

RESIDUAL EFFECT OF TILLAGE AND NUTRIENT MANAGEMENT ON GROWTH YIELD AND ECONOMICS OF RICE (*ORYZA SATIVA*) UNDER OAT-RICE CROPPING SYSTEM

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Abstract: A field experiment was conducted at forage research field of Birsa Agricultural University, Ranchi (Jharkhand) to study the residual effect of tillage and nutrient management on rice during 2011 and 2012 under oat-rice cropping system. Rice sown after oat influenced significantly due to residual effect of tillage and nutrient management applied in oat. Rice under residual effect of zero tillage recorded on growth, viz. tillers/m² at 60 DAT (233), LAI at 60 DAT (4.54), dry matter production (153.3, 488.8, 641.5 and 758.8 g/m² at 30, 60, 90 and at 120 DAT respectively), straw yield (57.14 q/ha) and gross return (Rs.36, 447 / ha), net return(Rs. 9,349/ ha) and B:C ratio (0.34) were significantly more than conventional as well as minimal tillage. Among the nutrient management residual effect of 125 % RDF recorded significantly higher with regards to growth, yield attributes & yield and economics of rice. The treatments 100 % RDF was at par with 75% RDF + Bio-fertilizer. No residual effect of interaction of treatments was observed on rice.

Keywords: Tillage, Nutrient management, Residual effect, RDF, Bio-fertilizer.

Introduction

Rice during *Kharif* and fodder oat in *Rabi* are important crops to fetch the demand of human as well as animal. As rice is suited with climatic condition of Jharkhand and fodder oat having capacity to tolerate moisture stress as well as acidity of soil. Monsoon in Jharkhand is erratic and rice usually harvested late. Land preparation during *Rabi* is very tedious and energy feeder. Availability of moisture and its efficient utilization is directly related with tillage operation which is difficult to provide in *Rabi* crops after harvest of transplanted rice. Besides it, oat is highly responsive to nitrogen and it has positive response with forage yield while, high dose of nitrogen in rice may leached out and uneconomical. Further, high dose of nitrogen also caused hazards to soil. Thus, suitable / optimum tillage practice and nutrient management in oat is important considerations to harvest maximum herbage yield. Bio-fertilizer (PSB + *Azotobactor*) inoculation in oat can solve the problem of availability of phosphorus and nitrogen and also improves the organic content & physical, chemical and

biological character of soil. Nutrient applied through different sources in oat may not utilize completely and its effect prolonged up to next few seasons. Rice after oat also require high nutrient which can be compensated with the residual nutrient applied during *Rabi*. Thus, looking after the importance of transplanted rice and nutrient during *Kharif*, an experiment was formulated to study the residual effect of tillage and nutrient management on rice cultivation under oat- rice cropping system.

MATERIALS AND METHODS

A field investigation was carried out during *Kharif* 2011 and 2012 at the forage research field situated at Ranchi Veterinary College, Kanke campus under Birsa Agricultural University, Ranchi. The soil of field was sandy loam in texture having sand (56.8%), silt (28.0 %), clay (15.2 %) and water holding capacity (38.68 %) with pH (6.2), Organic carbon (3.8 g/kg) with available nitrogen (232 Kg/ha), available phosphorus (23.25 kg/ha) and available potassium (156.41 kg /ha. The experiment were formulated in Split plot design with three tillage management viz. Zero tillage, Minimal tillage and Conventional tillage assigned in main plot and four nutrient management i.e. 125 % RDF, 100 % RDF, 75 % RDF and 75% RDF+ Bio-fertilizer (PSB+ *Azotobacter*) in sub plot treatment with three replications which were applied in oat . The fodder oat CV : Kent was sown in the second week of November, keeping row to row distance 25 cm with recommended seed rate 100 kg/ha in 5m X4m plot area under medium land condition. Fertilizers were applied at the time of sowing through urea, DAP, and MOP as basal application. Bio-fertilizer was applied as seed treatment in the form of PSB @ 500g/ha and *Azotobacter* @ 500 g/ha and further, top dressing were carried through urea. Rice was transplanted during *Kharif* after harvest of oat in the same lay outed field at same levels of tillage/agronomical practices and uniform fertilizer dose @100:50:25(N: P₂O₅:K₂O kg/ha). Rice was grown at normal agronomical practice to study the residual effect of treatments (applied in oat) on rice.

RESULT AND DISCUSSION

Tillage management

Tillers/m² at 60 DAT, Leaf area index (LAI) at 60 DAT, plant height at maturity and dry matter production at 30 days interval (i.e. 30, 60, 90, and at 120 DAT) in *Kharif rice* under zero tillage were significantly higher over minimal and conventional tillage and aforesaid all the parameters under minimal tillage were also significantly superior over conventional tillage, but dry matter production at 30 DAT and 60 DAT, under minimal tillage were at par to conventional tillage. Effective tillers/m² (230) and straw yield (57.14 q/ha) under zero

tillage were significantly superior over minimal tillage (223.9 and 52.74 q/ha) and conventional tillage (227 and 53.88 q/ha) respectively while both the parameters (effective tillers/m² and straw yield) under minimal and conventional tillage were at par to each other, while 1000-grain weight (23.08 g) and harvest index (37.38) under minimal tillage were more over conventional tillage (21.76 g and 36.21) respectively and 1000-grain weight under minimal tillage and zero tillage were at par to each other (Table: 2). The gross return (Rs 36,447/ha), net return (Rs9,349/ha) and B:C ratio (0.34) under zero tillage were significantly higher as compared to minimal tillage (Rs. 32,613 /ha, Rs 5,515 /ha and 0.20) and conventional tillage (Rs.32,051 /ha, Rs 4,953 /ha and 0.18). Similarly minimal tillage was significantly superior to conventional tillage with respect to net return and B: C ratio. This is due to more improvement in soil health and availability of residual nutrients under zero tillage. As C and N both are the constituents of the molecules of protein and vitally associated with the activity of every living cell. Thus, under high nitrogen availability, there was vigorous growth of aerial organs due to high rate of synthesis of protoplasmic protein. This constituent increases cell sizes and finally the vertical growth of plant. Similarly, better growth leads to improvement in yield attributes and yield which finally converted to economics.

Nutrient management

Residual effect of nutrient management were significant up to 125 % RDF and 100 % RDF were at par with 75% RDF + Bio-fertilizer; besides it, dry matter production at 90 DAT and 120 DAT under 100% RDF (615.1 and 728.9 g)were significantly superior over 75 % RDF + Bio-fertilizer (557.4 and 697.5 g) respectively (Table:1). This results indicating a professed influence of organic matter decomposition along with application of Bio- fertilizer on yield attributes of rice, These results are also closed confirmatory with the findings of Singh and Rai (2014) and Rayees and Kumar (2014) Effective tillers/m² (240), panicle length (25.7cm), grains/panicle (53.9), 1000-grain weight (23.05 g), grain yields (34.46 q/ha) and straw yield (60.7 q/ha) at 125 % RDF were significantly superior over rest of the nutrient management while harvest index (37.25) at 75% RDF + Bio- fertilizer were at par with 100 % RDF and superior over 125 % RDF. Gross return, net return and B: C ratio were recorded maximum with 125 % RDF (Rs. 39,102/ha Rs.12,004/ha and 0.44) followed by 100 % RDF (Rs.32,776/ha and Rs.5,678/ha 0.21) which was at par with 75 % RDF + Bio-fertilizer (Table3). Rice productivity increased by 12.29 % on application of 75 % RDF +Bio-fertilizer over 75 % RDF. This might be due to better availability of nutrients due to inoculation of bio-

fertilizer. These results are in confirmatory with the finding of Gaur (2006). Further, improvement in yield under 75 % RDF + Bio-fertilizer might be because of sufficient release of N by mineralization at a desired rate, which resulted in better growth and improvement in yield components of rice Babu *et al*(2002); Chhetri *et al.*(2002).

Interaction:

Interactions of treatments have no significant residual effect on growth, yield attributes and yield of rice.

Table 1: Residual effects of tillage and nutrient management on growth parameter of *Kharif* rice under oat - rice cropping system (pooled data 2011 and 2012).

Treatments	Tillers/m ² (60 DAT)	LAI at (60 DAT)	Plant ht (cm) at maturit	Dry matter production (g/m ²)			
				30	60	90	120
Tillage Management(T)							
Zero tillage	233.0	4.54	96.3	153.57	488.8	641.5	758.8
Minimal tillage	228.5	4.33	94.6	137.9	413.4	591.7	728.1
Conventional tillage	222.8	4.29	93.7	128.2	419.8	549.3	671.5
S.Em ±	0.89	0.022	0.20	1.15	4.41	2.32	4.42
CD at 5%	3.47	0.085	0.78	4.50	17.25	9.06	17.28
Nutrient Management (N)							
125% RDF	240.0	4.67	97.1	152.9	509.6	696.9	821.7
100% RDF	229.5	4.43	94.3	143.5	448.8	615.1	728.9
75% RDF	219.0	4.05	92.8	131.1	371.1	507.3	629.9
75% RDF+Bio-fertilizer	224.7	4.40	95.3	145.4	433.0	557.4	697.5
S.Em ±	2.45	0.05	1.30	1.59	5.05	7.34	8.47
CD at 5%	7.29	0.16	3.88	4.73	15.05	21.83	25.17
CV %	9.47	11.25	13.25	9.75	9.45	10.24	9.87
Interaction(TXN)	NS	NS	NS	NS	NS	NS	NS

NB: Uniform fertilizer dose@100:50:25 kg/ha (NPK) were applied in rice.

Table 2: Residual effect of tillage and nutrient management on yield and its attributes of *Kharif* rice under oat – rice system (Pooled data 2011 and 2012).

Treatments	Effectiv e tillers /m ² at 60DAT	Panicle length (cm)	Grain/ panicle	1000 – grain wt (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
Tillage Management (T)							
Zero tillage	230	25.1	52.5	22.95	32.87	57.14	36.51
Minimal tillage	224	24.4	47.5	23.08	31.35	52.74	37.38
Conventional tillage	227	22.7	47.0	21.76	30.64	53.88	36.21
S.Em ±	0.89	1.25	1.2	0.36	0.90	0.84	0.61
CD at 5%	3.46	NS	NS	NS	NS	3.27	NS
Nutrient Management (N)							
125% RDF	240	25.7	53.9	23.09	34.46	60.70	36.21

100% RDF	224	23.5	48.7	22.43	32.36	54.91	37.08
75% RDF	219	21.8	44.9	22.34	28.54	48.76	36.92
75% RDF+Bio-fertilizer	225	25.3	48.5	22.53	32.05	53.98	37.25
S.Em ±	2.80	0.24	0.56	0.29	0.42	0.76	0.97
CD at 5%	8.34	0.73	1.66	NS	1.27	2.26	NS
CV %	11.25	8.87	9.87	12.35	14.35	12.47	7.89
Interaction(TXN)	NS	NS	NS	NS	NS	NS	NS

NB: Uniform fertilizer dose@100:50:25 kg/ha (NPK) were applied in rice.

Table 3: Residual effect of tillage and nutrient management on yield and its attributes of *Kharif* rice under oat – rice system (Pooled data 2011 and 2012).

Treatments	Gross return (Rs./ha)	Net return (Rs /ha.)	B:C ratio
Tillage Management (T)			
Zero tillage	36447	9349	0.34
Minimal tillage	32613	5515	0.20
Conventional tillage	32051	4953	0.18
S.Em ±	348	348	0.012
CD at 5%	1359	1359	0.046
Nutrient Management (N)			
125% RDF	39102	12004	0.44
100% RDF	32776	5678	0.21
75% RDF	29386	2288	0.08
75% RDF+Bio-fertilizer	33549	6451	0.23
S.Em ±	342	342	0.00510
CD at 5%	1018	1018	0.012
CV %	12.35	13.25	12.75
Interaction(TXN)	NS	NS	NS

NB: Uniform fertilizer dose @100:50:25 kg/ha (NPK) were applied in rice.

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