The Pharma Innovation Journal 2023; 12(12): 290-294

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 290-294

www.thepharmajournal.com
Received: 11-09-2023
Accepted: 27-10-2023

Aditya Shukla
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Anil Verma
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Akanksha Shukla
Department of Plant Pathology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Aditya Shukla
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Effect of combination of chemical, mechanical and manual methods of weed control on growth and profitability in wet-direct seeded rice (*Oryza sativa* L.)

Aditya Shukla, Anil Verma and Akanksha Shukla

Abstract
During the 2019 kharif season, an experiment was carried out at the Agronomy Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) to ascertain the impact of integrated weed management strategies on the weed dynamics, growth, yield, and economics of wet direct-seeded rice. Post-emergence herbicide (Bispyribac-Na), mechanical and manual weeding, and early post-emergence herbicides (Oxadiargyl and Pretilachlor) were the next steps. Pretilachlor did not perform as well as plots treated with Oxadiargyl. When combined with hand weeding (HW) 35 days after sowing (DAS), Oxadiargyl produced outcomes that were superior to twice the HW plot (T_{10}). When it came to growth parameters, yield-attributing characteristics, and the economics of wet direct-seeded rice, Oxadiargyl @ 70 g/ha at 7-11 DAS fb HW at 30-35 DAS (T_4) outperformed all other treatments and was statistically comparable to the twice HW plot (T_{10}) and Oxadiargyl @ 70 g/ha at 7-11 DAS fb bispyribac-Na @ 25 g/ha at 30-35 DAS (T_2).

Keywords: Oxadiargyl, pretilcahlor, wet direct seeded rice, integrated weed management, weed control efficiency

Introduction
The most significant staple crop in Asia and other tropical and subtropical regions of the world is rice (*Oryza sativa* L.). In Asia, 35–80% of calories are consumed through rice (Anonymous, 1997) [4]. Rice provides almost two thirds of the people in Asian countries with the daily calories they need (Rahman and Masood, 2012) [16]. Since 1950, rice output has increased six times thanks to high-yielding varieties, irrigation resources, fertilizer application, etc. To satisfy the demands of an expanding population, the demand for rice is predicted to increase globally by 25% between 2001 and 2025 (Rosegrant *et al*., 2002) [17]. Worldwide, rice acreage is around 167.2 Mha, yields 769.6 Mt, and has a productivity of 4.6 t ha-1 (Anonymous, 2017a) [5]. In Indian subcontinent rice is grown with an area of 43.38 M ha and 104.32 Mt of production in the year 2016-17 (Anonymous, 2017b) [3]. Chhattisgarh, the rice bowl of India, accounts for 3.88 M ha area with the production of 5.74 Mt and average productivity of 1.48 t ha^{-} (Anonymous, 2017c) [6].
According to Kumar *et al*. (2015) [13], there are three main techniques used to cultivate rice: transplanting, wet-direct seeding, and dry-direct seeding. In Asia, the benefits of transplanting on puddled soil are acknowledged, but the lack of water for irrigation and increased labor costs make the practice less profitable. Combined, transplanting and paddling use around 30% of the total water needed for rice farming (Chauhan, 2012) [8]. Direct seeded rice (DSR) requires 67% less labor and 35–57 percent less water than transplanted rice (Chauhan *et al*., 2012) [9].
When it comes to effectively controlling weeds in direct wet-seeded rice, herbicides are thought to be very important (De Datta *et al*., 1989) [10]. When it comes to herbicide selection for wet seeding, when the soil may be saturated or contain standing water, the options are more limited than for dry seeding because the mechanism of action cannot always depend on soil particle adsorption or weed uptake in an aqueous environment. It has been advised to apply pre-emergence herbicides such pendimethalin, butachlor, oxadiargyl, pretilachlor, almix, etc. Herbicides can also be used again at 30-to 40 DAS to further diminish the population of weed flora (Kim and Ha, 2005) [12].
To manage weeds in rice, one weed management strategy is insufficient. As a result, managing weeds in rice requires an integrated approach. Adopting alternative weed control techniques, including integrated weed management (IWM), is being encouraged by both financial and environmental factors (Swanton and Weise, 1991) [19].

Maintaining the weed population below an economic threshold is one of IWM's objectives (Auld and Tisdell, 1987) [7].

Materials and Methods

Field preparation

In the 2019 kharif season, the field experiment was carried out at the Agronomy Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.). The experimental site was located 290.20 meters above mean sea level at latitude 21°4' N and longitude 81°35' E. As a test crop, the rice variety "Rajeshwari" was planted. The crop lasts for roughly 120–125 days. Prior to the experiment's commencement on August 10, 2019, the field had one thorough plowing. Planking eventually covered the caged wheel puddles in the field. The recommended dose of nutrients, 120:60:40 kg N: P2O5: K2O ha-1, was applied using urea, muriate of potash (MOP), and diammonium phosphate (DAP), in that order. Urea was applied in three split doses as basal, at tillering and panicle initiation stage while DAP and MOP was applied as basal.

Experimental details

Three replications of the experiment were conducted using a randomized block design. Table 1 contains the specifics of the treatment. The available N (164.50 kg/ha), P (15.80 kg/ha), and K (278.00 kg/ha) were all low, medium, and medium in the clayey (Vertisols) texture of the experimental field's soil. A drum seeder was used to sow the pre-germinated seeds. The interrow spacing was 20 cm, and the seed rate applied was 40 kg/ha. Herbicides were sprayed in their appropriate plots after being completely dissolved in water at a rate of 500 liters per hectare as a carrier. Mechanical inter-row weeding was done with an Ambika paddy weeder. Using a drum seeder, seeds were planted with a 20 cm gap between rows and the seeder filled to two thirds of its height at a rate of 40 kg/ha. After soaking in water for 24 hours, seeds were pre-germinated and then allowed to drain off any remaining water by being placed in a jute bag under shade for another 24 hours. The seeds were kept outside for an hour prior to sowing, which made it easier to sow because the somewhat dried seeds split more easily and were less entangled.

Observations

The plant height was recorded for 5 randomly tagged plants from base to the tip of panicle. Number of tillers was counted using 50 cm x 50 cm (0.25 m^2) quadrates from 4 places and values obtained were summed up and total number of tillers/m^2 was obtained. Five randomly selected plants were uprooted for the determination of dry matter accumulation. Plants were washed, roots were cut off and oven dried at 60ºC for 48 hours to attain constant dry biomass. The samples were weighed thereafter and average dry weight was worked out and expressed as g/plant. Leaf area of all the leaves present in each plant was determined with the help of leaf area metre device namely 'Biovis Leaf Area Meter'. From different panicles of each plot, 1000 grains were counted and electronically weighed to obtain test weight (g).

The observation for number of panicles/m2 was done at harvest. Panicle bearing tillers were counted from randomly selected quadrates from 4 places at maturity stage of crop. The values thus obtained were summed for panicles/m2, which was used for statistical analysis. Separately five panicles were harvested. The length of the panicles was measured from the panicle node up to the apex of each panicle and the weight of each panicle was recorded with electronic balance. Thereafter, the average was worked out for both the yield attributes. Panicle length was expressed in cm and panicle weight in grams. The numbers of filled and unfilled grains/panicles were counted from ten panicles picked at randomly from plants after harvest and then averaged to obtain the mean value. From different panicles of each plot, 1000 grains were counted and electronically weighed to obtain test weight (g). The crop was harvested separately from each net plot. Clean grains were separated by threshing. The grain yield was recorded and straw yield was obtained by subtracting grain yield from biological yield and expressed in t/ha.

Weed count was rendered randomly from 4 spots of 50 cm x 50 cm (0.25 m^2) quadrates. The data was obtained by counting the number of weeds /m^2 for statistical analysis. Weeds were uprooted which were present inside the quadrates (0.25 cm^2), segregated species-wise then roots were sliced of and sundried for 48 hours. Then the weeds were oven dried at 60 ºC for 48 hours till a constant weight was obtained when weighed consecutively. After oven drying, dry weight of weed was recorded by weighing with electronic balance in g/m^2.

Statistical analysis

The design of the experiment was randomized block design (RBD). The variance analysis approach, as described by Gomez and Gomez (1984) [11], was used to examine the data collected from the several characteristics that were the subject of the study. Five percent is the level of significance used in the "F" test. Wherever the "F" test was significant at the five percent level, the critical difference (CD) values and standard error of means (S.Em±) are displayed in the table at the five percent significance level.

Results and Discussion

Growth of rice

The plant height was highest for oxadiargyl @ 70g/ha at 7-11 DAS *fb* HW at 30-35 DAS (T_4) which was closely followed by oxadiargyl @ 70 g/ha at 7-11 DAS *fb* bispyribac-Na @ 25 g/ha at 30-35 DAS (T_2) and HW twice at 25 and 50 DAS (T_{10}). Similar pattern of growth was also noted for other growth attributes like total tillers, leaf area and dry matter accumulation. Application of oxadiargyl provided early season weed control and when coupled with HW provided more resources for growth and this increased growth resulted in more canopy which would have had suppressive effect on weeds as a result of which higher yield was also noted in above stated treatments. When compared with pretilachlor, oxadiargyl treated plots recorded better growth parameters. The plots which had sole application of pretilachlor recorded least growth after weedy check.

Yield attributes

Data on yield attributes has been presented in Table 3. Application of oxadiargyl @ 70 g/ha at 7-11 DAS *fb* HW at 30-35 DAS registered highest number of panicles/m2 which was significantly superior over rest of the treatments except HW twice at 25 and 50 DAS, oxadiargyl @ 70 g/ha at 7-11 DAS *fb* bispyribac-sodium @ 25 g/ha at 30-35 DAS and pretilachlor with Safener @ 750 g/ha at 7-11 DAS *fb* HW at 30-35 DAS. The minimum number of panicles/m2 was observed under weedy check which was significantly inferior to all the treatments but it was comparable with oxadiargyl @ 70 g/ha at 7-11 DAS *fb* mechanical weeding at 30-35 DAS, pretilachlor with safener @ 750 g/ha at 7-11 DAS *fb* mechanical weeding at 30-35 DAS, oxadiargyl @ 70 g/ha at 7-11 DAS and pretilachlor with safener @ 750 g/ha at 7-11 DAS. The highest number of grains/panicle was recorded under oxadiargyl @ 70 g/ha at 7-11 DAS *fb* HW at 30-35 DAS which was statistically at par with the HW twice at 25 and 50 DAS, pretilachlor with safener @ 750 g/ha at 7-11 DAS *fb* HW at 30-35 DAS and oxadiargyl @ 70 g/ha at 7-11 DAS *fb* bispyribac-sodium @ 25 g/ha at 30-35 DAS. The lowest number of filled grains/panicle was observed under weedy check. Higher number of filled grains/panicle might have been due to enhanced translocation of photosynthates from source to sink in absence of weed competition. This is in accordance with the findings of Kumari (2015) [14], Samant (2016) [18] and Nasseruddin and Subramanyam (2013) [15].

Hand weeding twice at 25 and 50 DAS exhibited lowest number of unfilled grains/ panicle and it was significantly lower than rest of the treatments except oxadiargyl @ 70 g/ha at 7-11 DAS *fb* HW at 30-35 DAS. The maximum number of unfilled grains/panicle was recorded under weedy check. The high infestation of weeds in the weedy check might be resulted in less availability of key resources for grain development resulting in less translocation of photosynthates from source to sink ultimately increased the number of unfilled grains/panicle. The similar findings were also reported by Ahmed and Chauhan (2014) [1]. The highest test weight was obtained under oxadiargyl @ 70 g/ha at 7-11 DAS *fb* HW at 30-35 DAS which was at par with HW twice at 25 and 50 DAS, oxadiargyl @ 70 g/ha at 7-11 DAS *fb* bispyribac-sodium @ 25 g/ha at 30-35 DAS and pretilachlor with safener @ 750 g/ha at 7-11 DAS *fb* HW at 30-35 DAS. The lowest value of test weight was recorded under weedy check but it was comparable with pretilachlor with safener @ 750 g/ha at 7-11 DAS.

Economics

Table 4 contains data on economic factors that were computed using the current market prices for input and product. Under the application of oxadiargyl @ 70 g/ha at 7-11 DAS fb HW at 30-35 DAS, the maximum gross return, net return, and B: C ratio were obtained. The application of oxadiargyl @ 70 g/ha at 7-11 DAS and bispyribac-sodium @ 25 g/ha at 30-35 DAS stood as the next best treatment with respect to net return and B:C ratio, despite the fact that hand weeding twice at 25 and 50 DAS was found to be the next best treatment for obtaining gross return. Under weedy check, the minimal gross return, net return, and B:C ratio were recorded.

Oxadiargyl @ 70 g/ha at 7-11 DAS fb bispyribac-sodium @ 25 g/ha at 30-35 showed an increase in gross return, net return, and B:C ratio because the higher gross return was linked to a lower cultivation cost.

Table 1: Treatment details of experiment

Tr. No.	Treatment details	Dose	Time of application
T_1	Oxadiargyl	70 g/ha	7-11 DAS
T_2	Oxadiargyl + Bispyribac-Na	70 g/ha and 25 g/ha	7-11 DAS and 30-35 DAS
T_3	Oxadiargyl + Mechanical weeding	70 g/ha	7-11 DAS and 30-35 DAS
T_4	Oxadiargyl + Hand weeding	70 g/ha	7-11 DAS and 30-35 DAS
T_5	Pretilachlor	750 g/ha	7-11 DAS
T_6	Pretilachlor + Bispyribac-Na	750 g/ha and 25 g/ha	7-11 DAS and 30-35 DAS
T_7	Pretilachlor + Mechanical weeding	750 g/ha	7-11 DAS and 30-35 DAS
T_8	Pretilachlor + Hand weeding	750 g/ha	7-11 DAS and 30-35 DAS
T_9	Mechanical weeding twice	-	20-25 and 40-45 DAS
T_{10}	Hand weeding twice	-	25 and 50 DAS
T_{11}	Weedy check	-	-

Table 2: Plant height, total tillers, leaf area and dry matter accumulation of rice as influenced by integrated weed management practices

Treatments	Plant height (cm)	Total tillers (No./m^2)	Leaf area (cm^2/plant)	Dry matter accumulation (g/plant)
T_1	93.87	319.33	564.70	25.30
T_2	111.70	373.00	641.33	35.03
T_3	95.53	336.33	597.73	28.50
T_4	113.87	396.67	654.23	38.00
T_5	94.30	308.00	552.37	26.43
T_6	95.33	332.67	602.47	28.07
T_7	94.70	315.67	587.33	27.20
T_8	104.87	373.33	635.33	31.10
T_9	100.70	318.33	580.10	30.13
T_{10}	111.97	390.67	657.53	36.80
T_{11}	92.00	242.60	531.83	23.80
S.Em±	4.15	11.80	13.13	1.06
CD (P=0.05)	12.28	34.90	38.83	3.13

Table 3: Number of panicles, number of filled grains/panicle and number of unfilled grains/panicle of rice as influenced by integrated weed management practices

Treatments	Panicles (No./m^2)	Filled grains (No./panicle)	Unfilled grains (No./panicle)	Test weight (g)
T_1	250.1	107.1	23.0	26.6
T_2	365.9	123.5	16.8	27.9
T_3	265.5	115.8	19.1	26.9
T_4	370.3	134.4	14.5	28.7
T_5	233.1	113.5	24.6	26.5
T_6	312.8	121.1	20.5	26.9
T_7	256.2	122.9	21.2	26.6
T_8	344.0	126.0	17.0	27.5
T_9	293.9	119.4	16.3	27.2
T_{10}	358.7	129.8	12.7	28.0
T_{11}	231.1	73.0	29.5	25.4
S.Em±	12.0	3.7	0.9	0.4
C.D. (P=0.05)	35.4	11.2	2.8	1.2

Table 4: Economics of rice as influenced by different integrated weed management practices

Treatment	Total cost of cultivation (₹/ha)	Gross monetary return (₹/ha)	Net monetary return (₹/ha)	B: C ratio
T_1	29,832	56,900	27,068	1.91
T_2	31,928	73,190	41,262	2.29
T_3	31,612	61,435	29,823	1.94
T_4	32,502	81,210	48,708	2.50
T_5	29,530	49,220	19,690	1.67
T_6	31,626	63,105	31,479	2.00
T_7	31,310	54,180	22,870	1.73
T_8	32,200	72,325	40,125	2.25
T_9	32,891	66,365	33,474	2.02
T_{10}	37,341	78,195	40,854	2.09
T_{11}	28,441	43,695	15,254	1.54

Future scope

To assess the impact of different weed control techniques on weed management, the timing of their application could be adjusted. A better way to manage weeds would be to test different combinations of pesticides and physical methods of weed control. Research specifically focused on weed flora is necessary since weed flora might differ greatly between two areas. Since integrated weed management mitigates the harm that excessive chemical use is causing to our ecosystem, it should also be studied for alternative rice-planting techniques.

Conclusions

The best growth and yield qualities were obtained by using oxadiargyl at a rate of 70 g/ha between 7 and 11 days after sowing (DAS), followed by hand weeding at 30 to 35 DAS or twice at 25 and 50 DAS. The application of oxadiargyl @ 70 g/ha at 7-11 DAS fb HW at 30-35 DAS yielded the highest gross returns, net returns, and B:C ratio. It was closely followed by oxadiargyl @ 70 g/ha at 7-11 DAS fb bispyribac-Na @ 25 g/ha at 30-35 DAS.

References

1. Ahmed S, Chauhan BS. Performance of different herbicides in dry-seeded rice in Bangladesh. The Scientific World Journal. 2014;7(4):453-468.
2. Ali A, Erenstein O, Rahut DB. Impact of direct rice sowing technology on rice producer's earnings: Empirical evidence from Pakistan. Development Studies Research. 2014;1(1):244-254.
3. Anonymous. Annual Report 2016-17. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India; c2017b.
4. Anonymous. Rice Almanac: Source book for the most important economic activity on Earth 3rd Edition, International Rice Research Institute, Los Banos, Philippines; c1997. p. 12-13.
5. Anonymous. FAOSTAT. Food and Agriculture Organization of the United Nations, Rome; c2017a. http://www.fao.org/faostat/en/data/QC
6. Anonymous. Department of Agriculture, Govt. of Chhattisgarh, Raipur; c2017c. http://agriportal.cg.nic.in/agridept/AgriHi/KHARIF15.html
7. Auld BA, Tisdell CA. Economic thresholds and response to uncertainty in weed control. Agricultural Systems. 1987;25:219-227.
8. Chauhan BS. Weed management in direct-seeded rice systems. 1st Edition, International Rice Research Institute, Los Banos, Philippines; c2012. p. 1-2.
9. Chauhan BS, Mahajan G, Sardana V, Timsina J, Jat ML. Productivity and sustainability of the rice-wheat cropping system in the Indo-Gangetic plains of the Indian sub-continent: Problems, opportunities, and strategies. Advances in Agronomy. 2012;117(2):315-369.
10. De Datta SK, Bernasor PC, Migo TR, Llagas MA, Nantasomsaran P. Emerging weed control technology for broadcast seeded rice. In: Progress in irrigated rice research. Proceedings of International Rice Research Conference, 21-25 September, Hangzhou, China; c1989. p. 133-146.
11. Gomez KA, Gomez A. Statistical Procedures for Agricultural Research, IInd edition. Wiley, New York; c1984.
12. Kim SC, Ha WG. Direct-seeding and weed management in Korea, In: Rice is life: Scientific perspective s for the =

21st century. Proceedings of the World Rice Research Centre Conference, 4-7 November, Tokyo, Japan; c2005. p. 181-184.
13. Kumar R, Kumar M, Deka BC. Production potential, profitability and energetic of transplanted rice as influenced by establishment methods and nutrient management practices in Eastern Himalaya, Research on Crops. 2015;16(4):11.
14. Kumari G. Effect of establishment and weed control methods on growth and yield of rice. Msc. Thesis, Birsa Agricultural University, Ranchi; c2015. p. 96.
15. Naseeruddin R, Subramanyam D. Performance of low dose high efficacy herbicides in drum seeded rice. Indian Journal of Weed Science. 2013;45(4):285–288.
16. Rahman MM, Masood MM. Aerobic system: A potential water saving boro rice production technology. National conference on adaptation of aerobic system for boro rice cultivation in farmer's field for saving irrigation water and attaining food security, Manilla, Philippines; c2012. p. 1-2.
17. Rosegrant MW, Cai X, Cline SA. World, water and food to 2025: dealing with scarcity. 1st Edition, I.F.P.R.I., Washington, D.C.; c2002. p. 5.
18. Samant TK. Effect of oxadiargyl on weed density, yield and economics in dry seeded rice through front line demonstration. Journal of Crop and Weed. 2016;12(1):120-124.
19. Swanton CJ, Weise SF. Integrated weed management: The rationale an approach. Weed Technology. 1991;5:657-663.