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Evaluation of Suitable Cropping Sequence at Mid Reach of Mudimanikyam Major of Nagarjuna Sagar Project Left Canal of Nalgonda District, Andhra Pradesh

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ABSTRACT

On farm demonstrations on system of rice intensification during *kharif* and zero tillage maize during *rabi* were studied in the farmers field pertaining to rice at mid reach of mudimanikyam major of Nagarjuna Sagar Project left canal of Nalgonda district of Andhra Pradesh during 2008- 09. In mid reach, farmers are followed System of Rice Intensification (SRI) during *kharif* and zero tillage maize cultivation during *rabi* season.SRI method recorded 13.1% higher grain yield (6560 kg ha^{-1}) and 37.4% saving in water (860 mm) than the traditional system of flood irrigation (5800 kg ha^{-1} and 1375 mm). During *rabi,* maize grain equivalent yield was 14211 kg ha^{-1} as compared to rice grain yield (5900 kg ha^{-1}). By practicing SRI rice – zero tillage maize the net returns were Rs 94030 and 2.54 benefit per rupee investment. Where as in rice – rice practice the net returns were Rs 65000 and 1.25 benefit per rupee investment.

Key words : Flood irrigation, Grain equivalent yield,Mid reach, System of rice intensification, Zero tillage maize.

Agriculture is the largest water user in most river basins where irrigated rice forms the main activity. In many irrigation projects the competition for water is increasing day by day. Hence the intensive water use in traditional wet rice cultivation comes into question. Under this scarce water situation, water saving irrigation technologies such as rotational system of irrigation, semi-dry rice and system of rice intensification (SRI) are receiving greater attention by the individuals and Government. These technologies reduce water input with similar or slightly higher yields and there by becoming popular among farmers in some parts of Asia who confronts scarcity of water or high cost of water.

Zero tillage maize production conserves soil and water and reduces capital investment in machinery, but most important to many producers, zero tillage can improve maize yields. For example, in a 15-year study at Virginia Tech, zero tillage maize planted into a rye cover crop out-yielded conventional tillage maize by 16 percent (Moschler et al. 1972). In a three-year University of Maryland study, zero tillage maize in a small-grain/double-crop soybean stubble out-yielded conventional tillage maize by 28 bushels per acre. By reducing water runoff and soil erosion, zero tillage reduces soil loss and improves stream water quality. Adding organic matter through residue can improve soil structure and fertility. The residue cover also provides for better flotation of equipment over the field surface, allowing planting and harvesting to occur under wetter soil conditions. However, it must be noted that planting or harvesting when the soil is too wet may contribute to soil compaction. Obtaining significant yield increases from zero tillage requires sound management decisions and attention to some unique problems.

Hence the present study was conducted to evaluate the system of rice intensification during *kharif* and zero tillage maize during *rabi* season in comparison with traditional system of flood irrigation in rice under Nagarjuna Sagar Project left canal command of Nalgonda district of Andhra Pradesh.

Nagarjuna sagar left canal supplies irrigation water for 4 lakh ha. Rice-Rice mono crop is in vogue for last 30 years and though water is sufficient at mid reach, selection of profitable crops improves farmers' income. To overcome this problem mid reach area farmer should implement water saving technique like system of rice intensification in rice during *kharif* and zero tillage maize during *rabi* to get profitable income and increased water use efficiency instead of traditional system of flood irrigation in rice.

Table 1. Grain yield and water use of rice (System of Rice Intensification) during *kharif* and maize (Zero tillage) during *rabi* at mid reach of mudimanikyam major of NSP left canal command area of Nalgonda district of Andhra Pradesh

S.No	Farmer Name and address	Grain yield (kg ha^{-1})		Water use (mm)		Water Use Efficiency (kg ha mm^{-1})	
		Rice	maize	Rice	Maize	Rice	Maize
1	Peddishetti srinivas rao nethapuram	8050	7500	780	380	10.3	19.70
2.	Kutala venkanna nethapuram	6700	7170	850	250	7.88	28.68
3.	Kutala basavaiah, nethapuram	6650	7750	905	405	7.34	19.13
4.	Kutala basavaiahnaidu, nethapuram	6350	6850	960	360	6.61	19.02
5.	Alugula saidireddy, nethapuram	7080	7490	905	405	7.82	18.42
6.	Kutala venkateshwarlu, nethapuram	6250	8115	750	350	8.33	23.18
7.	Shankar shetti srinu, nethapuram	6500	7625	805	305	8.07	25.00
8.	Mandarin mangamma, nethapuram	5950	7270	790	390	7.53	18.64
9.	Peddishetti venkateshwarlu, nethapuram	6280	6950	900	400	6.97	17.37
10.	Peddishetti krishnaiah, nethapuram	6000	6500	895	295	6.70	22.03
11.	Kutala Nagamma, nethapuram	6450	6870	860	360	7.50	19.08
12.	Kutala ramaiah, Nethapuram	6550	7000	920	320	7.11	21.87
13.	Kutala mattaiah, nethapuram	6450	7450	880	380	7.32	19.60
	Average grain yield (SRI- zero tillage maize)	6560	7270	860	354	7.62	20.53
	Flood irrigation in rice	5800	5900	1375	1400	4.21	4.21
	Maize grain equivalent yield		12275				
	CV%	2.6	3.4				

MATERIAL AND METHODS

Thirteen number of demonstrations were conducted in the farmers fields at Nethapuram village of Nidamanoor mandal of Nalgonda district, Andhra Pradesh during *kharif and rabi season* of 2008 -09 to evaluate the system of rice intensification during *kharif* and zero tillage maize during *rabi* season in comparison with flood irrigation in rice. The demonstration fields are situated in mid reach of Mudimanikyam major of Nagarjuna sagar left canal. The soils were sandy clay loam in texture with a P^H range of 7-7.6. Low to medium in nitrogen, medium to high in available P_2O_5 and high in available K_2O. The treatments include T_1- system of rice intensification and T_2- farmers practice of flood irrigation during *kharif*, where as in *rabi* T_1- zero tillage maize T_2 – Rice cultivation. During *kharif* season, BPT 5204 was the test variety in all the demonstrations and transplanting were done between 15th August to 31st August . In *rabi* Maize hybrid 'Cargill 900' was sown in all the zero tillage demonstrations plots immediately after *kharif* rice harvestings. The plot size for each treatment was 4000 m^2.

In SRI, Rice variety BPT 5204 @ 5 kg seed ha^{-1} was sown in raised beds of puddled field. Pre-germinated seeds were broadcasted uniformly on nursery beds. After broadcasting the seed, 1:1 soil-FYM mixture was spread in a thin layer of one centimeter to cover the seeds. The beds were irrigated with a rose can daily in the morning and evening. Before lifting the seedlings, nursery beds were thoroughly irrigated. After lifting, seedlings were immediately transplanted in the main field. Seedlings of 12 days old were transplanted in the main field in square pattern, spacing at 25 x 25 cm with single seedling per hill. In farmers practice of flooding, seed was sown @ 50 kg ha^{-1}. 30 days old seedlings were transplanted at a spacing of 20X15 cm. The main field was prepared by ploughing twice followed by thorough puddling. The farm yard manure @ 15 t ha^{-1} was applied during first pudding in the main field. The fertilizers of N, P_2O_5 and K_2O applied at 180:60:40 kg ha^{-1} applied. The entire phosphorous and half of the recommended potassium was applied as basal dose during transplanting and another half of recommended potassium applied during panicle initiation stage. Nitrogen applied in 3 equal splits at transplanting, active tillering and panicle initiation stage.

In SRI, field was irrigated just enough to saturate the soil with moisture. Subsequent irrigation was given as the soil starts forming fine cracks throughout vegetative phase. From flowering to 10-12 days before harvesting, a thin film of water was maintained continuously by frequent irrigation.

Table 2. Economic analysis of Rice (SRI)-Maize and Rice-Rice systems.

S. No	Cropping sequence	Average grain yield (kg ha^{-1})		Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B C Ratio
		Rice	Maize				
1.	Rice (SRI) – zero Tillage maize	6560	7270	131030	37000	94030	2.54
2.	Rice – Rice (flood irrigation)	5800	5900	17000	52000	65000	1.25

During cono weeding, standing water was maintained to facilitate for easy movement of cono weeder. Whereas in farmers practice of flood irrigation, 2 cm standing water was maintained up to vegetative stage, after that 5cm standing water was maintained till 10 days before of physiological crop maturity. Irrigation water was measured by use of parshall flumes.

Pre emergence herbicide oxadiargyl @ 90 g ha^{-1} was applied with sand mixture immediately 3 days after transplanting in traditional system of flood irrigation. Where as in SRI cono weeding was done thrice at an interval of 15 days. In addition to this one manual weeding was done at 30 days after transplanting in all the treatments. Plant protection was done as per the requirement.

In zero tillage maize during *rabi* after *kharif* rice harvest, maize hybrid Cargill 900 was sown on 25th December 2008. The seed was sown @ 20 kg ha^{-1} at a spacing of 50 X 20 cm. Atrazine @ 1.25 kg a.i. ha^{-1} + paraquat @ 0.75 kg a.i. ha^{-1} were sprayed as pre emergence two days after sowing to control the already existing and upcoming grassy and broad leaved weeds.

The nitrogen, phosphorous and potassium was applied @ 120:60:40 kg ha^{-1}. Nitrogen was applied in three equal splits at sowing, knee high stage and panicle initiation stages in the form of urea. Phosphorous @ 60 kg P_2O_5 ha^{-1} through single super phosphate and potassium @ 40 kg K_2O ha^{-1} through muriate of potash were applied to all the treatments uniformly at the time of sowing by pocket application. Totally 8 irrigations were given from sowing to maturity. Need based pesticides were sprayed to control pests and diseases.

Data on crop yield, and depth of water given through parshall flume during crop growth period were recorded. Finally water use efficiency and benefit cost ratio were calculated.

RESULTS AND DISCUSSION

Results are presented in table 1 & 2. During *kharif* season the grain yields under system of rice intensification ranged from 5950 kg ha^{-1} to 8050 kg ha^{-1}. The water use ranged from 750 mm to 960 mm. The Water Use Efficiency also ranged from 6.61 kg ha mm^{-1} to 10.3 kg ha mm^{-1}. When compared to traditional system of flood irrigation, system of rice intensification registered 13.1% higher grain yield (6560 kg ha^{-1}) and 37.4% saving in water (860 mm) than the traditional system of flood irrigation (5800 kg ha^{-1} and 1375 mm) during *kharif* season. The water Use efficiency was 7.62 kg ha mm^{-1} as compared to traditional system of flood irrigation (4.21 kg ha mm^{-1}). The higher grain yield with SRI cultivation can be attributed to rotary weeding, keeping moisture condition of the field at saturation level, better aeration and optimum utilization of nutrients which helped the plant to put forth better root system and plant growth there by more number of productive tillers, more panicle length and filled grains over other systems. Abu yamah (2002), Bruno Andrianaivo (2002) and Subbarao *et al.* (2009) have also reported similar positive results with SRI cultivation over traditional farmers practice.

Water saving of 40% with moisture level at field saturation point was reported by Bhagat *et al.* (1999) when compared to continuous shallow ponding with similar yields. Whereas Subbarao *et al* (2009) reported 47% water saving in SRI than farmers practice.

In *rabi* season under zero tillage, maize grain yield levels varies from 6500 kg ha^{-1} to 8115 kg ha^{-1}. The water use varies from 250 mm to 405 mm. the water use efficiency was registered with zero tillage maize was ranged from 17.3 kg ha mm^{-1} to 28.6 kg ha mm^{-1}. The Maize grain equivalent yield was 14211 kg ha^{-1} as compared to rice grain

yield (5900 kg ha^{-1}). The results are in conformity with the findings of Jehan Bakht *et al.* (2006) and Imtiaz Ahmad *et al.* (2010) in maize crop.

System of rice intensification-zero tillage maize sequence registered Rs 131030 and Rs 94030 total system gross and net returns and 2.54 BC ratio during 2008-09. Where as in traditional system of flood irrigation, in rice-rice sequence the total system gross and net returns and BC ratio were Rs. 117000, Rs 65000 and 1.25.

From this study it can be concluded that in mid reach of canal commands, system of rice intensification – zero tillage maize is the best alternative to flood irrigation in rice for increasing gross and net returns and reducing water inputs.

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