E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(8): 566-570
Received: 21-05-2025
Accepted: 23-06-2025

Bhim Singh
Ph.D. Scholar Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

BR Bazaya
Professor, Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Ramphool Puniya
Associate Professor, college of Agriculture, kumher (SKNAU, Jobner) Rajasthan, India

AP Singh
Professor and Head Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Swati Mehta
Assistant Professor, school of agriculture, Lovely Professional University, Phagwara, Punjab, India

Naveena
Ph.D. Scholar Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Sudha Verma
Ph.D. Scholar Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Geetika
Ph.D. Scholar Division of Agronomy, Punjab Agricultural University, Ludhiana, Punjab, India

Rahul
M.Sc. Student Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Shivani
Ph.D. Scholar Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Corresponding Author:
Bhim Singh
Ph.D. Scholar Division of Agronomy, SKUAST-JAMMU, Jammu and Kashmir, India

Impact of pre and post emergent herbicides on nutrient uptake and quality of direct seeded rice

Bhim Singh, BR Bazaya, Ramphool Puniya, AP Singh, Swati Mehta, Naveena, Sudha Verma, Geetika, Rahul and Shivani

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8Sh.3681

Abstract
A field experiment was conducted at SKUAST-Jammu during the Kharif season of 2020 in direct-seeded rice (DSR) to evaluate the performance of pre- and post-emergence herbicides on weed control, nutrient uptake by rice and weeds, and grain quality. The pre-emergence application of pretilachlor + pyrazosulfuron ethyl (615 g/ha) combined with post-emergence application of triafamone + ethoxysulfuron (66.5 g/ha at 25 DAS) resulted in the highest uptake of nitrogen, phosphorus, and potassium by rice, while minimizing nutrient removal by weeds. The highest protein and amylose contents were also recorded under these treatments. The findings suggest the effectiveness of integrated herbicide application for better nutrient use efficiency and improved grain quality.

Keywords: Direct-seeded rice, nutrient uptake, herbicides, weed management, grain quality

Introduction
Rice is the staple food crop of the tropics, in general and India in particular. “Rice is Life” aptly describes the importance of rice in food and nutritional security for the Asian countries. India is the second largest producer of rice in the world grown in an area of 43.8 million hectares with a production of 118.4 million tonnes and productivity of 2.7 t/ha (GOI 2021) [8]. Weed infestation is the primary biotic limitation to increased productivity, particularly in direct-seeded rice. (Rao *et al*. 2007, 2017) [11, 10].

The yield losses in DSR due to weeds can range from 50% to 91%. This suggests that weeds have a major influence on direct seeded output; thus, weed control is essential for rice production that is sustainable in dry-seeded conditions. However, in DSR, varied weeds were not efficiently controlled by applying pre- or post-emergence herbicides alone (Awan *et al*., 2015) [2]. Herbicides are typically applied by farmers by combining them with sand to make the process easier. They also prefer to use pre- or post-herbicides just once, which is ineffective in controlling the variety of weed flora found in DSR (Chauhan 2012) [4]. Herbicides used before weeds emerge may not be as effective in suppressing weeds that arise later in life or that are more established. Conversely, post-emergence herbicides are sprayed on actively developing weeds after they have emerged. Post-emergence herbicides work well against weeds that develop later in the growing season or that pre-emergence herbicides have not been able to sufficiently suppress (Chauhan *et al*., 2015) [2]. Grain yield from the DSR system can resemble PTR when all of its components are used well (Gill *et al*., 2013, Bhullar *et al*., 2018) [7, 8]. However, the use of DSR technology typically results in a change in the composition of weeds, favoring those that are challenging to control (Singh *et al*., 2013) [13]. In this case, the use of herbicides is growing in popularity in DSR due to its increased effectiveness, ease of application, ability to give targeted control, reduced manpower expenses, and lower cost.

Materials and Methods
The field study was conducted during the Kharif season of 2020 at SKUAST-Jammu under irrigated conditions. The experimental soil was sandy clay loam, slightly alkaline (pH 7.75), low in organic carbon (4.68 g/kg) and available nitrogen (247.5 kg/ha), but medium in available

phosphorus (14.05 kg/ha) and potassium (128.50 kg/ha). The field was prepared with a tractor-drawn cultivator followed by harrowing. Direct seeding of 'Basmati 370' was carried out at 30 kg/ha with 25 cm row spacing. Irrigation was provided immediately after sowing to ensure uniform germination. Fertilizers were applied at recommended rates of 30 kg N, 20 kg P, and 10 kg K per hectare using urea, single superphosphate, and muriate of potash, respectively.

Chemical analysis of plant and weed samples

The plant samples (grain straw and weeds) taken at the time of harvesting were used for estimation of N, P and K content. The samples were oven dried at 65°C till constant weight, then finely ground with electric grinder and mixed well before being proceeded for chemical analysis for nitrogen, phosphorus and potassium concentration. N, P and K uptake by grain, straw and weed samples were calculated by multiplying percent nutrient content with their respective dry matter accumulation as per the formula given below:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{dry matter accumulation (kg/ha)} \times \text{Nutrient content (\%)}}{100}$$

Protein content (%)

Treatment wise grain samples of rice were subjected to nitrogen content analysis by modified micro kjeldhal method. Then the protein content in the rice grain of individual treatment was calculated by multiplying nitrogen content (percent) in the grain by factor 6.25 and expressed in percentage (A.O.A.C., 1970) [1].

Amylose content (%)

Amylose content in rice was determined according to the procedure given by Juilano (1971) [9]. Rice grains were cleaned, dried, dehusked and ground to powder in pestle motor for the estimation of amylose content. In 100 gm of rice powder 1 ml of ethanol was added and was shaken well. Then 100 ml of 1N sodium hydroxide was added and was kept overnight. Next day the mixture was filtered through Whatman filter paper and 2.5 ml extract was taken in conical flask. Three drops of phenolphthalein indicator were added till pink colour developed. One ml of iodine reagent was added and the final volume of 50 ml was made by adding distilled water. The colour so developed was measured at 620 nm using UV spectrophotometer.

Results and Discussion

Effect of nutrient uptake by weeds

N, P and K uptake by weeds at harvest stage significantly influenced pre-and post-emergence herbicides (Table 1). Higher nutrient uptake of N, P and K was noticed in control plot. Pre-emergence herbicide, pretilachlor + pyrazosulfuron ethyl 615 g/ha obtained significantly lower N, P and K uptake by weeds. Amongst post- emergence herbicides, triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS recorded lower nutrient uptake by weeds followed by bispyribac-sodium 25 g/ha at 25 DAS and penoxsulam + cyhalofop-butyl 135 g/ha at 25 DAS. The higher uptakes of N, P and K by weeds were noticed in control treatment. The reason might be due to the lower weed population and dry matter of weeds owing to better control of weeds under pre- and post-emergence herbicides. Rana and Angiras (1999) [12] confirmed that N, P and K removal by weeds was limited in herbicide applied plots compared to un weeded control. Due to uncontrolled weed growth, the uptake of N, P and K by weeds was highest in the control which resulted in increased dry matter production of weeds.

Effect of nutrient uptake by crop

Nutrients (N, P, K) uptake by grain and straw significantly influenced by pre- and post-emergence herbicides (Table 2,3,4). The higher nutrient uptake of N, P and K was recorded in treatment pretilachlor + pyrazosulfuron ethyl 615 g/ha as pre-emergence which found statistically at par with pendimethalin 1 kg /ha pre-emergence herbicides and significantly higher than pyrazosulfuron ethyl 20 g/ha, pretilachlor 600 g/ha and control treatment. The reason might be higher available N, P and K in the soil which favoured crop growth due to better weed control resulting in higher grain and straw yield and ultimately increased nutrient uptake by crop. Similar results were reported by (Singh *et al.,* 2013) [13]. In post-emergence herbicides triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS recorded highest nutrient uptake followed by penoxsulam + cyhalofop-butyl 135 g/ha at 25 DAS where as lowest in control treatment. The reason may be reduced crop-weed competition for nutrients due to excellent weed control by post-emergence herbicide which registered higher uptake of nitrogen, phosphorus and potassium. Nutrient uptake being a function of dry matter production and partly due to increase in its concentration gave more total dry matter and registered significantly higher uptake of nitrogen, phosphorus and potassium (Singh *et al*., 2013) [13].

Effect on quality

Protein content (%) and Amylose (%) presented in (Figure 1&2) indicates that non-significant influence of the treatments (pre- and post-emergence herbicides treatments). However, the higher value of protein content and amylose in pre-emergence herbicides was recorded in pretilachlor + pyrazosulfuron ethyl 615 g/ha and lowest value in control treatment. Amongst post-emergence herbicides, higher value are observed in triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS and lowest value in treatment control.

Table 1: Effect of pre and post-emergence herbicides on N, P, K uptake by weeds at harvest of direct seeded rice

Treatment	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
Factor -A: Pre emergence herbicides			
Pendimethalin 1.0 kg/ha	12.37	5.89	18.38
Pyrazosulfuron ethyl 20 g/ha	22.33	9.50	28.80
Pretilachlor 600 g/ha	16.12	7.01	23.74
Pretilachlor + pyrazosulfuron ethyl 615 g/ha	10.14	5.10	16.12
Control	31.05	13.69	42.02
SEm±	0.55	0.05	0.24
CD (5%)	1.57	0.16	0.70
Factor – B: Post emergence herbicides			
Bispyribac-sodium 25 g/ha at 25 DAS	13.15	6.05	19.51
Penoxsulam+ cyhalofop – butyl 135 g/ha at 25 DAS	15.40	6.35	20.47
Triafamone +ethoxysulfuron 66.5 g/ha at 25 DAS	11.79	4.94	17.03
Control	33.27	15.61	46.26
SEm±	0.49	0.05	0.22
CD (5%)	1.41	0.14	0.62

Table 2: Effect of pre- and post-emergence herbicides on nitrogen uptake by crop at harvest of direct seeded rice

Treatment	Nitrogen (kg/ha)		
Factor -A: Pre emergence herbicides	**Grain**	**Straw**	**Total**
Pendimethalin 1.0 kg/ha	49.52	33.54	83.06
Pyrazosulfuron ethyl 20 g/ha	43.90	30.25	74.15
Pretilachlor 600 g/ha	46.45	31.74	78.19
Pretilachlor + pyrazosulfuron ethyl 615 g/ha	51.38	34.46	85.84
Control	34.96	24.33	59.29
SEm±	0.81	0.52	1.20
CD (5%)	2.32	1.48	3.44
Factor – B: Post emergence herbicides			
Bispyribac-sodium 25 g/ha at 25 DAS	47.24	32.37	79.61
Penoxsulam+ cyhalofop – butyl 135 g/ha at 25 DAS	49.38	33.68	83.06
Triafamone +ethoxysulfuron 66.5 g/ha at 25 DAS	50.58	33.90	84.48
Control	33.77	23.50	57.28
SEm±	0.73	0.46	1.07
CD (5%)	2.08	1.32	3.08

Table 3: Effect of pre- and post-emergence herbicides on phosphorus uptake by crop at harvest of direct seeded rice

Treatment	Phosphorus(kg/ha)		
Factor -A: Pre emergence herbicides	**Grain**	**Straw**	**Total**
Pendimethalin 1.0 kg/ha	9.13	9.41	18.54
Pyrazosulfuron ethyl 20 g/ha	8.21	8.48	16.69
Pretilachlor 600 g/ha	8.90	8.52	17.41
Pretilachlor + pyrazosulfuron ethyl 615 g/ha	9.80	9.55	19.35
Control	6.13	6.55	12.68
SEm±	0.15	0.14	0.26
CD (5%)	0.42	0.41	0.75
Factor – B: Post emergence herbicides			
Bispyribac-sodium 25 g/ha at 25 DAS	8.91	9.88	17.71
Penoxsulam+ cyhalofop – butyl 135 g/ha at 25 DAS	9.27	9.57	18.47
Triafamone +ethoxysulfuron 66.5 g/ha at 25 DAS	9.33	10.10	18.75
Control	6.49	5.06	12.80
SEm±	0.13	0.26	0.23
CD (5%)	0.36	0.74	0.67

Table 4: Effect of pre- and post-emergence herbicides on Potassium uptake by crop at harvest of direct seeded rice

Treatment	Potassium (kg/ha)		
Factor -A: Pre emergence herbicides	**Grain**	**Straw**	**Total**
Pendimethalin 1.0 kg/ha	13.46	67.90	81.37
Pyrazosulfuron ethyl 20 g/ha	12.10	61.24	73.34
Pretilachlor 600 g/ha	13.02	63.48	76.50
Pretilachlor + pyrazosulfuron ethyl 615 g/ha	14.10	69.33	83.43
Control	6.13	49.59	55.72
SEm±	0.20	1.04	1.18
CD (5%)	0.56	2.98	3.39
Factor – B: Post emergence herbicides			
Bispyribac-sodium 25 g/ha at 25 DAS	12.24	65.35	77.59
Penoxsulam+ cyhalofop – butyl 135 g/ha at 25 DAS	12.81	68.00	80.82
Triafamone +ethoxysulfuron 66.5 g/ha at 25 DAS	13.08	68.45	81.53
Control	8.92	47.42	56.35
SEm±	0.18	0.93	1.06
CD (5%)	0.50	2.67	3.03

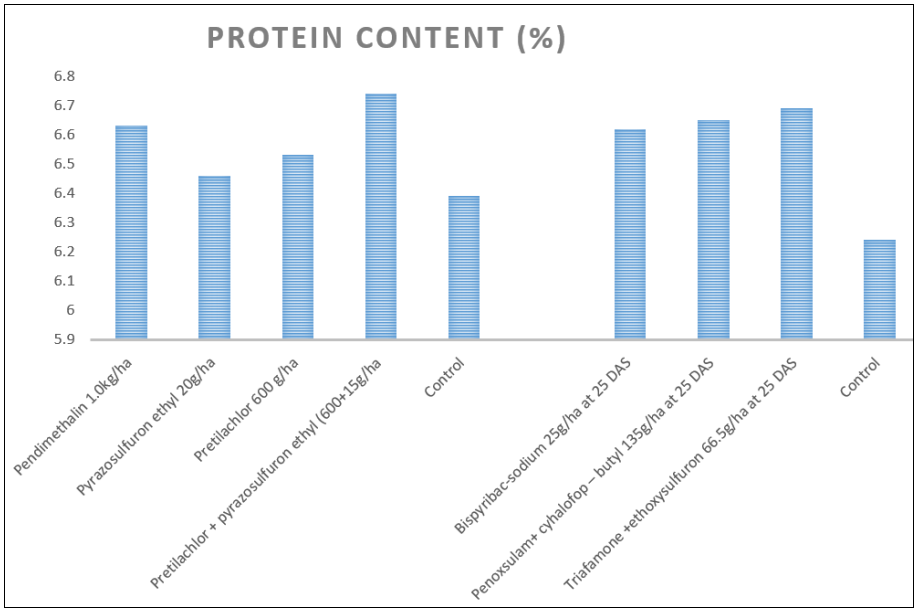

Fig 1: Effect of pre and post emergent herbicides on protein content (%)

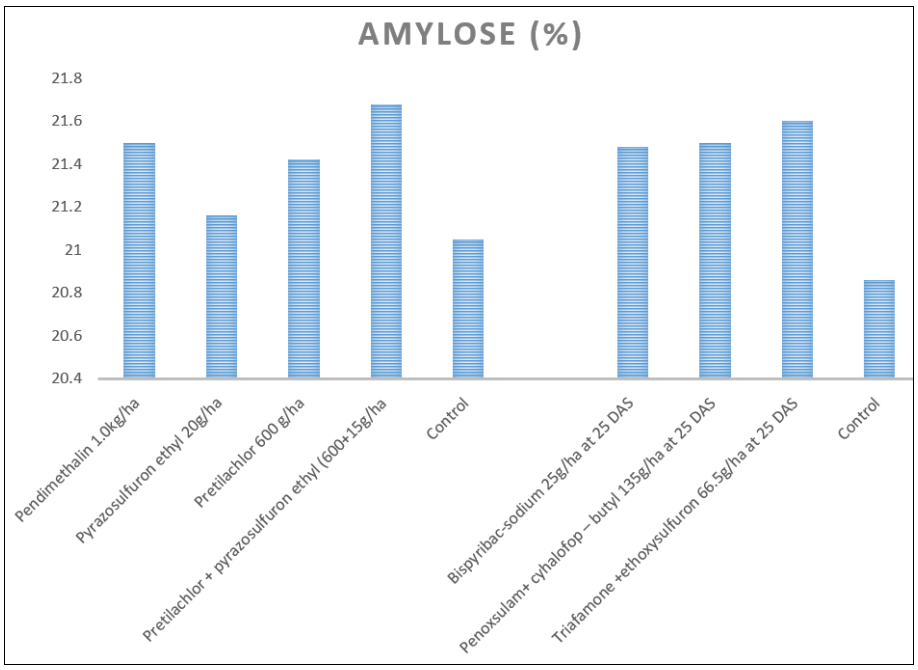

Fig 2: Effect of pre and post emergent herbicides on Amylose (%)

Conclusion

On the basis of 1 year study pre-emergence herbicides, pretilachlor + pyrazosulfuron ethyl 615 g/ha recorded higher N, P and K uptake than other treatments. Amongst post- emergence herbicides, triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS recorded significantly higher N, P and K uptake

Reference

1. AOAC. Methods of analysis. Washington, D.C (USA): Association of Official Analytical Chemistry; 1970.
2. Awan TH, Sta Cruz PC, Chauhan BS. Agronomic indices, growth, yield-contributing traits, and yield of dry seeded rice under varying herbicides. Field Crop Research. 2015;177:15-25.
3. Bhullar MS, Singh S, Kumar S, Gill G. Agronomic and economic impacts of direct seeded rice in Punjab. Agricultural Research Journal. 2018.
4. Chauhan BS. Weed ecology and weed management strategies for dryseeded rice in Asia. Weed Technol. 2012;26:1-13.
5. Chauhan BS, Opena J. Effect of tillage systems and herbicides on weed emergence, weed growth, and grain yield in dry-seeded rice systems. Field Crops Research. 2012;137:56–69.
6. Chauhan BS, Ahmed S, Awan TH, Jabran K, Sudheesh M. Integrated weed management approach to improve weed control efficiencies for sustainable rice production in dry-seeded systems. Crop Protection. 2015;71:19-24.
7. Gill G, Bhullar MS, Yadav A, Yadav DB. Technology for Successful Production of Direct Seeded Rice. A Training Manual Based on the Outputs of ACIAR (Australian Centre for International Agricultural Research) Funded Project CSE/ 2004/033. (A Joint Publication of University of Adelaide, South Australia. Punjab Agricultural University Ludhiana, Punjab; CCS Haryana Agricultural University, Hisar, Haryana). 2013;32.

8. GOI (Government of India). Economic Survey 2020-21. Statistical Appendix. Volume 2. New Delhi: Ministry of Finance. Government of India; 2021.
9. Juilano BO. A simplified assay for milled rice amylose. Cereal Science Today. 1971;16:334-41.
10. Rao AN, Wani SP, Ahmed S, Ali HH, Marambe B. An overview of weeds and weed management in rice of South Asia. In: Weed Management in Rice in the Asian-Pacific Region. Asian-Pacific Weed Science Society; 2017. p. 247–81.
11. Rao AN, Johnson DE, Sivaprasad B, Latha JK, Mortimer AM. Weed management in direct seeded rice. Advances in Agronomy. 2007;93:153–255.
12. Rana SS, Angiras NN. Influence of integrated weed management practices on weed competition for nutrients in puddle sown rice. Indian Journal of Weed Science. 1999;31(3&4):161-3.
13. Singh A, Singh RK, Kumar P, Singh S. Growth, weed control and yield of direct-seeded rice as influenced by different herbicides. Indian Journal of Weed Science. 2013;45(4):235-8.
14. Singh VP, Singh SP, Dhyani VC, Tripathi N, Banga A, Yadav VR. Effect of establishment methods on shifting of weed flora in rice-wheat cropping system. In: Proc. 24th Asian-Pacific Weed Science Society Conference. Bandung, Indonesia; 2013. p. 494.