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Research Paper

Effect of agronomic practices on the performance of aerobic rice (*Oryza sativa*) and associated weeds under Alfisols of eastern dry zone of Karnataka

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ABSTRACT

An experiment was conducted during the rainy season (*kharif*) of 2011 and 2012 at Bengaluru, Karnataka to evaluate the effect of integrated package of agro-techniques on weeds and aerobic rice (*Oryza sativa* L.). The experiment was set up in a randomized complete-block design replicated thrice, consisting of 10 treatment combinations of recommended dose of fertilizers (RDF), FYM, $FeSO_4$ and biofertilizers along with pre-emergence herbicide pyrazosulfuron ethyl at 25 g a.i./ha alone and with integrated weed-management practices. Along with this, site-specific nutrient management for targeted yield of 6.5 and 7.5 t/ha, respectively, + integrated weed management practices were also tried. Treatments receiving integrated weed management practices (pre-emergence herbicide pyrazosulfuron ethyl at 25 g a.i./ha + hand-weeding at 20 days after sowing + first intercultivation 25 days after sowing and subsequent intercultivations at 15 days interval up to panicle-initiation stage) recorded significantly lower weed population, weed dry weight and nutrient uptake by weeds than pre-emergence application of pyrazosulfuron ethyl alone. Application of RDF + FYM + biofertilizers + $FeSO_4$ + integrated weed management resulted in significantly higher grain and straw yields, water productivity and nutrient uptake (N,P,K, Zn and Fe) by crop than that with RDF + FYM + pyrazosulfuron ethyl at 25 g a.i./ha. Similar trend was also observed for net returns and benefit: cost ratio.

Key words : Aerobic rice**,** Biofertilizers, *Eleusine indica,* Micronutrients, Nutrient uptake

Traditional submerged rice having high yield potentials contributes more than 75% of total rice production by consuming 1,650 to 2,000 mm of water (Suryavanshi *et al*., 2012) indicating that the water requirement of submerged rice is very high. Because of water scarcity, it would be very difficult to cultivate submerged rice in tail end of command areas and tankfed areas. There is also decrease in groundwater level in well-irrigated areas resulting in scarcity of water and it is difficult to grow rice under submerged conditions. Research results have revealed that rice could be cultivated as semi-irrigated crop like ragi, maize or sorghum and method of cultivating rice as semi-irrigated crop known as aerobic rice through which 30–50% of water can be saved (Shekara *et al*., 2010). The saved water can be used for extending the area under irrigation.

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The major constraint to get higher yield in aerobic rice is weed infestation which causes around 80–100% reduction in grain yield (Mishra and Singh, 2007; Sunil *et al*., 2010). Weeds that grow with the crop deplete considerable amount of plant nutrients, resulting in lower crop yields. Nutrient depletion by weeds, besides other factors, depends on soil type and composition of weeds. Management of weeds in aerobic rice is a very difficult task. In submerged soils ferric compounds are converted to ferrous form and large amount of iron are brought into solution, whereas in aerobic situation due to absence of reduced zone, the available ferrous form of iron is converted to unavailable ferric form thereby making it unavailable (Kanwar, 2012). Further, limited use of organics and absence of proper recycling of crop residues also added to deficiencies under this system of rice cultivation. Thus, to achieve higher yields and also to overcome iron deficiencies, application of iron becomes most relevant.

Biofertilizers, being alternative low-cost plant-nutrient resources, have gained prime importance in recent decades and they play a vital role in maintaining long-term soil fertility sustenance. Biological nitrogen-fixing microorganisms have significantly contributed for nitrogen addition to soil while phosphate solubilizers help in solubilizing bound form of phosphorus and iron. These beneficial microorganisms are known to secrete plant growth-promoting substances for improved plant growth and crop yield (Venkateshwarlu, 2008). The site-specific nutrient management (SSNM) is a repackaging of management concepts. The SSNM avoids indiscriminate use of nutrients by preventing excessive and/or inadequate nutrient inputs and helps maintain soil health over a long period of time as well as it helps in getting higher yield and uptake of nutrients by crop (Police Patil, 2011). Since information on integration of all available technologies in aerobic rice production is lacking, the present investigation was undertaken to study the effect of integrated package of agrotechniques on water productivity, nutrient uptake by weeds and aerobic rice and its economics.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season (*kharif*) of 2011 and 2012 at Zonal Agricultural Research Station, GKVK, Bengaluru, Karnataka. The farm is located in the Eastern Dry Zone of Karnataka and is geographically situated at (12° 58' N, 77° 35' E, 930 m above the mean sea-level). The soil was red sandy loamy and pH was neutral (6.57). The soil was medium in available nitrogen (297.1 kg/ha), phosphorus (21.2 kg/ha) and potassium (137.8 kg/ha). The organic carbon content was low in range (0.45).

The experiment was conducted in a randomized block design with 3 replications. There were 10 treatments, viz. T_1, Recommended dose of fertilizers (RDF-100:50:50:20 kg NPK and $ZnSO_4$/ha) + farmyard manure (FYM) at 10 t/ha + pyrazosulfuron ethyl at 25 g a.i./ha; T_2, RDF + FYM + $FeSO_4$ at 12.5 kg/ha + pyrazosulfuron ethyl at 25 g a.i./ha; T_3, RDF + FYM + biofertilizers (soil application of *azospirillum* and phosphate-solubilizing bacteria (PSB-*Bacillus megaterium*) at 4 kg/ ha each mixed with 80 kg of farmyard manure) + pyrazosulfuron ethyl at 25 g a.i./ha; T_4, RDF + FYM + biofertilizers + $FeSO_4$ + pyrazosulfuron ethyl at 25 g a.i./ha; T_5, RDF + FYM + integrated weed management (pre-emergence herbicide pyrazosulfuron ethyl at 25 g a.i./ha + hand-weeding 20 days after sowing + first intercultivation 25 days after sowing and subsequent intercultivations at 15 days interval up to panicle initiation stage); T_6, RDF + FYM + $FeSO_4$ + integrated weed management; T_7, RDF + FYM + biofertilizers + integrated weed management; T_8, RDF + FYM + biofertilizers + $FeSO_4$ + integrated weed management; T_9, Site specific nutrient management (SSNM) for targeted yield of 6.5 t/ha + integrated weed management; T_{10}, SSNM for targeted yield of 7.5 t/ha + integrated weed management (IWM).

'MAS 26', a popular semi-dwarf, medium-duration and deep-rooted aerobic rice variety developed by using Marker Assisted Selection at the University of Agricultural Sciences, Bengaluru, was sown in July with a spacing of 30 cm × 30 cm. All the plots were irrigated with a depth of 5 cm immediately after sowing and subsequent irrigations (4 cm depth) were given at 5 days interval during vegetative growth stage followed by 3 days interval during reproductive growth stage of the crop. The FYM at 10 t/ha was applied 3 weeks prior to sowing**.** A common dose of nutrients was applied at 50 kg of N, 50 kg of P_2O_5, 50 kg of K_2O and 20 kg of $ZnSO_4$/ha as basal at sowing through urea, single superphosphate, muriate of potash and zinc sulphate respectively. Remaining 50 kg nitrogen was applied in 2 equal splits-each at 30 and 60 days after sowing through urea. Iron as $FeSO_4$ at 12.5 kg/ha, *Azospirillum* and PSB (*Bacillus megaterium*) at 4 kg each/ha mixed with 80 kg of FYM were applied as per the treatments. Site-specific nutrient management procedure outlined by Pillai and Kundu (1993) was followed to fix the fertilizers required to get the targeted yield of 6.5 t/ha (130:32:162 kg N, P and K/ha) and 7.5 t/ha (150:37:187 kg N, P and K ha/ha), respectively. Irrigation was stopped a week before harvesting of the crop.

Pre-emergence application of herbicides was done 3 days after sowing. Data on weed count (species-wise and total) and weed dry weight were recorded from 1 m^2 area. Weed-control efficiency was worked out as per Sunil *et al*. (2010). The grain and straw yields were recorded during physiological maturity. Water productivity was worked out from the yield of paddy and the amount of water used and expressed in kg/m^3. The economics was also worked out. The composite plant and weed dry-matter samples collected at harvesting were oven-dried and grounded into fine powder using Wiley mill and were analyzed for nutrient content (N, P K, Zn and Fe respectively). Nitrogen, phosphorus, potassium, zinc and iron content of the samples were estimated by microkjeldhal's method, vanadomolybdo phosphoric yellow colour method, flame photometer method and Atomic Absorption Spectrophotometer method, respectively, and subsequently the uptake per hectare was computed both in weeds, grain and straw separately.

The data were analysed statistically by analysis of variance method for randomized block design (Gomez and Gomez, 1984). Critical differences were worked out at 5% probability level. Aerobic rice in treatments receiving pre-emergence application of pyrazosulfuron ethyl alone (without integrated weed management) (T_1 to T_4) experienced severe weed competition resulting in complete death of all rice plants. Statistical analysis, therefore was done for only 6 treatments (T_5 to T_{10}) by leaving first 4 treatments (T_1 to T_4). Correlation studies were made between grain yield of aerobic rice, weed number and weed dry weight and nutrient uptake by weeds and aerobic rice. The values of correlation coefficient (r) were calculated and tested for their significance at 1% (indicated by **) as per the procedure outlined by Gomez and Gomez (1984). The response of aerobic rice to integrated package of agrotechniques was similar in both the years of study. Therefore, only pooled data of 2 years were discussed.

RESULTS AND DISCUSSION

Weed flora

The predominant weed flora observed in the experimental field in association with the aerobic rice included narrow leaf weeds, viz. *Eleusine indica* L. (31.3%), *Digitaria marginata* L. (10.2%), *Dactyloctenium aegypticum* L. (5.2%) and broad-leaf weeds like *Alternanthera sessilis* L. (19.2%), *Borreria hispida* (16.6%), *Mollugo distica* L. (4.9%), *Spilanthes acmella* (4.1%), *Celosia argentia* (2.2%), *Emilia sonchifolia* (2.6%), *Phyllanthus niruri* (2.1%) and *Euphorbia geniculata* L. (1.6%).

Weed population, weed dry weight and weed-control efficiency

Treatments receiving integrated weed management recorded the lowest weed population as compared to application of pyrazosulfuron ethyl at 25 g a.i./ha alone (Table 1). Similar trend was also observed for dry weight of weeds (Table 2). Higher weed-control efficiency was recorded with RDF + FYM + biofertilizers + $FeSO_4$ + IWM than all the other treatments. Correlation studies also revealed a significant and negative association between grain yield and total weed density (r = –0.957**) and total weed dry weight (r = –0.982**). However, the highest weed-control efficiency was recorded with integrated weed management (68.7 to 75.9%) compared to pyrazosulfuron ethyl at 25 g a.i./ha alone 2.9 to 12.7% (Table 2).

Grain yield and water productivity

No yield was harvested in the treatments (T_1 to T_4) receiving pre-emergence application of pyrazosulfuron ethyl at 25 g a.i./ha alone (without any integrated weed management). Since the aerobic rice completely failed due to significantly higher weed density and weed dry weight indicating that pre-emergence application of pyrazosulfuron ethyl alone was not able to control weeds particularly *Eleusine indica* (Heap, 2002) under Alfisols of eastern dry zone of Karnataka.

Application of RDF+ FYM + biofertilizers + $FeSO_4$ + integrated weed management being an par with RDF +

Table 1. Individual weed species count and total weed population (TWP) associated with aerobic rice as influenced by integrated package of agrotechniques (pooled data of 2 years)

Treatment	Weed species (No./m^2)											
	Narrow leaf weeds			Broad leaf weeds								TWP
	Ei	*Dm*	*Da*	*As*	*Bh*	*Md*	*Sa*	*Es*	*Pn*	*Eg*	*Ca*	
T_1	5.15 (26.11)	2.93 (8.10)	1.95(3.32)	3.54 (12.00)	3.25 (10.11)	1.70 (2.39)	1.58 (2.00)	0.91 (0.33)	1.57 (1.97)	0.71 (0.00)	0.71 (0.00)	8.17 (66.33)
T_2	5.07(25.16)	2.81 (7.37)	2.34 (4.98)	3.93 (15.02)	2.76 (7.11)	1.25 (1.07)	2.15 (4.13)	1.35 (1.33)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	8.16 (66.17)
T_3	5.50 (29.77)	2.08(3.83)	1.54 (1.86)	2.97 (8.30)	3.38 (10.9)	2.14 (4.07)	0.71 (0.00)	1.85 (2.93)	1.35 (1.33)	0.71 (0.00)	1.53 (1.84)	8.08 (64.83)
T_4	5.59 (30.81)	1.35 (1.33)	1.25(1.07)	3.38 (10.93)	3.44 (11.33)	1.47 (1.67)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	2.09 (3.86)	7.84 (61.00)
T_5	2.53 (5.93)	1.68 (2.33)	1.86 (2.97)	2.81 (7.37)	2.57 (6.10)	1.96 (3.33)	1.82 (2.80)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	5.59 (30.83)
T_6	1.88 (3.03)	1.73 (2.50)	1.78 (2.67)	2.47 (5.62)	1.89 (3.10)	1.68 (2.33)	1.81 (2.76)	1.56 (1.93)	1.82 (2.83)	1.55 (1.90)	0.71 (0.00)	5.40 (28.67)
T_7	1.79 (2.71)	2.16 (4.16)	0.71 (0.00)	2.18 (4.27)	2.48 (5.63)	1.47 (1.67)	0.71 (0.00)	0.71 (0.00)	1.36 (1.36)	2.32 (4.87)	1.47 (1.66)	5.17 (26.33)
T_8	1.56 (1.93)	2.08(3.83)	1.55 (1.90)	1.81 (2.79)	2.18 (4.27)	0.71 (0.00)	1.88 (3.05)	2.09 (3.90)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	4.69 (21.67)
T_9	2.41 (5.32)	2.17(4.25)	1.48 (1.68)	3.11 (9.20)	2.34 (4.96)	1.68 (2.33)	0.71 (0.00)	0.71 (0.00)	1.41 (1.50)	0.71 (0.00)	1.56 (1.93)	5.62 (31.17)
T_{10}	1.91 (3.13)	2.54 (5.93)	1.59 (2.03)	2.70 (6.79)	2.86 (7.66)	1.63 (2.17)	1.84 (2.92)	1.17 (0.87)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	5.65 (31.50)
SEm±												
CD (P=0.05)	0.39	0.36	0.34	0.38	0.34	0.35	0.31	0.34	0.36	0.23	0.25	0.47

Treatment details (T_1-T_{10}) are given under Materials and Methods. Original values are in parentheses; Ei, *Eleusine indica;* Dm, *Digitaria marginata;* Da, *Dactyloctenium aegyptium;* As, *Alternanthera sessilis;* Eg, *Euphorbia geniculata;* Md, *Mollugo distica;* Ca, *Celosia argentia;* Es, *Emilia sonchifolia;* Pn, *Phyllanthus niruri;* Bh, *Borreria hispida* and Sa, *Spilanthes acmella*

FYM + biofertilizers + integrated weed management gave significantly 27.1 and 18.9 to 25.7% higher grain yield than RDF+ FYM + integrated weed management and SSNM + integrated weed management respectively. Similar trend was also observed for straw yield. Water productivity was significantly higher with RDF +FYM + biofertilizers + $FeSO_4$ at 12.5 kg/ha + integrated weed management than RDF + FYM + integrated weed management and SSNM + integrated weed management and was on a par with RDF + FYM + biofertilizers + integrated weed management (Table 2). Significantly higher grain yield of aerobic rice with RDF + FYM + biofertilizers + $FeSO_4$ at 12.5 kg/ha + integrated weed management over RDF + FYM + integrated weed management and SSNM + integrated weed management was attributed to better control of weeds throughout the crop-growth period and also significant increase in growth and yield attributes (Jayadeva *et al*., 2011). The significant increase in grain yield has led to increase in water productivity of aerobic rice (Shashidhar, 2010) under RDF + FYM + biofertilizers + $FeSO_4$ at 12.5 kg/ha + integrated weed management (Table 2).

Economics

Application of RDF + FYM + biofertilizers + $FeSO_4$ + IWM had the highest cost of cultivation followed by RDF + FYM + biofertilizers + IWM. It was mainly due to high labour and input cost like cost of $ZnSO_4$, $FeSO_4$, FYM, *Azospirillum* and PSB. The maximum net returns and higher benefit: cost ratios were also achieved with RDF + FYM + biofertilizers + $FeSO_4$ + IWM followed by RDF + FYM + biofertilizers + IWM contributing higher grain and straw yields (Table 2).

Nutrient uptake by weeds and aerobic rice

Treatments receiving pre-emergence application of pyrazosulfuron ethyl at 25 g a.i./ha alone resulted in significantly higher nitrogen, phosphorus, potassium, zinc and iron uptake by weeds than integrated weed management (Table 3). Dry tillage practices, direct seeding practices, alternating wetting and dry cycles and wide spacing make the conditions conducive for germination and growth of competitive weeds under aerobic rice system. In turn the treatments receiving pre-emergence application of pyrazosulfuron ethyl at 25 g a.i./ha alone failed to control weeds particularly *Eleusine indica* (Heap, 2002) under Alfisols of eastern dry zone of Karnataka under aerobic conditions. Correlation studies also revealed a significant and negative association between grain yield and N uptake (r= –0.990**), P uptake (r= –0.997**), K uptake (r= –0.992**), zinc uptake (r= –0.994**) and iron uptake (r=0.998**) by weeds. Increase in nutrient uptake by increase in weed competition was also reported by Sunil *et al*. (2011) and Revathi *et al.* (2012).

Application of RDF + FYM + biofertilizers + $FeSO_4$ + IWM resulted in significantly higher N, P, K, Zn and Fe

Table 2. Weed dry weight, weed control efficiency (WCE), grain yield, straw yield, water productivity and economics of aerobic rice as influenced by integrated package of agrotechniques (pooled data of 2 years)

Treatment	Weed dry weight (g/m^2)	WCE (%)	Grain yield (t/ha)	Straw yield (t/ha)	Water productivity (kg/m^3)	Net returns (₹/ha)	Benefit: cost ratio
T_1, RDF + FYM + pyrazosulfuron ethyl at 25 g a.i./ha	5.37 (28.43)	-	0	0	-	-	-
T_2, RDF + FYM + $FeSO_4$ + pyrazosulfuron ethyl at 25 g a.i./ha	5.22 (26.81)	5.7	0	0	-	-	-
T_3, RDF+ FYM + biofertilizers + pyrazosulfuron ethyl at 25 g a.i./ha	5.30 (27.60)	2.9	0	0	-	-	-
T_4, RDF + FYM + biofertilizers + $FeSO_4$+ pyrazosulfuron ethyl at 25g a.i./ha	5.03 (24.83)	12.7	0	0	-	-	-
T_5, RDF+ FYM + IWM	3.02 (8.63)	69.6	3.05	4.26	0.292	37178	2.76
T_6, RDF + FYM + $FeSO_4$ + IWM	2.92 (8.07)	71.6	3.21	4.42	0.308	39628	2.83
T_7, RDF + FYM + biofertilizers + IWM	2.70 (6.84)	75.9	3.48	4.69	0.334	44407	3.04
T_8, RDF + FYM + biofertilizers + $FeSO_4$ + IWM	2.40 (5.29)	81.4	3.88	5.05	0.366	51278	3.30
T_9, Site specific nutrient management for targeted yield of 6.5 t/ha + IWM	3.05 (8.86)	68.8	3.26	4.41	0.308	41528	3.01
T_{10}, Site specific nutrient management for targeted yield of 7.5 t/ha + IWM	3.06 (8.89)	68.7	3.09	4.25	0.290	37599	2.77
SEm±							
C D (P=0.05)	0.31	-	0.423	0.39	0.030	NA	NA

NA, Not analysed; Total water used (Effective rainfall + irrigation water) = 10,811/m^3

uptake by grain and straw. However, it was on a par with RDF + FYM + biofertilizers + IWM as compared to RDF + FYM + IWM and SSNM + IWM (Table 4). Significant increase in total N, P, K, Zn and Fe uptake with application of RDF + FYM + biofertilizers + $FeSO_4$ at 12.5 kg/ha + IWM was due to higher grain and straw yield. Correlation studies also revealed a significant and positive association between grain yield and total crop N uptake (r=0.950**), total P uptake (r=0.968**), total K uptake (r=0.978**), total zinc uptake (r=0.952**) and total iron uptake (r=0.818**). Loosening of soil through repeated intercultivations and hand-weeding might have encouraged better root aeration (Shashidhar, 2010). The combined application of Zn and Fe and biofertilizers (*Azospirillum* and *Bacillus megaterium*) may have enhanced the N fixation, phytohormone production, synthesis of phytosedirosphores, increased Zn absorption in plants and also enhanced the phosphate and iron solubilization by the production of organic acids resulting in better development and proliferation of roots and thereby uptake of nutrients by rice (Mohammad *et al*., 2011; Davis and Bayer, 1971).

In aerobic rice weeds are the major hurdle in getting good yield. Therefore under this system of rice cultivation instead of application of pyrazosulfuron ethyl at 25 g a.i./ha alone following integrated weed management practices effectively reduced the weeds dry weight and uptake of nutrients by them. Along with this, application of RDF + FYM + biofertilizers + $FeSO_4$ + IWM resulted significantly higher water productivity and nutrient uptake by

Table 3. Nutrient uptake by weeds as influenced by integrated package of agro-techniques (pooled data of 2 years)

Treatment		Nutrient uptake				
		N (kg/ha)	P (kg/ha)	K (kg/ha)	Zn (g/ha)	Fe (g/ha)
T_1,	RDF + FYM + pyrazosulfuron ethyl at 25 g a.i./ha	21.80	4.03	29.10	155.9	1326.4
T_2,	RDF + FYM + $FeSO_4$ + pyrazosulfuron ethyl at 25 g a.i./ha	20.71	4.28	29.71	156.9	1350.9
T_3,	RDF + FYM + biofertilizers + pyrazosulfuron ethyl at 25 g a.i./ha	21.47	4.25	34.52	158.8	1379.6
T_4,	RDF + FYM + biofertilizers + $FeSO_4$ + pyrazosulfuron ethyl at 25 g a.i./ha	20.31	3.86	30.92	144.3	1325.9
T_5,	RDF + FYM + integrated weed management	5.63	1.36	6.63	17.1	399.1
T_6,	RDF + FYM + $FeSO_4$ + integrated weed management	5.20	1.25	6.32	16.3	408.1
T_7,	RDF + FYM + biofertilizers + integrated weed management	4.31	1.06	4.58	9.7	302.3
T_8,	RDF + FYM + biofertilizers + $FeSO_4$ + integrated weed Management	3.19	0.77	3.69	7.1	257.3
T_9,	Site-specific nutrient management for targeted yield of 6.5 t/ha + Integrated weed management	5.82	1.29	6.40	16.2	400.4
T_{10},	Site-specific nutrient management for targeted yield of 7.5 t/ha + integrated weed management	6.01	1.44	6.77	17.2	430.5
	SEm±					
	CD (P=0.05)	1.37	0.33	1.83	6.1	76.6

Table 4. Nutrient uptake by aerobic rice as influenced by integrated package of agrotechniques (pooled data of 2 years)

Treatment		N (kg/ha)		P (kg/ha)		K (kg/ha)		Zn (g/ha)		Fe (g/ha)	
		Grain	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*
T_5,	RDF+ FYM + integrated weed management	29.86	26.87	5.45	5.02	10.63	71.13	110.3	252.8	1,013	3,110
T_6,	RDF + FYM + $FeSO_4$ + integrated weed management	33.17	28.33	5.86	5.33	12.58	74.10	123.3	257.1	1,167	3,409
T_7,	RDF + FYM + biofertilizers + integrated weed management	37.68	34.32	7.43	6.41	13.62	82.90	148.7	298.7	1,234	3,539
T_8,	RDF + FYM + biofertilizers + $FeSO_4$ + integrated weed management	40.91	35.80	7.98	6.94	14.93	87.36	158.1	317.5	1,280	3,748
T_9,	Site specific nutrient management for targeted yield of 6.5 t/ha + integrated weed management	33.09	30.32	5.92	5.42	12.08	74.94	106.0	218.3	991	2,911
T_{10},	Site specific nutrient management for targeted yield of 7.5 t/ha + integrated weed management	32.48	30.05	5.46	5.02	12.05	72.19	103.3	211.0	954	2,844
	SEm±										
	CD (P=0.05)	4.15	3.20	0.78	0.69	1.44	6.97	11.9	27.3	107.4	313.4

rice crop. Similar trend was also observed with net returns and B:C ratio.

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