Environment and Ecology 40 (3) : 1098—1102, July—September 2022
ISSN 0970-0420

Influence of Mulching, Nitrogen Levels and Weed Management Practices on Various Growth Factors and Yield of Direct Seeded Rice in Eastern Uttar Pradesh

Gargi Goswami, Yashwant Singh, Munigela Raghuveer, Avinash Chandra Maurya

Received 14 March 2022, Accepted 19 April 2022, Published on 5 July2022

ABSTRACT

In the year 2014 and 2015 a field experiment was carried out at experimental field of Banaras Hindu University, Varanasi, Uttar Pradesh to study the influence of mulching, nitrogen levels and weed management practices on plant height, number of tillers, leaf area index and yield of direct seeded rice. Twenty-four treatment combinations consisting of two mulching viz.. no mulch and live mulching (brown manuring with *Sesbania*) and nitrogen levels (120 kg ha^{-1}, 150 kg ha^{-1} and 180 kg ha^{-1}) in main plot and four weed management practices viz., weedy check, two hand weeding at 20 and 40 DAS, azimsulfuron @ 30 g ha^{-1} + bispyribac-sodium @ 25 g ha^{-1} at 10-15 DAS and pendimethalin @ 1 kg ha^{-1} at 1-3 DAS *fb* bispyribac-sodium @ 25 g ha^{-1} 15-20 DAS were applied to sub plots. It was observed that various growth factors and yield of DSR recorded significantly superior result with live mulching of *Sesbania* under 150 kg nitrogen level and application of a pre emergence herbicide followed by a post emergence herbicide.

Keywords Direct seeded rice, Plant height, Tillers, Leaf area index, yield.

INTRODUCTION

Rice (*Oryza sativa*) is an important staple food of more than half of the population of the world which targets to provide food security and livelihoods for millions. In Asia, it is the main item of the diet of 3.5 million people. Therefore, increase in population will require 70% more rice in 2025 than is consumed today (Kim and Krishnan 2002). Uttar Pradesh is the largest rice growing state after West Bengal in India. However, to sustain the present food self sufficiency and to meet future food requirements, there is need to increase rice productivity. Direct seeded rice (DSR) is becoming popular nowadays because of its low-input demanding nature. It offers a very exciting opportunity to improve water and environmental sustainability.

Under the scenario of labor and water scarcity DSR is considered as a potential alternative to

Gargi Goswami*
Assistant Professor, Department of NRM, College of Horticulture, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand 246123, India

Yashwant Singh
Professor of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221 005, India

Munigela Raghuveer
[3]Assistant Professor, Department of Agronomy, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana 500036, India

Avinash Chandra Maurya
Lecturer, Veer Smarak Inter College, Barut, Bhagpat, Uttar Pradesh 250611, India
Email : gargi.goswami1423@gmail.com
*Corresponding author

transplanted rice. Despite its benefits, however, the economic benefit from DSR is not realized many times by the farmers due to severe competition and infestation from weeds. Risk of higher weed infestation and resulting higher yield losses is one of the major constraints in the wider-scale adoption of DSR. Weed competition reduces the grain yield by 50-60% in direct seeded rice. The use of only one method of weed control in a DSR crop may not be successful for raising a good crop. Manual weeding has become difficult because of labor scarcity and increased cost (Rao *et al*. 2007) and sole dependence on herbicidal control is not good considering the environmental aspect and also chances of weed resistance towards herbicides cannot be neglected. Therefore crop management technologies that help to reduce the competitive effects of weeds on crops, environmental friendly and economical are needed. Mulching is a technique to reduce weed problems in direct seeded rice. It also helps in maintaining optimum surface soil moisture for germination and rooting of the crop along with controlling weeds. Brown manuring of *Sesbania* can be done in DSR which is simply a no-till version of green manuring, in which selective herbicide 2, 4 –D @ 400-500 g/ha is applied to knockdown and desiccate the *Sesbania* nearly at blooming (30- 40 days) stage. Integration of suitable herbicides (pre and post-emergence) (Singh 2009) or/and *Sesbania* co-culture (Maity and Mukherjee 2011) can help in effective reduction of crop-weed competition by reducing weed population and their biomass in direct seeded rice and improved growth parameters which ultimately results in higher yield. Manipulation of crop fertilization is a promising approach to reduce weed infestation and may contribute to long-term weed management. Fertilizer management should aim at maximizing nutrient uptake by crop and minimizing nutrient availability to weeds. It is important to understand weed responses to N rates for the development of strategies that reduce N availability to weeds. Therefore, the study of inclusion of live mulch under different nitrogen levels and application of herbicides in combination or sequence was conducted.

MATERIALS AND METHODS

The experiment was laid out in split-plot design with three replications. The mulching (no mulch and live mulch i.e. brown manuring with *Sesbania*) and nitrogen doses (120, 150 and 180 kg ha^{-1}) were assigned to main plots and weed management practices (weedy, two hand weeding at 20 and 40 DAS, azimsulfuron @ 30 g ha^{-1} + bispyribac-sodium @ 25 g ha^{-1} at 10-15 DAS; and pendimethalin @ 1 kg ha^{-1} at 1-3 DAS *fb* bispyribac-sodium @ 25 g ha^{-1} 15-20 DAS) in sub plots. Rice variety Sarjoo 52 was sown in the last week of June. Seed of *Sesbania* was broadcasted just after seeding of rice for brown manuring and was knockdown at 25 DAS with the help of 2, 4 D @ 0.5 kg ha^{-1}. A uniform dose of 60 kg P_2O_5 and 60 kg K_2O ha^{-1} was applied in all the treatments through single super phosphate and muriate of potash, respectively. Nitrogen doses of 120, 150 and 180 kg/ha was given as per treatment through urea. Half dose of total nitrogen and full dose of phosphorus and potassium were applied to rice crop as basal application before sowing. Remaining half dose of nitrogen in the form of urea was top dressed in two equal splits at active tillering and panicle initiation stage during both the years. Five plants from each experimental plot were selected randomly and tagged. Plant height of the rice was recorded with the help of meter scale from base of the plant to the tip of upper most leaf of the plant before panicle emergence and up to the tip of panicle after heading. Number of tillers were recorded by counting tillers number per 50 cm row length at five rows in each plot then averaged and expressed in terms of number of tillers m^{-1} row length. The leaf area index (LAI) is the area of leaf surface per unit area of land surface. Plants of 50 × 50 cm (0.25 m^2) were cut to the ground at 30 DAS, 60 DAS and 90 DAS stage from each plot and their green leaves with the sheath portion were separated from the plants. Leaf area of collected leaves/2500 cm^2 was determined by portable leaf area meter and finally total leaf area was expressed in per unit ground area basis. The leaf area index was obtained by the following formula:

$$\text{LAI} = \frac{\text{Total area of green leaves}}{\text{Ground area}}$$

Produce of each net plot was then threshed separately and grains thus obtained were winnowed, cleaned and weighed. The moisture content of harvested grain was measured by using moisture meter. The yield recorded in kg $plot^{-1}$ was standardized to 14% moisture and

Table 1. Effect of mulching, nitrogen levels and weed management practices on plant height and number of tillers at different growth stages of direct seeded rice (Pooled data of two years).

Treatments	Plant height (cm)				Number of tillers m^{-1} row length			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Mulching								
No mulch	22.73	48.87	74.64	72.30	38.45	70.05	57.89	57.33
Live mulch (brown manuring with *Sesbania*	25.47	53.91	81.42	77.24	42.23	74.03	62.48	60.69
SEm±	0.36	0.95	1.16	1.06	0.64	0.91	1.10	1.14
CD (P=0.05)	1.11	2.97	3.26	3.27	1.38	3.34	3.65	3.01
Nitrogen levels (kg ha^{-1})								
120	21.23	46.24	73.40	72.52	37.18	65.46	53.72	54.38
150	23.16	49.20	76.46	74.25	41.90	72.80	62.82	60.59
180	24.71	52.05	78.49	75.94	40.07	70.40	59.01	58.56
SEm±	0.32	0.91	1.42	1.19	0.60	0.85	1.38	1.16
CD (P=0.05)	1.01	2.50	4.12	3.23	1.87	3.72	3.79	3.71
Weed management practices								
Weedy	18.67	44.10	75.14	74.44	37.37	65.87	54.88	49.72
Two hand weeding (20 and 40 DAS)	23.76	55.53	83.23	82.06	40.31	69.68	59.18	53.81
Azimsulfuron @ 30 g ha^{-1} + bispyribac- sodium @ 25 g ha^{-1}	25.28	57.98	84.63	84.33	40.62	70.24	60.75	54.42
Pendimethalin @ 1kg ha^{-1} *fb* bispyribac- sodium @ 25 g ha^{-1}	28.37	62.38	89.46	87.85	43.32	73.62	64.67	59.38
SEm±	0.44	1.01	1.65	1.51	0.73	0.85	1.03	1.14
CD (P=0.05)	1.28	2.91	4.77	4.35	2.37	3.15	2.88	3.09

then weight was converted into t ha^{-1}.

RESULTS AND DISCUSSION

Plant height (cm)

The pooled data of two years revealed that plant height increased gradually with age of the crop till 90 DAS and then decreased at maturity (Table 1). Mulching have significant effect on plant height and was recorded maximum under live mulch (brown manuring with *Sesbania*). Plant height under various nitrogen levels also showed significant result. It was observed that maximum plant height was recorded with 180 kg N ha^{-1} which was statistically at par with 150 kg N ha^{-1} while 120 kg N ha^{-1} recorded lowest plant height. The maximum plant height was recorded with pendimethalin @ 1kg ha^{-1} *fb* bispyribac- sodium @ 25 g ha^{-1} at all crop growth stages.

Tillers (No.) m^{-1} row length

The pooled data revealed that mulching, nitrogen levels and weed management practices significantly influenced the number of tillers m^{-1} row length (Table 1) which increased up to 60 DAS and then decline gradually till harvest stage. Brown manuring with *Sesbania* and application of 150 kg N ha^{-1} resulted in highest number of tillers m^{-1} row length. Pendimethalin @1 kg ha^{-1} *fb* bispyribac- sodium @ 25 g ha^{-1} and weedy check recorded significantly maximum and minimum number of tillers m^{-1} row length at all the stages of observation.

Leaf area index

Leaf area index (LAI) was significantly influenced by mulching, nitrogen levels and weed management practices (Table 2). It was observed that maximum LAI was recorded at 90 DAS when compared to other stages of crop growth. Brown manuring with *Sesbania* recorded highest value of LAI at all the stages of crop growth and was significantly better than no mulching in direct seeded rice. Under nitrogen levels, 180 kg N ha^{-1} recorded maximum LAI but was found to be

Table 2. Effect of mulching, nitrogen levels and weed management practices on LAI at different growth stages and yields of direct seeded rice.

Treatments	Leaf area index			Yield (t ha^{-1})	
	30 DAS	60 DAS	90 DAS	Grain yield	Straw yield
Mulching					
No mulch	1.13	2.41	4.02	4.03	5.75
Live mulch (brown manuring with *Sesbania*)	1.64	3.85	5.11	4.47	6.01
SEm±	0.04	0.07	0.12	0.03	0.03
CD (P=0.05)	0.11	0.21	0.40	0.13	0.13
Nitrogen levels (kg ha^{-1})					
120	1.23	3.07	4.33	3.78	5.18
150	1.33	3.26	4.52	4.41	5.79
180	1.36	3.35	4.70	4.26	5.68
SEm±	0.02	0.05	0.06	0.05	0.05
CD (P=0.05)	0.07	0.14	0.19	0.15	0.16
Weed management practices					
Weedy	0.77	2.18	4.85	3.54	5.61
Two hand weeding (20 and 40 DAS)	1.55	3.20	5.12	4.03	5.66
Azimsulfuron @ 30 g ha^{-1} + bispyribac-sodium @ 25 g ha^{-1}	1.63	3.40	5.25	4.08	5.70
Pendimethalin @ 1kg ha^{-1} *fb* bispyribac-sodium @ 25 g ha^{-1}	1.95	4.11	5.61	4.32	5.78
SEm±	0.04	0.07	0.05	0.03	0.02
CD (P=0.05)	0.11	0.22	0.14	0.07	0.06

statistically at par with 150 kg N ha^{-1} at all growth stages. Significantly highest leaf area index was recorded under pendimethalin @ 1kg ha^{-1}*fb* bispyribac-sodium @ 25 g ha^{-1} under weed management practices

Grain and straw yield

The effect of mulching, nitrogen levels and weed management practices on grain yield and straw yield of direct seeded rice was found to be significant in the pooled data of two years i.e. 2014 and 2015 (Table 2). Maximum grain yield and straw yield was recorded under brown manuring with *Sesbania* and among nitrogen levels, 150 kg N ha^{-1} produced highest grain and straw yield. Under weed management practices maximum grain yield was registered with pendimethalin @ 1 kg ha^{-1}*fb* bispyribac- sodium @ 25 g ha^{-1} which was significantly superior over rest of the weed management practices.

Significantly taller plant, maximum number of tillers m^{-1} row length and higher leaf area index resulting in maximum grain and straw yield might be due to better crop growth and development because of favorable environment and ample space available for growth of rice as growth of weeds were checked due to mulch crop. Better supply of plant growth factors are positively correlated with plant height, higher number of tillers m^{-1} row length and higher LAI by addition of live mulch under 150 kg ha^{-1} nitrogen level. Amongst various weed management practices, pendimethalin @ 1 kg ha^{-1} *fb* bispyribac- sodium @ 25 g ha^{-1} increased plant height, number of tillers m-1 row length and LAI because of higher weed control and minimum competition from weeds for growth factors. Yield is the result of coordinated outcome of growth characters like plant height, number of tillers per meter row length and LAI. Grain yield and straw yield of DSR was affected by mulching and nitrogen levels. Significantly lower weed growth and higher

growth factors were registered under live mulching with *Sesbania* under 150 kg N ha^{-1} with application of a pre and post emergence herbicides resulting in higher grain and straw yield.

CONCLUSION

From the experiment it can be concluded that growth factors like plant height, number of tillers m^{-1} row length, LAI and yields of direct seeded rice can be enhanced with the application of *Sesbania* as live mulch and application of 150 kg N ha^{-1} along with the combination of pre and post emergence herbicides in the eastern Uttar Pradesh.

REFERENCES

Kim JK, Krishnan HR(2002) Making rice a perfect food: tuning dreams into reality. *J Crop Pro.* 5(1/2) : 93-130.

Maity Swapan Kumar, Mukherjee PK (2011) Effect of brown manuring on grain yield and nutrient use efficiency in dry direct seeded *kharif* rice (*Oryza sativa* L.), *Ind J Weed Sci* 42 (1/2) : 61-66.

Rao AN, Johnson DE, Sivaprasad B, Ladha JK, Mortimer AM (2007) Weed management in direct-seeded rice *Adv Agron* Agronomy. 93 : 153-255.

Singh MV (2009) Micronutrient nutrition problems in soils of India and improvement for human and animal health *Ind J Fertil izers* 5 (4) : 11-16.