Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 3117-3121
Received: 25-05-2018
Accepted: 30-06-2018

Harveer Singh
Ph.D. Scholar, Department of Agronomy, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut, Uttar Pradesh, India

NS Rana
Professor, Department of Agronomy, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

VD Yadav
Ph.D. Scholar, Department of Agronomy, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut, Uttar Pradesh, India

SS Tomar
Associate Professor, RVSKVV, ZARS-Morena, Madhya Pradesh, India

Correspondence
Harveer Singh
Ph.D. Scholar, Department of Agronomy, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut, Uttar Pradesh, India

Effect of crop establishment techniques and weed management practices on productivity and nutrient uptake of hybrid rice (*Oryza sativa*)

Harveer Singh, NS Rana, VD Yadav and SS Tomar

Abstract
A field experiment was conducted at Modipuram, Meerut during the *kharif* season of 2007-08 and 2008-09 to study the effect of crop establishment techniques and weed management practices on the productivity and nutrient uptake of hybrid rice (*Oryza sativa* L.). In this investigation four rice establishment techniques *viz;* puddled transplanting, unpuddled transplanting, puddled drum seeding and direct sowing (line sowing) and six weed management practices *viz.*, weedy, weed free, pendimethalin PE @ 1.0 kg a.i./ha, pendimethalin PE @ 1.0 kg a.i./ha + hand weeding at 30 DAS, pendimethalin PE @ 1.0 kg a.i./ha + almix PoE @ 4 g a.i./ha and pendimethalin PE @ 1.0 kg a.i./ha + fenoxaprop-p-ethyl PoE @ 70 g a.i./ha were tested in split plot design with three replications. The study revealed that puddled transplanted rice, being at par with puddled drum seeding recorded significantly highest numbers of panicles/m^2 (311.3 and 315.7), panicle length (28.9 and 30.6 cm), (151.7 and 155.7 cm), yield of rice, grain yield (5.99 and 6.14 t/ha), straw yield, nutrient uptake. Pendimethalin @ 1.0 kg a.i./ha + hand weeding followed by pendimethalin @ 1.0 kg a.i./ha + almix @ 4 g a.i./ha recorded significantly highest grain yield (59.8 and 62.5 q/ha), straw yield (83.4 and 85.6 q/ha), harvest index of rice, nutrient uptake. The study recommended that the cultivation of hybrid rice with drum seeding establishment technique with pendimethalin @ 1.0 kg a.i./ha + almix @ 4 g a.i./ha gave the maximum yield and economic benefit to the farmers of India.

Keywords: Crop establishment techniques, Productivity, nutrient uptake and weed management practices

Introduction
Sustainability of rice-wheat cropping system, vital in providing food security and livelihood to hundreds of millions of people around the globe, is under question due to various environmental, economic and management problems (Fujsaka *et al*., 1994) [3]. Hybrid rice is one of the viable and proven technologies available at present to enhance the rice productivity and production in the India. Since, rice is mostly taken as manually transplanted crop under puddled condition the yield is high and water losses through deep seepage and percolation are reduced compare with unpuddled condition, but it has its own limitation and ill effect on soil health. The agricultural production and productivity depends largely on the quality of land and sustainable practices (Yadav *et al*., 2013a) [21]. This technique is cumbersome, labour intensive and requires continuous pounding of water creating a compacted layer (plough pan) which restrict the percolation of water and creates temporary water logging resulting poor root penetration and growth of succeeding crops (Tomar *et al*., 2006) [17]. Therefore, production practices for rice cultivation are need to shift from paddy-rice to aerobic rice/direct seeding to make more efficient use of irrigation water (Yadav *et al*., 2013d) [20]. Direct seeding of rice in rows, under dry condition; offer a useful option to reduce the adverse effect of puddling. Besides, this also aids in quick establishment and early harvest of rice thereby, early sowing of wheat (Singh *et al.*, 2007) [14].

However, the direct seeded rice culture is subjected to greater weed competition than transplanted rice. Yield reduction due to weeds have been reported to the extent of 25% in transplanted rice, 32% in puddled broadcasted rice and 52% in direct sown rice (Manna, 1991) [6]. Hence to avoid yield losses, weed control in direct seeded rice becomes an immensely important practice. Traditionally weed control is done by hand weeding but now a days weeding becomes rather difficult due to costly and scarce labour. Application of herbicides with hand weeding may be a good option to control the weeds. Effort is needed to formulate an input package with the combination of different practices, so that it will be technically effective, feasible and environmentally acceptable (Yadav *et al*., 2013c) [22]. Therefore, the present investigation was undertaken to study the effect of sequential application of pre and

post-emergence herbicides on yields and nutrient uptake of hybrid rice under different establishment techniques.

Materials and Methods

A field experiment was conducted during rainy and winter season of 2007-08 and 2008-09 on sandy loamy soil at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture and Technology, Modiouram, Meerut. (29^0 05' 19" N latitudes, 77^0 41' 50" E longitudes and 237 metres above mean sea level). The rainfall during cropping seasons from July to April was 429.5 mm and 480.5 mm during 2007-08 and 2008-09, respectively. The soil at site was sandy loam with organic carbon 0.47 and 0.42, available N 224.1 and 225.6 kg/ha, available P 13.5 and 13.7 kg/ha and available K 176.5 and 177.3 kg/ha, during 2007 and 2008, respectively. The experiment was carried out in split plot design with three replications. The treatments include four rice establishment techniques *viz;* puddled transplanting, unpuddled transplanting, puddled drum seeding and direct sowing (line sowing) and six weed management practices *viz.*, weedy, weed free, pendimethalin PE @ 1.0 kg a.i./ha, pendimethalin PE @ 1.0 kg a.i./ha + hand weeding at 30 DAS, pendimethalin PE @ 1.0 kg a.i./ha + almix PoE @ 4 g a.i./ha and pendimethalin PE @ 1.0 kg a.i./ha + fenoxaprop-p-ethyl PoE @ 70 g a.i./ha to rice.

Main field was irrigated, ploughed with tractor-drawn disc plough followed by harrowing after the soil reached to tilth conditions and leveling was done with land leveler. Hybrid rice 'PRH-10' was sown on 6 and 10 June and; transplanted on 1 and 3 July during 2007 and 2008, respectively. Recommended doses of NPK (120, 26.2, 33.2 kg/ha) were applied. Total P, K and 1/3 N were broadcasted before sowing and rest was top dressed at tillering and flowering stages in two equal half. All the treatments were applied to rice as per the standard methods and data on yield attributes and yield were recorded. All the data obtained from rice for two consecutive years of study were statistically analysed using the *F*-test the procedure given by Gomez and Gomez (1984) [4]. Critical difference (CD) values at *P*=0.05 were used for determine the significance of differences between means.

Results and Discussion

Yield attributes and yield

All the yield attributes of rice (number of panicles per m^2, panicle length (cm) and number of grains/panicle) were significantly affected by establishment technique are presented in Table 1. The puddled transplanted rice, being at par with puddled drum seeding recorded the significantly highest numbers of panicles/m^2 (311.3 and 315.7), panicle length (28.9 and 30.6 cm), (151.7 and 155.7 cm) as compared to all other treatments during 2007 and 2008, respectively. However, 1,000 grain weight was not significantly affected by establishment techniques. Effective weed control and thereby better crop weed competition resulted in beneficial effects on the yield contributing character *viz*., number of panicles, panicle length, number of grains/panicle and 1000-grains weight (Table 1). The findings are in consonance with those reported by Reddy (1999) [9], Rath *et al*. (2000) [8] and Yadav *et al*. (2011) [19].

Table 1: Yield attributes of rice as influenced by crop establishment and weed management practices at harvest

Treatment	Number of panicles/m^2		Panicle length (cm)		Grains/ panicle		1000- grain weight (g)	
	2007	2008	2007	2008	2007	2008	2007	2008
Crop establishment techniques								
Puddled transplanting (PT)	311.3	315.7	28.9	30.6	151.7	155.7	22.5	23.3
Puddled drum seeding (PDS)	306.1	312.4	27.8	28.9	143.1	148.2	22.6	23.7
Unpuddled transplanting (UPT)	298.6	304.3	27.0	28.3	135.4	140.6	21.8	22.7
Direct seeding (DS)	280.7	288.3	25.7	27.0	125.6	130.4	22.0	23.2
SEm±	4.00	4.26	0.44	0.46	1.92	2.18	0.28	0.30
CD (P=0.05)	13.8	14.7	1.5	1.6	6.6	7.5	NS	NS
Weed management practices								
Weedy (W_0)	217.5	222.7	19.8	21.3	75.1	80.0	19.2	19.8
Weed-free (W_1)	349.3	355.0	32.7	34.1	168.8	173.7	24.0	25.3
Pendimethalin (PE) (W_2)	299.8	305.8	26.6	27.9	134.1	139.1	21.1	22.3
Pendimethalin + HW at 30 DAS/DAT (W_3)	317.1	323.1	29.0	30.3	157.5	162.8	23.8	24.6
Pendimethalin +Almix at 25 DAS/DAT (W_4)	310.8	317.1	28.4	29.7	152.1	157.1	23.2	24.3
Pendimethalin + Fenoxaprop at 25 DAS/DAT (W_5)	300.6	307.5	27.7	29.1	146.1	149.6	22.1	23.1
SEm±	2.59	2.64	0.27	0.32	2.24	2.47	0.32	0.34
CD (P=0.05)	7.4	7.6	0.8	0.9	6.4	7.1	0.9	1.0

The results also showed that the yield attributes of rice *viz.* number of panicles, panicle length, number of grains/panicle and 1000-grains weight were highest with pendimethalin @ 1.0 kg a.i./ha + hand weeding followed by pendimethalin @ 1.0 kg a.i./ha + almix @ 4 g a.i./ha during both the years. Effective suppression of weed growth throughout the critical period of crop weed competition might have enabled the rice crop to bear promising architecture of yield attributes and higher grain filling percentage in integrated weed-management practices of pendimethalin @ 1.0 kg a.i./ha + hand weeding compared with the weedy check. The results are in close conformity with Saha (2006) [10].

From perusal of the results presented in Table 2 it becomes clear that the rice transplanted in puddled condition gave significantly more grain yield than other methods. Puddled drum seeding also proved significantly superiority to direct line sowing. The grain yield of puddled transplanted rice was 4.9, 10.5 and 8.7%, respectively more over puddled drum seeding, unpuddled transplanting and direct seeding during 2007 and 1.15, 7.91 and 6.04% more during 2008. Yadav *et al*. (2011) [19] also reported higher grain yield in puddled field than unpuddled one. It could be due to improvement in soil physico-chemical properties and low competition of weeds during initial period of crop growth.

The straw yield influenced significantly due to different crop establishment techniques during both the years. Puddled transplanted rice, being at par with puddled drum seeding recorded significantly highest straw yield of rice (8.63 and 8.79 t/ha), while the lowest straw yield (7.38 and 7.62 t/ha) was recorded with direct seeding during 2007 and 2008,

respectively, which was significantly lower than the straw yield obtained in treatments of puddled rice during both the years. The extent of increase in straw yield of rice due to rice sowing in puddled condition over direct sowing and unpuddled transplanting was attributed to better tiller production and height of plant. Puddling as a means of improving the productivity of rice through land submergence and weed control is well documented (Adachi, 1992; Singh *et al*., 1995) [1, 13].

Besides, the better yield achieved under puddled condition compared to other sowing methods might be assigned to the fact that puddled crop was not affected by transplanting shock and crop establishment was better throughout the growing period. Puddled transplanted method also had positive effect on size of grain, ear weight and numerically positive effect on grains/ panicle, panicle length, productive tillers which cumulatively resulted in significant increasing in the grain yield. The results are in conformity with the findings of Trinh *et al.* (2002) [18], Singh *et al.* (2004) [12], Singh *et al.* (2005) [16], Singh *et al.* (2006) [11] and Yadav *et al*. (2011) [19].

Harvest index was not influenced significantly due to various crop establishment techniques during both the years of experimentation. However, the significantly maximum values of harvest index (0.42 and 0.43) were noticed in direct seeding, while the minimum harvest index (0.41 and 0.41) was recorded with puddled transplanted rice during 2007 and 2008, respectively.

Perusal of the results presented in Table 2 makes it clear that all the weed management practices increased significantly the grain and straw yields over weedy check. Significantly highest grain and straw yields were recorded with pendimethalin @ 1.0 kg a.i./ha + hand weeding during both the years. The possible reason for this might be effective suppression of weeds without phytotoxicity and consequent higher values of yield contributing characters (panicles/m^2, effective spikelets/panicle and test weight). This result can also be attributed to marked improvement in dry matter accumulation, plant height and leaf area index under pendimethalin @ 1.0 kg a.i./ha + hand weeding. Lowest grain yield was recorded under weedy check attributed to vigorous weed growth and consequent reduction in growth of crop plants. The results are in agreement with the findings of Mohan *et al.* (2005) [7].

Table 2: Grain yield, straw yield and harvest index of rice as influenced by crop establishment and weed management practices

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Harvest index	
	2007	2008	2007	2008	2007	2008
Crop establishment techniques						
Puddled transplanting (PT)	5.99	6.14	8.63	8.79	0.41	0.41
Puddled drum seeding (PDS)	5.71	6.07	8.11	8.35	0.41	0.42
Unpuddled transplanting (UPT)	5.42	5.69	7.84	8.02	0.41	0.41
Direct seeding (DS)	5.51	5.79	7.38	7.62	0.42	0.43
SEm±	0.05	0.05	0.19	0.19	0.005	0.005
CD (P=0.05)	0.17	0.16	0.66	0.67	NS	NS
Weed management practices						
Weedy (W_0)	4.17	4.43	7.33	7.49	0.36	0.37
Weed-free (W_1)	6.62	6.92	8.49	8.70	0.44	0.44
Pendimethalin (PE) (W_2)	5.63	5.88	7.70	7.89	0.42	0.43
Pendimethalin + HW at 30 DAS/DAT (W_3)	5.98	6.25	8.34	8.56	0.42	0.43
Pendimethalin +Almix at 25 DAS/DAT (W_4)	5.89	6.13	8.16	8.36	0.41	0.42
Pendimethalin + Fenoxaprop at 25 DAS/DAT (W_5)	5.68	5.99	7.92	8.18	0.42	0.42
SEm±	0.05	0.05	0.19	0.18	0.01	0.01
CD (P=0.05)	0.15	0.15	0.57	0.54	0.02	0.03

Nutrient uptake

The significant difference in total NPK uptake of rice was recorded due to different crop establishment techniques during both the years of experimentation (Table 3). The significantly highest total N PK uptake by rice was recorded under puddled transplanted rice (118.9 and 125.4 kg N/ha, 30.6 and 33.3 kg P/ha, 136.9 and 141.2 kg K/ha) over rest of treatments which was at par with puddled drum seeding, while the lowest total N uptake in rice was recorded under direct seeding (95.6 and 104.3 kg N/ha, 23.1 and 25.9 kg P/ha, 104.2 and 109.7 kg K/ha) during 2007 and 2008, respectively. Similar result was also reported by Yadav *et al*. (2011) [19]. Rice grown under puddled condition gave higher grain and straw yields and consequently higher NPK uptake compared with unpuddled condition. This might be due to the fact that puddling reduced the weed population as well as increased the nutrient availability which led to higher grain and straw yield under transplanting and also higher concentration of nutrients in plant parts i.e. both grain and straw.

Table 3: Nutrient uptake in rice as influenced by crop establishment and weed management practices

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	2007	2008	2007	2008	2007	2008
Crop establishment techniques						
Puddled transplanting (PT)	118.9	125.4	30.6	33.3	136.9	141.2
Puddled drum seeding (PDS)	110.8	118.4	27.0	30.0	123.6	129.4
Unpuddled transplanting (UPT)	101.8	107.3	25.1	27.4	114.1	118.4
Direct seeding (DS)	95.6	104.3	23.1	25.9	104.2	109.7
SEm±	2.13	2.18	0.40	0.47	2.71	2.72
CD (P=0.05)	7.4	7.5	1.4	1.6	9.4	9.4
Weed management practices						
Weedy (W_0)	75.9	82.0	18.0	20.5	86.2	89.8

Weed-free (W_1)	130.6	138.7	33.4	36.3	146.4	152.2
Pendimethalin (PE) (W_2)	99.7	105.8	24.9	27.3	103.7	108.0
Pendimethalin + HW at 30 DAS/DAT (W_3)	117.7	124.4	28.9	31.5	133.9	139.2
Pendimethalin +Almix at 25 DAS/DAT (W_4)	112.5	120.1	28.0	30.6	130.8	136.1
Pendimethalin + Fenoxaprop at 25 DAS/DAT (W_5)	104.2	112.1	25.8	28.6	117.2	122.8
SEm±	1.73	1.91	0.48	0.51	2.94	2.92
CD (P=0.05)	4.9	5.5	1.4	1.5	8.4	8.4

The weed management practices had significant effect on total N uptake in rice during both the years of experimentation. The significantly highest total N uptake in rice was recorded with pendimethalin @ 1.0 kg a.i./ha + hand weeding (117.7 and 124.4 kg N/ha, 28.9 and 31.5 kg P/ha, 133.9 and 139.2 kg K/ha) over rest of treatments. However, the lowest total N uptake in rice was recorded with weedy check (75.9 and 82.0 kg N/ha, 18.0 and 20.5 kg P/ha, 86.2 and 89.8 kg K/ha) during 2007 and 2008, respectively. Similar finding was recorded by Chaubey *et al.* (1999) [2]. The lowest N, P and K content and uptake in grain and straw of rice was recorded with weedy check. This might be due to over exploitation of nutrients by weeds and resultant decline in N, P and K contents in rice. Since uptake is the function of dry matter and nutrient contents, the lower dry matter accumulation by rice due to weed infestation might have led to reduction in uptake of the nutrients. The results are in conformity with the findings of Singh *et al.* (1998) [15] and Jaiswal and Singh (2001) [5].

References

1. Adachi K. Effect of puddling on rice soil physics; softness of puddle soil and percolation. In proc. International workshop on soil and water engineering for paddy field management. Asian Institute of Technology, Bangkok, 1992, 220-231.
2. Choubey NK, Tripathi RS, Ghosh BC. Effect of fertilizer and weed management on direct-seeded rice on nutrient utilization. Indian Journal of Agronomy. 1999; 44(2):213-215.
3. Fujsaka S, Harrington L, Hobbs PR. Rice–wheat in south Asia: sytem and long term priorities established through diagnostic research. Agricultural Systems 1994; 45:169-187.
4. Gomez KA, Gomez AA. Statistical procedures for agricultural research. IInd Edition. An International Rice Research Institute Book. A Wiley-Interscience Publication, John Wiley & Sons, New York, 1984
5. Jaiswal VP, Singh GR. Performance of urea super granules and prilled urea under different planting methods in irrigated rice. Indian Journal of Agricultural Sciences. 2001; 71(3):187-189.
6. Manna GB. Weed management for increasing efficiency of fertilizer. Proceedings of Summer Institute on Nutrient Transformation and Management in flooded Soil Rice Ecosystem, held at CRRI, Cuttack (Orissa) during, 1991, 391-401.
7. Mohan KS, Muniyappa TV, Shiva Kumar HR. Effect of pre-emergence herbicides on growth and yield of direct seeded puddled rice (Oryza sativa). Extended Summaries, National Biennial Conference, held during 6–9 April 2005 at ISWS, PAU, Ludhiana, 2005, 28-9,
8. Rath BS, Mishara RD, Pandey DS, Singh VP. Effect of sowing methods on growth, productivity and nutrient uptake of wheat at varying levels of puddling in rice. Indian Journal of Agronomy. 2000; 45(3):463-469.
9. Reddy BS, Reddy SR. Effect of soil and water management on weed dynamics in low land rice. Indian Journal of Weed Science. 1999; 31(3-4):179-182.
10. Saha S. Comparative study on efficacy of sulfonylurea herbicides and traditional recommended herbicides in transplanted rice (*Oryza Sativa* L.). Indian. Journal of Agronomy. 2006; 51(4):304-306.
11. Singh UP, Singh Y, Prasad K. Effect of planting pattern and weed control on Boro Rice. Indian Journal of Weed Science. 2006; 38(1-2):42-44.
12. Singh G, Singh VP, Singh M. Effect of almix and butachlor alone and in combination on transplanted rice and associated weeds. Indian Journal of Weed Science 2004; 36(1-2): 64-67.
13. Singh R, Gajri PR, Gill KS, Khora BR. Pudding intensity and nitrogen use efficiency of rice on a sandy loam soil of Punjab. Indian Journal of Agricultural Sciences. 1995; 65:749-751.
14. Singh S, Ladha JK, Gupta RK, Lav B, Rao AN, Sivaprasad B *et al*. Evaluation of mulching, intercropping with Sesbania and herbicide use for weed management in dry-seeded rice (*Oryza sativa* L.). Crop Protection 2007; 26:518-524.
15. Singh SP, Bhan BM, Singh S. Performance of sulfonylurea herbicide on weed control in transplanted rice. Annals of Plant Protection. 1998; 6:189-191.
16. Singh VP, Singh G, Singh RK, Singh SP, Kumar A, Dhyani VC *et al*. Effect of herbicides alone and in combination on direct seeded rice. Indian Journal of Weed Science. 2005; 37(3/4):197-201.
17. Tomar RK, Singh D, Gangwar KS, Garg RN, Gupta VK, Sahoo RN *et al*. Influence of tillage system and moisture regimes on soil physical environment, growth and productivity of rice-wheat system in upper Gangetic plains of western Utter Pradesh. The Indian Journal of Crop Science. 2006; 1(1-2):146-50.
18. Trinh QK, Hiraoka H, Obayashi H. Phan, Sy. Tan. Optimum method and rate of seedling rice under various cultural practices in the Mekong Delta. JIRCAS Working Report. 2002; 26:11-16.
19. Yadav GS, Shivay YS, Kumar D. Effect of mulching and iron nutrition on productivity, nutrient uptake and economics of aerobic rice (*Oryza sativa*). Indian Journal of Agronomy. 2011; 56(4):59-66.
20. Yadav GS, Shivay YS, Kumar D, Babu S. Enhancing iron density and uptake in grain and straw of aerobic rice through mulching and rhizo-foliar fertilization of iron. African Journal of Agricultural Research. 2013d; 8(xx):5447-5454.
21. Yadav G, Debnath C, Datta M, Ngachan SV, Yadav JS, Babu S. Comparative evaluation of traditional and improved farming practices in Tripura. Indian Journal of Agricultural Sciences 2013a; 83(3):310-314.
22. Yadav GS, Datta M, Babu S, Debnath C, Sarkar PK. Growth and productivity of lowland rice (*Oryza sativa*) as influenced by substitution of nitrogen fertilizer by

organic sources. Indian Journal of Agricultural Sciences 2013c; 83(10):1038–1042.
23. Yadav SK, Babu S, Singh Y, Yadav MK, Yadav GS, Pal S *et al*. Effect of organic nutrient sources on yield, nutrient uptake and soil biological properties of rice (*Oryza sativa*)-based cropping sequence. Indian Journal of Agronomy. 2013b; 58(3):271-276.