

Alternative Crop Establishment Tillage Technologies in Rice

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ABSTRACT

The study aimed at evaluating the alternate tillage technologies for rice crop establishment. The participatory research was carried out at four permanent sites in villages Darar, Kurali, Newal and Barota during 2002-2004. Traditionally rice is transplanted after puddling which requires heavy amount of water and labour and affects the soil health due to dispersion of soil particles, increases soil compaction and make tillage operations difficult in succeeding crops requiring much energy. Concerns have now been raised for environment degradation and sustainability of resources. Direct seeding has been in practice for quite long particularly in the eastern parts of India. The direct seeding was done in puddled, un-puddled conditions and zero tillage fields, whereas, transplantation was done in zero tillage fields and on raised bed. Zero till establishment is used widely for many crops around the world but there has been less work on rice. This technology has potential to save time, energy, water and labour during rice establishment. It has been found that there was a problem of weed control in direct seeded rice particularly under un-puddled conditions. Transplantation under zero tillage was profitable as compared to conventional; however, transplantation on beds and direct seeding was less profitable. Therefore, work needs to be carried on weed and suitable variety development for direct seeded rice to popularize this technology among the farmers.

Key words: Participatory research; Puddling; Zero tillage

In India, rice is grown over an area of 43 m ha with total production of 87 m tons, contributing about 41.8 per cent of total food grain. Rice production has increased from 39 million tons in 1964-65 to 87 million tons in 2003-04. The increase in production has been mainly due to improved varieties and better agronomic practices. The irrigated areas have contributed to the grain pool and productivity in the rainfed areas continues to be low. To meet the targeted rice demand of 134-145 million tons by 2020 the productivity needs to be increased which is possible through alternative tillage options in rice *viz.* direct seeding under puddled, un-puddled conditions and zero tillage fields, and transplanting in zero tillage and raised bed fields. Zero till establishment is used widely for many crops around the world but there is little work on rice. This technology has potential to save time, energy, water and labour during rice establishment. Another technology is raised bed planting system, farmers can be benefited with saving of water (48%) in the long run by raising rice and wheat on beds as compared to conventional method. Transplanting of rice on beds was better than conventional in terms of greater plant height number of ears m², more ear length and 1000 grain weight and ultimately higher yield than conventional (Samar *et al* 2002). Direct seeding has been in practice for quite long particularly in the eastern parts of India. Conventional rice production technology requires heavy amount of labour in growing nursery,

uprooting seedlings, puddling field and seedling transplanting in fields (Singh *et al* 2002). However, during peak periods of transplanting, labour also becomes very scarce. It also affects the soil health due to dispersion of soil particles and soils becomes compact and make tillage operations difficult in succeeding crops requiring much energy. Moreover, concerns have been raised for environment degradation and sustainability of resources. Therefore, the project aimed at evaluating the alternate rice crop establishment technologies.

METHODOLOGY

The participatory research experiments were conducted from 2002 to 2004 at four permanent sites in Darar, Kurali, Barota and Newal villages of Karnal district under the NATP project. Soil type was loam and normal except in Newal where it was alkaline in nature. Water samples also exhibited similar pattern, low EC indicated that the concentration of salts was low, therefore suitable for irrigation. The site was almost leveled and has been cropped continuously, mainly to paddy and wheat for more than four decades. The treatments included direct seeding under puddled conditions and zero tillage fields, transplanting in zero tillage fields and on raised beds at the farmers' fields and their conventional practices were taken as control. During 2002, PR 116 variety was grown at all sites with recommended package of practices, used Butachlor to control the weeds in raised beds and

conventional, whereas, Glyphosate a non selective herbicide was used to control weeds in the direct seeded rice. Direct seeded rice was sown in the last week of May, however, transplantation was done in last week of June and first week of July. During 2003, all the sites had PR 116 variety but Darar had CSR 30, a fine variety of rice. Direct seeding was completed in the first week of June, whereas, transplantation was done in the first fortnight of July with similar package of practices. 72.5 Kg N, 40 Kg P, 20 Kg K and 5.25 Kg Zn/acre was applied in CSR 30. Farmers' conventional practice was taken as control to compare the results. During 2004, PR 120 at two sites, PR 114 and PR 126 on the other two sites were sown. Transplantation under zero tillage was taken up during this year only alongwith raised bed planting and conventional.

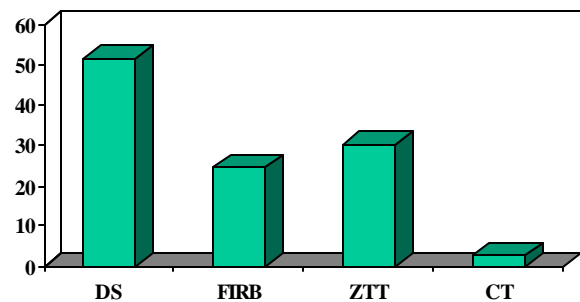
RESULTS AND DISCUSSION

Effect of Tillage Options on Weed Flora in Paddy : The problem of grassy weeds was more in the direct seeded rice as compared to other tillage technologies. There were very few broad leaf weeds across the sites, however, the problem of narrow leaf weeds was observed at almost all the sites. Controlling the grassy weeds in the direct seeded rice was a challenge, despite using the non selective herbicide particularly in zero tillage fields, the weeds could not be controlled. The weeds were also removed manually but it was difficult to get labour particularly in northern parts of the country. Even getting labour is highly cost intensive. It was encouraging to note that under puddled conditions, the weeds were comparatively less in direct seeded rice. Therefore, more experiments need to be conducted to tackle such problems.

Effect of tillage options on grassy weeds (no/m²) 2002-04

Village	Weeds	DS	FIRB	ZTT	CT
Kurali	Barta (<i>Echinochloa crusgalli</i>)	9	1	8	4.7
	Sanmak (<i>Echinochloa colonum</i>)	8	1.5	8	3.7
	Motha (<i>Cyprus rotundus</i>)	8.5	2.5	8	1.3
	Doob grass(<i>C. dactylon</i>)	1.5	0	0	0
Darar	Barta (<i>Echinochloa crusgalli</i>)	9	4.5	0	3.7
	Sanmak (<i>Echinochloa colonum</i>)	8	6.5	0	8.0
	Motha (<i>Cyprus rotundus</i>)	9	30	0	4.0
	Doob grass(<i>C. dactylon</i>)	0	0	0	0
Barota	Barta (<i>Echinochloa crusgalli</i>)	14.5	10	4.0	4.0
	Sanmak (<i>Echinochloa colonum</i>)	13.5	3	0	0
	Motha (<i>Cyprus rotundus</i>)	8.5	4	16.0	16.0
	Doob grass(<i>C. dactylon</i>)	0	0	0	0
Newal	Barta (<i>Echinochloa crusgalli</i>)	3.5	3.5	0	5.0
	Sanmak (<i>Echinochloa colonum</i>)	11	5.0	0	2.33
	Motha (<i>Cyprus rotundus</i>)	9	10	0	3.0
	Doob grass(<i>C. dactylon</i>)	1	0	0	0
Mean	Barta (<i>Echinochloa crusgalli</i>)	9.0	4.75	3.0	4.0
	Sanmak (<i>Echinochloa colonum</i>)	10.1	4.0	2.0	4.75
	Motha (<i>Cyprus rotundus</i>)	8.75	11.5	6.0	3.4
	Doob grass(<i>C. dactylon</i>)	0.5	0	0	0

Effect of tillage options on broad leaf weeds(no./m²) (2002-04)



The broad leaf weeds were also more in direct seeded rice as compared to conventional tillage, furrow irrigated raised bed system and zero tillage transplanting (ZTT).

Pest Scenario : The pest scenario has indicated incidence of termite at all sites in FIRB but at Barota site, it was in tillage options being a termite prone area. There were fewer incidences of stem borer and leaf hopper at all sites. False smut was observed in PR 116 variety at all sites. There was medium level of incidence of leaf folder at almost all the sites. Sheath blight was found in Kurali and Darar. In Darar village, there was medium level of incidence of sheath blight in direct seeded rice.

Pest scenario in different tillage options 2002-2004

Village	Tillage	Termite	Pink stem borer	Yellow stem borer	Leaf folder	Green leaf hopper	False smut	Brown leaf spot
Kurali	DS	*	*	**	**	*	*	**
	FIRB	***	*	**	**	*	*	**
	CT	*	*	**	***	*	*	**
Darar	DS	*	*	**	***	**	*	*
	FIRB	**	*	**	**	**	*	*
	CT	*	*	**	***	**	**	**
Barota	DS	**	**	**	***	***	*	*
	FIRB	***	**	*	**	**	**	**
	CT	**	**	*	**	***	***	**
Newal	DS	*	**	**	***	**	*	**
	FIRB	**	**	**	***	**	*	*
	CT	*	**	***	***	**	*	**

*No incidence, ** Less incidence, ***Medium level of incidence, ****High incidence

Rice Productivity and Economics : The findings have indicated that rice yield under direct seeding was lowest (4.85t/ha) as compared to zero tillage transplanting (7.04t/ha), FIRB (5.99t/ha), and conventional (5.95t/ha). One of the main reasons for low yield was more weeds in the direct seeded rice. The yield under zero tillage transplanting was only for one year, therefore, it may not be conclusive and needs further experimentation. To make direct seeding

a successful technique of crop establishment, control of weeds is of paramount importance. The net return was also highest in case of zero tillage transplantation (Rs 15632/ha), followed by conventional tillage (Rs 93152/ha), FIRB (Rs 7681/ha) and direct seeding (Rs 7350/ha). Therefore, the per ton cost of production was lowest in zero tillage transplantation. However, it would be appropriate to mention that the labour faced problems in transplanting rice in zero tillage fields due to hard surface and they had to be paid more labour wages for transplantation. Similarly direct seeding in zero tillage fields also created problem as controlling weed was difficult. Though Glyphosate was used to control weeds, it rained and the weeds could not be controlled effectively resulting in poor yield. The weedicide was applied thrice because of rains which increased the cost of cultivation in direct seeding. Rice yield in FIRB was noted to be satisfactory where the farmer could keep the water standing for 21 days after transplantation.

Effect of tillage options on yield and economic parameters

Parameters	Tillage technologies			
	DS	ZTT	FIRB	CT
Yield (t/ha)	4.85	7.04	5.99	5.95
Net return (Rs/ha)	7350	15632	7681	9315
Cost of production (Rs/t)	5080	3350	4410	4750

CONCLUSION

Transplantation under zero tillage was profitable as compared to conventional and transplantation on beds was less profitable than conventional. There were incidences of termite on raised beds. The findings have indicated that net profit under the direct seeding was less as compared to conventional. weedicides will help in controlling weeds in direct seeded rice particularly in unpuddled conditions than puddle. There were incidences of termite on raised beds. However, further research is needed to develop rice varieties suitable for direct seeding and new molecules to control weeds in direct seeded rice.

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