation in the price of agri inputs and produce . These finding are also similar with the findings of Nirmala *et al.* (2012). Singh *et al.* (2007) reported that *Sesbania* as brown manuring was as effective as the mulch in realizing higher economic returns. Thus, the existing farmer's practice can effectively be replaced by brown manuring practice in direct seeded rice in the existing farming situation for higher productivity, profitability and soil fertility.

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