https://doi.org/10.48047/AFJBS.6.14.2024.10216-10225

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Original Research Article

Effect of Various Nitrogen Levels and Herbicide Treatments on the Growth Attributes and Yield of Rice (*Oryza sativa* L.)

Vikash Singh[1*], Rajesh Kumar[2], Sushil Kumar Yadav[3], Saurabh Bharti[4], Atish Yadav[5], Divya Singh[6], R.K. Aryan[7]

[1, 4, 5, 6,] Research Scholar, [2, 3]Associate professor, [7]Assistant professor
[1, 2, 4, 5, 6] Department of Agronomy, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, Uttar Pradesh 224229 India
[3]Department of Soil Science and Agricultural Chemistry, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, Uttar Pradesh 224229 India
[7]Faculty of Agriculture, MAHGU, Pokhra, Uttrakhand, India-246169
*Corresponding author: E-mail- vikashsingh090797@gmail.com

Volume 6, Issue 14, Aug 2024

Received: 15 July 2024

Accepted: 05 Aug 2024

Published: 29 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.10216-10225

ABSTRACT

A field experiment was conducted during *Kharif* season 2022 and 2023 at Agronomy research farm, Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya Uttar Pradesh, (India). The experiment was laid out in split plot design with thrice replications. Taking three nitrogen levels 80 Kg/ha, 120 Kg/ha and 160 Kg/ha in main plot and five weed management practices Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT, Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT, Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT, Weed free and Weedy check in subplot. Results revealed that significantly higher plant height, number of tillers, LAI and grain yield was recorded in 160 Kg N ha^{-1} and Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT which was comparable to weed free during both the years of investigation on transplanting rice.

Keyword: Growth parameters, yield, LAI, Nitrogen levels, Herbicides and Transplanted rice

1.INTRODUCTION

Rice, scientifically known as *Oryza sativa* L., is a prominent cereal grain crop primarily grown during the *kharif* season and classified under the Poaceae family. On a global scale, it was cultivated over approximately 165.21 million hectares, resulting in an annual harvest of around 509.26 million metric tons (FAS/USDA, 2021-22) with an average yield of 4.6 t ha^{-1} (FAO, 2021). In India, rice cultivation spans about 450.57 lakh hectares, yielding an estimated 122.27 million tons with an average productivity of 2713 kg ha^{-1}in 2021-2022 (Anonymous, 2021-22). Uttar Pradesh, second only to West Bengal, emerges as a significant contributor to rice production in India, covering an area of roughly 59.70 lakh hectares. The state's annual rice production amounts to 159.68 lakh metric tonnes, with a productivity of 26.75 q ha^{-1} (Anonymous, April 2022). Despite Uttar Pradesh's rice productivity nearly matching the national average; it ranks seventh in terms of production, lagging behind Punjab, Tamil Nadu, Haryana, Andhra Pradesh, Karnataka, and West Bengal.Application of N can enhance the plant height, leaf area and biomass in early season rice, and thereby improved the competitive ability of rice against weeds (Evans *et al*., 2001). Mahajan *et al.* (2011) at Ludhiana reported that N rates and hand-weeding can improve the crop competitiveness against weeds, and therefore, can increase the rice grain yield. They reported that application of N at 150 kg ha^{-1} along with pendimethalin *fb* bispyribac Na + one hand-weeding or pendimethalin *fb* bispyribac- Na gave the higher grain yield and weed control use efficiency.

Weed competition is one of the major factors responsible for low yield of rice. Competition offered by weeds is most important and it reduces the grain yield up to the extent of 32 %. Thus, it is important that they are controlled in time to avoid unproductive use of growth factors to enable the crop plant to express fully by utilizing these factors meant for them. Herbicides are effective against weed species, but most of them are specific and are effective against narrow range of weed species (Mukerjee and Singh, 2005). Therefore, appropriate and economical weed management technology is to be developed for the sustainable rice cultivation.

2. MATERIALS AND METHODS

The experiment was conducted during two consecutive seasons of *Kharif* 2022 and 2023 at the Agronomy Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.). The experimental site falls under sub-tropical conditions with remarkable humidity and lies between 24.4^0 North latitude and 82.12^0 East longitudes with an altitude113 meters above mean sea level. The experimental site falls under sub humid subtropical zone in Indo-Gangetic plains receives a mean annual rainfall of about 1013 mm, out of which about 90 percent is receive from mid-June to end of September. However, occasional showers are also common during winter.The experiment was layout in split plot design (SPD) with three replications taking three nitrogen levels 80 Kg/ha, 120 Kg/ha and 160 Kg/ha in main plot and five weed management practices Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT, Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT, Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT, Weed free and Weedy check in subplot. Soil was sampled before sowing and after harvest of the crop to know the fertility status of the experiment field. The growth analysis was done as per standard procedures.

2.1 Plant Height (cm)

Height (cm) of the five tagged plants from five hills was measured from base of the plant to tip of the tallest leaf in each plot at different stages (30, 60, 90 days after transplanting and at harvest) of growth. Thereafter, average height per plant was worked out for each treatment.

2.2 Number of tillers (m^{-2})

The tiller number (m^{-2}) was counted at 30, 60, 90, days after transplanting and at harvest from 5 places randomly keeping a quadrate of 50 cm × 50 cm. The data so obtained were averaged and expressed as tillers m^{-2}.

2.3 Leaf area index

The total number of leaves of five hills were divided into three groups *i.e.*, small, medium and large leaves and measured their area. The maximum length and width of the three randomly selected leaves of each group was measured and the leaf area was calculated by using the formula as given by Yoshida *et al.* (1972) and multiplied with the total leaves from each group.

Leaf area= K × maximum length of leaf × maximum width of lea

Where, LAI: leaf area index, K: constant or factor (0.72). The value of K is calculated by dividing the leaf area obtained by maximum length x width of the leaves by the exact leaf area recorded by automatic leaf area meter.

$$Leaf\ area\ index = \frac{Total\ leaf\ area\ per\ plant\ (cm^2)}{Ground\ area\ occupied\ by\ plant(cm^2)}$$

2.4 Grain yield (q ha^{-1})

The harvest of net plot area was threshed manually and yield was recorded plot wise and computed as q ha^{-1}.

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

Data given Table 1 clearly indicate that nitrogen levels and weed management practices had significant effect on plant height at all stages of crop growth except 30 DAT under nitrogen levels which plant height did not influenced significantly during both the years of experimentation.

At 60, 90, DAT and at harvest plant height significantly influenced by nitrogen and weed management practices during both year. Data further revealed that maximum plant height 70.28 and 71.41cm, 84.56 and 85.97cm, 94.43 and 97.39cm recorded under 160 Kg N/ha during 2022 and 2023 respectively, which was statistically at par with 120 Kg N/ha while significantly higher than 80 Kg N/ha. This might be due to continues and optimum nitrogen available for plant growth at all stages in such treatment trends to increases in cell division and cell elongation resulted in higher plant height. All most similar results were reported by Tiwari *et al*. (2017) and Jan *et al*. (2018).

Among weed management practices, weed free recorded maximum plant height 37.77 and 38.38 cm, 71.77 and 72.81 cm, 86.06 and 87.49 cm, 97.67 and 99.50 cm, at 30, 60, 90 DAT, and at harvest during 2022 and 2023 respectively, which was at par with application of Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT. While, significantly higher than rest of the weed

management practices during both years.There was progressive increase in plant height with increase in age of crop up to at harvest. It indicates that grand growth period of rice lies between 30-90 DAT. Increase in plant height under different weed management practices as compare to weedy check was due to lowest weed population and dry weigh resulted lesser crop weed competition which provided better opportunity for better utilization of nutrient, moisture, space and solar radiation to the crop. This was ultimately resulted to improved plant height. These results are supported by the finding of Charan *et al*. (2016) and Raghuveer Singh and Singh.(2016).

3.2 Numbers of tillers (m^{-2})

Data given Table 2 clearly indicate that nitrogen levels and weed management practices had significant effect on numbers of tillers at all stages of crop growth except 30 DAT which numbers of tillers did not influenced significantly during both the years of experimentation.

Numbers of tillers significantly influenced by nitrogen and weed management practices during both years. Data revealed that significantly maximum numbers of tillers 345.68 and 348.15 m^{-2}, 392.90 and 397.14 m^{-2}, 379.43 and 384.61 m^{-2}, recorded with 160 Kg N/ha at 60, 90 DAS and at harvest during 2022 and 2023 respectively, which was statistically at par with 120 Kg N/ha, while significantly higher than 80 Kg N/ha. The N plays an important role in the growth and development of crop during the entire cycle as involved in photosynthesis. Application of N enhanced the chlorophyll synthesis and resulted into higher DM synthesis, and therefore improvement in growth and numbers of tillers rice crop. Plant increasing in number of tillers results are supported by the findings of Hemalatha *et al*. (2016).

Among weed management practices, weed free recorded significantly higher tillers 350.92 and 352.94 m^{-2} 397.69 and 401.85 m^{-2}, 384.51 and 389.52 m^{-2} at 60, 90 DAT, and at harvest during 2022 and 2023 respectively, which was at par with application of Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT. While significantly higher than the rest of the weed management practices during both years.This might be due to effective control of weeds reduce the crop weed competition, increased the availability of moisture, nutrient, space and light etc. To the plant resulted in higher numbers of tillers. These results are in conformity with of Khalifa (2009).

3.3 Leaf area index

Data given Table 3 clearly indicated that nitrogen and weed management practices had significant effect on Leaf area index at all stages of crop growth except 30 DAT during both the year of experimentations.

Data further revealed that maximum leaf area index 4.76 and 4.90, 5.27 and 5.34, at 60 and 90 DAT during 2022 and 2023 respectively recorded under 160 Kg N/ha, which was statistically at par with 120 Kg N/ha, while significantly higher than 80 Kg N/ha. This might be due to continuous supply of optimum nitrogen which Improve the availability of nutrient to plant resulted in increasing leaf area index. These results are supported by the findings Sandhya. (2012).

Among weed management practices weed free recorded maximum leaf area index 3.63 and 3.75, 3.98 and 4.03 at 60 and 90 DAT during 2022 and 2023 respectively, which was at par with application of Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT. While significantly higher than the rest of the weed management practices during both years. This might be due to effective control of weeds reduce the crop weed competition, increase maximum availability of moisture, nutrient, space and light. To the plant resulted in higher crop growth and

maximum number of leaf responsible for higher LAI. This result are almost similar with the Gill *et al.* (2016) and Yadav and Singh, (2006).

3.4 Grain yield (q/ha)

Data given Table 3 clearly indicate that nitrogen levels and weed management practices have significant effect on grain yield (q/ha) during both the years of experimentation.

Data further revealed that 160 Kg N/ha produced maximum grain yield (q/ha) 50.06 and 51.41 during 2022 and 2023 respectively, which was statistically at par with 120 Kg N/ha while significantly higher than 80 Kg N/ha. This might be due to continues and optimum nitrogen available for plant growth at all stages in such treatment trends to higher number of effective tillers, number of grain per panicle and test weight resulted in higher grain yield . All most similar results were reported Maurya *et al.* (2021)**.**

Among weed management practices, weed free recorded significantly maximum grain yield (q/ha) 53.72 and 54.36 during 2022 and 2023 respectively, which was at par with application of Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT, while, significantly higher than rest of the weed management practices during both years. This might be due to effective control of weeds resulted in minimum crop weed competition which was respectable for better number of effective tillers, number of grain per panicle and test weight resulted in higher grain yield. These results are supported by the finding Kumar *et al.* (2017).

Table 1 Plant height (cm) at different growth stages of rice as influenced by nitrogen levels and weed management practices

Treatments	Plant height (cm)							
	30 DAT		60 DAT		90 DAT		At harvest	
	2022	2023	2022	2023	2022	2023	2022	2023
Nitrogen Levels								
N_1 : 80 Kg/ha	35.04	35.43	61.83	62.79	76.43	77.83	87.32	89.23
N_2 : 120 Kg/ha	35.13	36.56	66.48	67.52	80.76	82.18	90.52	92.79
N_3 : 160 Kg/ha	36.22	37.06	70.28	71.41	84.56	85.97	94.43	97.39
SEm±	0.58	0.45	1.28	1.15	1.38	1.41	1.56	1.22
CD at 5%	**NS**	**NS**	**5.16**	**4.65**	**5.58**	**5.68**	**6.31**	**4.90**
Weed Management Practices								
W_1 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT	35.07	36.15	63.73	64.71	78.01	79.41	88.38	91.42
W_2 : Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	33.91	35.23	66.31	67.43	80.25	81.75	90.70	92.85
W_3 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	36.53	37.03	70.59	71.72	85.42	86.84	96.50	98.85
W_4 : Weed free	37.77	38.38	71.77	72.81	86.06	87.49	97.67	99.50
W_5 : Weedy check	33.69	35.08	58.59	59.55	72.86	74.27	80.27	83.06
SEm±	0.92	0.68	1.41	1.46	1.76	1.72	1.98	2.01
CD at 5%	**2.69**	**1.99**	**4.11**	**4.27**	**5.12**	**5.03**	**5.77**	**5.87**

Table 2 Numbers of tillers (m^{-2}) at different growth stages of rice as influenced by nitrogen levels and weed management practices.

Treatments	Numbers of tillers (m^{-2})							
	30 DAT		60 DAT		90 DAT		At harvest	
	2022	2023	2022	2023	2022	2023	2022	2023
Nitrogen Levels								
N_1 : 80 Kg/ha	187.17	191.18	289.70	291.10	335.78	339.84	322.45	327.51
N_2 : 120 Kg/ha	193.38	196.29	314.08	316.36	361.12	365.27	347.71	352.75
N_3 : 160 Kg/ha	196.96	201.49	345.68	348.15	392.90	397.14	379.43	384.61
SEm±	3.62	2.67	8.20	6.56	5.67	6.15	5.79	6.06
CD at 5%	**NS**	**NS**	**33.07**	**26.46**	**22.84**	**24.79**	**23.34**	**24.41**
Weed Management Practices								
W_1 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT	194.12	198.71	290.50	292.63	337.36	341.48	324.20	329.30
W_2 : Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	188.89	190.79	321.66	323.67	368.17	372.31	354.98	360.02
W_3 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	194.90	199.13	349.10	351.12	395.87	400.03	382.66	387.67
W_4 : Weed free	199.16	203.81	350.92	352.94	397.69	401.85	384.51	389.52
W_5 : Weedy check	185.45	189.17	270.26	272.32	317.24	321.41	302.96	308.26
SEm±	4.14	4.19	6.98	7.48	7.89	7.57	7.17	7.55
CD at 5%	**NS**	**NS**	**20.38**	**21.83**	**23.04**	**22.11**	**20.94**	**22.04**

Table 3 Leaf area index at different growth stages and grain yield of rice as influenced by nitrogen levels and weed management practices

Treatments	Leaf area index						Grain yield (q/ha)	
	30 DAT		60 DAT		90 DAT			
	2022	2023	2022	2023	2022	2023	2022	2023
Nitrogen Levels								
N_1 : 80 Kg/ha	1.94	1.96	4.17	4.31	4.58	4.66	39.48	40.79
N_2 : 120 Kg/ha	1.96	1.98	4.47	4.60	4.96	5.03	45.18	46.81
N_3 : 160 Kg/ha	2.02	2.05	4.76	4.90	5.27	5.34	50.06	51.41
SEm±	0.03	0.04	0.08	0.08	0.09	0.08	1.35	1.40
CD at 5%	**NS**	**NS**	**0.34**	**0.32**	**0.37**	**0.33**	**5.44**	**5.64**
Weed Management Practices								
W_1 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT	1.95	1.98	3.94	4.07	4.34	4.40	38.25	39.86
W_2 : Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	1.94	1.97	4.57	4.70	5.06	5.13	48.15	49.77
W_3 : Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT	2.01	2.04	5.01	5.16	5.56	5.65	51.83	53.46
W_4 : Weed free	2.03	2.05	5.17	5.33	5.73	5.84	53.72	54.36
W_5 : Weedy check	1.93	1.96	3.63	3.75	3.98	4.03	32.59	34.24
SEm±	0.04	0.03	0.11	0.11	0.12	0.12	1.54	1.12
CD at 5%	**NS**	**NS**	**0.31**	**0.32**	**0.36**	**0.35**	**3.48**	**3.27**

4. CONCLUSIONS

It is concluded that, 160 Kg N/ha and Pyrazosulfuron ethyl 10 % WP @ 20g a.i/ha (PE) at 0-3 DAT *fb* Bispyribac sodium 10 % SC @ 25g a.i/ha (PoE) at 25 DAT for weed management practices was found better for all growth parameter plant height, numbers of tillers, leaf area index and grain yield under transplanted rice.

REFERENCES

Anonymous 2022. Agricultural Statistics at a Glance, Ministry of Agriculture and Farmers Welfare (DAC and FW), GOI.

Anonymous, 2021-22. Annual Report, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Krishi Bhawan, New Delhi; p:4-5.

Anonymous, April 2022. Department of Agriculture, National Conference on Kharif Crops, Government of Uttar Pradesh, p: 8-9.

Charan, K., Duary, B., Subhapradha and Mallikarjun. 2016. Effect of post- emergence herbicides and their combination on composite weed flora of wet season transplanted rice. In: *Extended summary* 1 of *4th International Agronomy Congress: Agronomy for sustainable management of natural resources, environment, energy, and livelihood security to achieve zero hunger challenge*. pp. 328–329

FAS/USDA, 2021-22. Global Market Analysis, Foreign Agriculture Service- U S *Department of Agriculture, Washington*.

Hemalatha, K., Singh, Y. and Kumar, S. 2020. Leaf colour chart-based nitrogen and weed management impacts on weeds, yield and nutrient uptake in dry direct-seeded rice. *Indian Journal of Weed Science*. **52**(4): 318-321.

Jan, R., Bahar, F.A., Singh, T. and Lone, R. 2018. Effect of nitrogen and silicon on growth and yield attributes of transplanted rice (*Oryza sativa* L.) under Kashmir conditions. *Journal of pharmacognosy and phytochemistry*.**7**(1): 328-332.

Kalifa, A, Matloob, A, Ahmad, N, Rasul, F and Awan, IU. 2009. Post emergence chemical weed control in direct seeded fine rice, *The Journal of Animal & Plant Sciences*, **22**(4): 1101-1106.

Kumar, S. and Chaudhary, K. 2017. Weed management effects on weed control efficiency, yield and economics of transplanted rice in Typic Ustochrept soil of Uttar Pradesh. *International Journal of Chemical Studies*, **5(**4): 1346-1351.

Maurya, R., Singh, M.K., Singh, N.K., Singh, M.K. and Singh, A.K. 2021. Effect of nitrogen levels on growth attributes, yield and nutrient uptake of different rice (*Oryza sativa* L.) varieties under the transplanted condition. *Journal of Experimental Biology and Agricultural Sciences.* **9**: S336-S342.

Mukherjee, D. and Singh, R.P. 2005. Effect of micro-herbicides on weed dynamics, yield and economics of transplanted rice (*Oryza sativa*). *Indian Journal of Agronomy*. **50**(4): 292-295.

Raghuveer Singh, and Singh, V. P. 2016. Evaluation of herbicides efficacy for weed control in dry seeded rice. In: *Extended summary* 1 of *4th International Agronomy Congress: Agronomy for sustainable management of natural resources, environment, energy, and livelihood security to achieve zero hunger challenge*. pp.

320–323.

Sandhya, R. 2012. Influence of nitrogen and weed management on growth and yield of aerobic rice. *M.Sc. (Ag.) Thesis.* Acharya N G Ranga Agricultural University, Hyderabad, India.

Tiwari, R. K., Mahajan, G., Amit J. and Tripathi, S. K. 2017. Growth efficacy, productivity and economics of direct seeded rice as influenced by nitrogen level and weed management. *Journal of Pure and Applied Microbiology* **11**(2): 98–991.

Yadav, V., & Singh, B. 2006. Effect of crop establishment method and weed-management practice on rice (Oryza sativa) and associated weeds. *Indian Journal of Agronomy*, **51**(4):301-30