JOURNAL OF PURE AND APPLIED MICROBIOLOGY, June 2017. Vol. **11**(2), p. 987-991

Growth Efficiency, Productivity and Economics of Direct Seeded Rice as Influenced by Nitrogen Level and Weed Management

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http://dx.doi.org/10.22207/JPAM.11.2.41

(Received: 10 March 2017; accepted: 04 May 2017)

Field experiment conducted at College of Agriculture, Rewa, Madhya Pradesh revealed that plant height, number of tillers/m², leaf area index (LAI), dry matter accumulation (DMA) in plants, Crop growth rate (CGR) and net assimilatory rate (NAR) were higher in plots getting hand weeding twice and with application of 125 kg N/ ha (N_3) as compared to lower levels of nitrogen application and other weed management practices, whereas, application of butachlor + dhaincha (1:1) + 1hand weeding had comparatively surpassed other weed management practices. Similarly, yield attributes were significantly higher in hand weeding twice with application of butachlor + dhaincha (1:1) + 1 hand weeding . Highest (1.77) net B:C ratio was captured with application of butachlor + dhaincha (1:1) + 1hand weeding and lowest (0.87) under weedy check.

Keywords: Direct seeded rice, Economics, Nitrogen level, Weed management.

Direct seeded rice (DSR) is becoming popular as it is cheap alternative to transplanting. Weeds have been persistent problem in rice since the beginning of settled agriculture. For Asia as a whole, weed causes an estimated 10-15 % reduction in rice yield equivalent to about 50 mt of rice annually. Also, reduction in grain yield to the tune of 20-95% is visualized as a result of sever crop-weed competition (Gogoi 1998). Direct seeded rice needs only 34% of the total labour requirement and saves 29% of the total cost of the transplanted crop (Ho and Romill 2000). Direct seeded rice also allows early establishment of the succeeding wheat crop, reduces methane emissions and ensures higher profit in areas with assured water supply (Balasubramanian and Hill 2000). Manual weeding is expensive, laborious and time consuming as well as difficult in early stage of crop growth. To make paddy cultivation cost effective, DSR provides an option which saves labour and water. Use of pre emergence herbicides has been found effective in early stage only but the second flush of weeds at 25-30 days after sowing (DAS) become problematic. Hence integrated weed management is one of the effective alternatives. Moderate nitrogen rates increase the crop yield independent of weed density but higher doses increase the risk of yield loss due to increased weed (Geetadevi *et al* 2000) Therefore the present study was undertaken to find out an effective method of weed management at varied nitrogen levels in direct seeded rice.

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MATERIALS AND METHODS

The experiment was conducted at Research Farm, College of Agriculture, Rewa (M.P.) during *kharif* season of 2009 & 2010. Rewa is situated in North – Eastern part of Madhya Pradesh at latitude 24° 312 N and longitude 81° 152 E and at an altitude of 365.7 meter above the

mean sea level. The region falls under sub tropical climate having extreme winter and summer season. More or less the weather conditions throughout the crop season during both the seasons were quite favourable for growth and development of rice crop. The soil of experimental site was mixed red and black with clay loam texture having 7.7 pH. It was low in available nitrogen (252 kg/ ha), medium in available phosphorus (15.6 kg/ ha) and high in available potassium (340 kg/ha). The organic carbon of the soil was 0.70 percent. The experiment was laid out in split plot design with treatments comprising three nitrogen levels *viz*. 75 kg N/ha (N_1), 100 kg N/ha (N_2) and 125 kg N/ha (N_3) as main plot treatments and five weed management practices *viz.* butachlor + dhaincha +1 HW , butachlor + 2 mechanical weeding , butachlor + cowpea + 1 HW , 2 HW and weedy check as sub plot treatments. The experimental field was thoroughly prepared for sowing of the seeds by one ploughing followed by harrowing and then leveling by planker. After that experiment was laid out as per lay out plan and sowing was done according to the treatments. A uniform dose of 50 Kg P_2O_5 + 40 Kg K_2O/ha was applied in all plots through single super phosphate (SSP) and muriate of potash (MOP) respectively. Nitrogen was applied through urea in 3 split doses *i.e*. 50% at basal, 25% at tillering and 25% at panicle initiation stage. Seed of variety '*JR-201'* was sown in lines 20 cm apart. Before sowing, seed was soaked in water for 10 hours followed by incubation for 12 hours. Sowing of cowpea and dhaincha was done as intercrop in 1:1 ratio (one line of rice followed by one line of cowpea/dhaincha) manually. Weed management practices were followed according to the lay out plan of the experiment. Butachlor at 1.25 kg /ha was applied 3 days after sowing. Cowpea/dhaincha was incorporated 30 days after sowing. Mechanical weeding was done by paddy weeder. Five plants were randomly selected and tagged in each plot for recording the observations of the characters under study for comparing the effects of nitrogen levels and weed management practices.Weed density was recorded by placing the quadrats randomly three times in each plot and all the weeds under quadrats were counted and then average values were worked out for 25 and 55 DAS. Dry weight of weeds was recorded from collected weeds from the randomly selected area after drying in oven. The cost of cultivation incurred in each treatment was worked out by considering the prevailing market rates of input used. he significance of various treatments was judged as suggested by applying "F" test. Crop growth rate (CGR) and Net assimilation rate (NAR) was calculated using below given formulae as suggested by Watson (1952) and Gregory (1926), respectively.

RESULTS AND DISCUSSION

Effect on weeds

Both the weed population and weed biomass were higher under 125 kg N/ha application, at both the stages of crop growth. However, weed control efficiency was not significantly affected due to different levels of nitrogen application. Weed population, weed biomass and weed control efficiency were better in plots maintained weed free by hand weeding twice followed by application of butachlor + dhaincha (1:1) + 1hand weeding Pandey et al 2008.

Effect on crop growth

Crop growth is mixed response of increase in plant height, number of tillers/m^2, leaf area index (LAI) and dry matter accumulation (DMA) in plants. The growth of crop was significantly higher with application of 125 kg N/ ha (N_3) as compared to lower levels of nitrogen application. Crop growth rate (CGR) and net assimilatory rate (NAR) was also higher with same level of nitrogen application (Table 1). The variation in growth parameters was more pronounced under the different weed management practices. Application of butachlor + dhaincha (1:1) + 1 hand weeding produced comparatively taller plants than the other treatments, the same treatment accounted for higher number of tillers/m row length and dry matter accumulation in plants except the treatment where weed free conditions was maintained by hand weeding twice. Both CGR and NAR were significantly more under weed free environment maintained by hand weeding twice. The treatment 2 hand weeding and butachlor + dhaincha +1 HW were next in this regard. CGR and NAR in these two treatments were observed to be higher than rest of the treatments (Table 1). When the plots were kept weed free with hand weeding, it resulted in better aeration and plant growth leading to better expression of growth characters.

Effect on yield attributes and yield

Among the yield attributing characters, number of panicles/m^2 was significantly higher (301.0) with hand weeding twice. Whereas, different nitrogen levels failed to have any significant effect on number of panicles/ m^2. Test weight was not affected significantly either due to nitrogen levels or weed management practices. For all the other yield attributes and yield *viz*. weight of panicle, grain and straw yield, application of 125 kg N/ha had a significant effect over rest of the treatments. Among the weed management practices, maximum grain yield (2.76 t/ha) was recorded with application of butachlor + dhaincha (1:1) + 1hand weeding followed by Butachlor + cowpea (1:1) + 1 HW 2.51 and weed free

Table 1. Effect of nitrogen levels and weed management on growth attributes of rice (mean data of two years)

Treatment	Plant height (cm)	No. of tillers/m^2	Dry matter accumulation (g)	CGR (g/m2/day) 60-90 DAS	NAR (g/m2/day) 60-90 DAS	LAI at 90 DAS
Nitrogen level						
75 kg N/ha	80.8	257.8	101.2	1.08	0.32	3.6
100 kg N/ha	837	264.3	104.9	1.12	0.40	3.8
125 kg N/ha	85.9	267.0	110.8	1.20	0.42	4.0
LDS (P= 0.05 %)	0.64	2.32	10.2	0.10	0.09	0.28
Weed management						
Butachlor + dhaincha (1:1) + 1 HW	85.8	278.9	109.5	1.40	0.41	3.9
Butachlor + 2 mechanical weedings	84.1	275.0	102.3	1.10	0.39	3.3
Butachlor + cowpea (1:1) + 1 HW	84.9	275.9	105.1	1.20	0.40	3.5
Hand weeding twice	86.8	283.3	126.0	1.60	0.42	4.1
Weedy check	72.3	207.9	60.0	0.70	0.20	2.8
LDS (P= 0.05 %)	0.99	2.96	14.6	0.10	0.10	0.30

Table 2. Effect of nitrogen levels and weed management on yield components, yield and economics of rice (mean data of two years)

Treatment	No. of panicles /m^2	Weight of panicle (g)	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	B:C
Nitrogen level								
75 kg N/ha	269.3	1.20	20.00	2.08	3.62	15050	22094	1.45
100 kg N/ha	267.9	1.34	21.20	2.56	3.83	15324	23106	1.49
125 kg N/ha	275.3	1.45	22.10	2.31	4.49	15603	24773	1.55
LDS (P= 0.05 %)	NS	0.02	NS	0.06	0.02			
Weed management								
Butachlor + dhaincha (1:1) + 1 HW	310.6	1.94	21.40	2.74	4.74	16543	29280	1.77
Butachlor + 2 mechanical weedings	221.0	1.06	20.70	2.28	3.87	14731	25257	1.64
Butachlor + cowpea (1:1) + 1 HW	303.8	1.76	21.10	2.55	4.27	16843	26852	1.59
Hand weeding twice	301.0	1.13	20.90	2.32	3.90	15333	24798	1.62
weedy check	113.1	0.81	20.50	1.30	2.83	13175	11434	0.87
LDS (P= 0.05 %)	21.88	0.06	NS	0.07	0.09	-	-	

Table 3. Effect of nitrogen levels and weed management on weed density, weed biomass and weed control efficiency in rice (mean data of two years)

Treatment	Weed density/m^2		Weed biomass (g/m2)		Weed control efficiency (%)	
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS
Nitrogen level						
75 kg N/ha	45.4	63.1	19.56	45.39	37.94	81.07
100 kg N/ha	44.9	68.5	20.30	47.57	38.94	81.34
125 kg N/ha	79.4	72.0	21.08	49.81	39.68	80.74
LDS (P= 0.05 %)	0.96	1.86	1.54	2.33	NS	NS
Weed management						
Butachlor + dhaincha (1:1) + 1 HW	25.5	37.9	13.02	19.21	52.80	85.39
Butachlor + 2 mechenical weedings	45.9	43.3	22.27	27.32	22.83	79.38
Butachlor + cowpea (1:1) + 1 HW	40.9	49.3	19.24	31.85	35.15	76.34
Hand weeding twice	33.2	40.8	16.41	22.11	43.31	83.09
Weedy check	87.4	167.9	29.17	34.80	0.00	0.00
LDS (P= 0.05 %)	1.48	1.86	2.87	4.94	1.81	1.01

conditions maintained by hand weeding twice. In respect of straw yield similar trend was observed. Hand weeding twice surpassed all the other treatments followed by application of butachlor + dhaincha (1:1) + 1hand weeding. The lowest grain and straw yields were recorded under the control plots (Table 2) similar results were found Parihar, S.S.2004 ,Singh and Tripathi 2007, and Singh et al 2005.

Economics

The economic yields are the outcome of yield and yield attributes which increases yield and vice-versa increase the economic output. Gross Monetary Return under different treatments varied from Rs. 29280 to 11434 /ha. B:C ratio was captured highest (1.55) with application of 125 kg N/ha and lowest (1.45) with application of 75 kg N/ha. The higher returns with higher dose of nitrogen application were mainly due to higher grain yield . The results were in line with those obtained by Mahajan *et al*. 2010. Highest (1.77) net B:C ratio was captured with application of butachlor + dhaincha (1:1) + 1hand weeding and the lowest (0.87) under weedy check (Table 2)

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