



Evaluation of post-rainy season crops with residual soil moisture and different tillage methods in rice fallow of eastern India

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ABSTRACT

In eastern India, farmers grow rice during rainy season (June–September) and land remains fallow after rice harvest in the post-rainy season (November–May) due to lack of sufficient rainfall or irrigation facilities. But in lowland areas of eastern India, sufficient carry-over residual soil moistures are available in rice fallow in the post-rainy season (November–March), which can be utilized for growing second crops in the region. During the post-rainy season when irrigation facilities are not available and rainfall is meager, effective utilization of carry-over residual soil moisture and conservation agriculture become imperative for second crop production after rice. Implementation of suitable tillage/seeding methods and other agro-techniques are thus very much important to achieve this objective. In this study four pulse crops (lathyrus, blackgram, pea, and greengram) were sown utilizing carry-over residual soil moisture and with different tillage/seeding methods viz. relay cropping (RC)/farmers' practice, reduced tillage (only two ploughing) (RT), conventional tillage (CT) and zero tillage (ZT). Study revealed that the highest grain yields of 580, 630, 605 and 525 kg ha⁻¹ were obtained from lathyrus, blackgram, pea and green gram, respectively, with RT treatment. On the other hand, with conventional tillage, 34–44% lower yields were obtained than that of RT. Crops with reduced tillage performed better than that with zero tillage or relay cropping also. Impacts of different tillage methods on important soil physical properties like infiltration, bulk density were also studied after harvesting first crop (rice) and before growing second crops (pulses) in rice fallow. The lowest mean bulk density (1.42) was recorded in the surface soils of CT treatment while the corresponding value under ZT treatment was 1.54 Mg m⁻³.

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1. Introduction

Eastern India, the rice-dominated area of the country, accounts for about 63.3% of the India's total rice area. About 78.7% of rice area in the region is rainfed where rice is grown only during rainy season (June–September). Though a major portion (48%), particularly lowland rice areas, is able to support a good second crop with carry-over residual soil moisture (due to heavy texture and high moisture retention), it is mostly mono-cropped. In some areas farmers grow second crops by broadcasting the seeds within the standing rice crop (first crop) in well-moistened soils without any tillage at 15–20 days prior to the harvest of rice. The system of growing crops without tillage is called relay cropping where farmers obtain much less yield (0.2–0.3 t ha⁻¹) from second crops. It might be due to unfavourable physical conditions of the soil which inhibit crop growth and nutrient uptake in rice fallow.

Productivity and profitability from second crops in rice fallow can be improved with suitable crop management technique even by utilizing residual soil moisture (Pratibha et al., 1996; Mahata et al., 1992; Kar et al., 2004). The soil structure was improved by growing of second crops after rice with suitable seeding and tilling methods (Sidhu and Beri, 1989; Ghuman and Sur, 2001; Ishaq et al., 2001; Gangwar et al., 2006).

During the post-rainy season (dry season) irrigation facilities are not available and rainfall is meager, therefore, second cropping after wet season rice depends on the effective utilization of carry-over residual soil moisture. Conservation tillage with suitable cropping systems was helpful to maintain soil health, increase water use efficiency and check erosion (Fuzisaka, 1990; So et al., 2001). Inclusion of short duration low water requiring legumes (grain/green manure purpose) offered excellent opportunity to utilize carry-over residual soil moisture in rice fallow (Rahmiaanna et al., 2000; Diaz-Ambrona and Minguez, 2001; Kar et al., 2004). Higher yield of pulse after wet season (rainy season) rice with reduced tillage was also reported by Pratibha et al. (1996), Mahata et al. (1992) under rainfed situation of eastern India. Minimum tillage with crop residue management reduced soil water evaporation, soil sealing and

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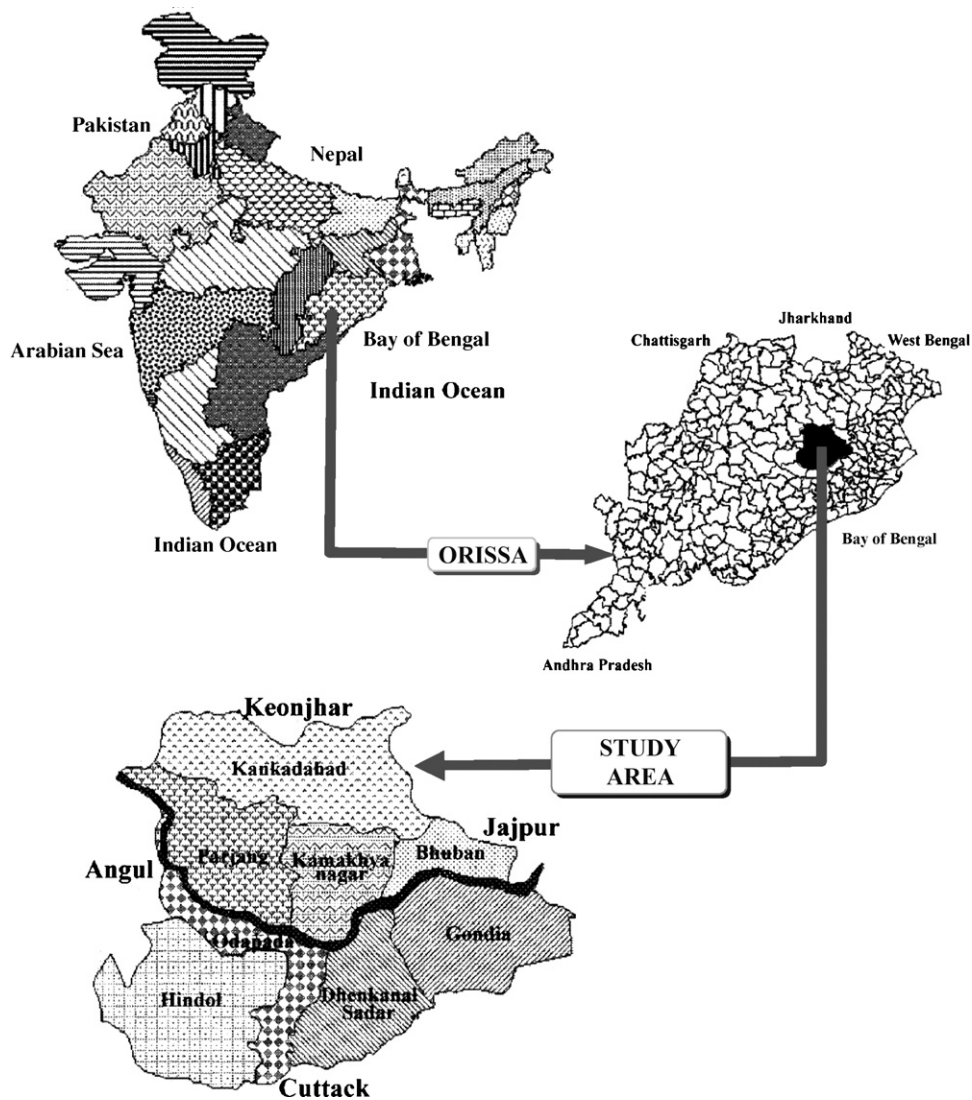


Fig. 1. Spatial location of the study area.

crusting (Chaudhary et al., 1991; Verma and Bhagat, 1992; Meelu et al., 1994; Gangwar et al., 2006).

Resource-poor rainfed farmers of the region cannot afford to provide irrigation facilities or to use fertilizers to grow second crops during post-rainy season. Proper technology of low input conservation tillage and sustainable cropping system are the viable options to grow second crops in rice fallow in the region. The present study has explored the possibility of growing second crops after applying tillage in rice fallow during post-rainy season utilizing carry-over soil moisture and residual soil fertility. After harvesting first crop (rice) the land was prepared with different tillage methods and productivity and water use efficiency of the second crops in tilled soils were compared with that of farmers' practice (relay cropping). The effects of different tillage/seeding methods on important soil properties like bulk density and infiltration were also studied after imposing tillage treatments and before planting of second crops.

2. Materials and methods

2.1. Location of experimental site

The study was conducted at Kadalipal village, Dhenkanal, Orissa, India (139 m above msl, 20°40'N latitude and 85°36'E

longitude) during three post-rainy seasons (2004–2005, 2005–2006, 2006–2007). The spatial location of the study area is given in Fig. 1.

The region belongs to Mid Central Table Land Zone of Orissa where cropping season is mainly confined to rainy season.

2.2. Climate

The region receives 80% of the annual rainfall during southwest monsoon season (June–September), but rainfall during winter/post-rainy season is meager. To grow second crops during the post-rainy season (after wet season rice) either supplemental irrigations are required or available carry-over residual moisture should be effectively utilized. In the region the mean date of onset of effective monsoon was found to be 15th June and southwest monsoon generally ended on 27th October. During rainy season rice is the main crop grown under rainfed condition. In regard to monthly rainfall in rainy season at 75% probability level (dependable limit), highest (237 mm) amount of rainfall was computed in the month of July, followed by rainfall in August (200 mm), June (181 mm) and September (154 mm). Study revealed that pre-monsoon shower might occur between 16th and 19th weeks making summer tillage and preparation of seed beds for rainy season rice crops feasible then. The initial and conditional probabilities of

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