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# INFLUENCE OF CROP ESTABLISHMENT METHODS AND DIFFERENT WEED MANAGEMENT PRACTICES ON GROWTH, YIELD AND QUALITY OF DIRECT SEEDED RICE (*ORYZA SATIVA* L.)

**VINAY KUMAR*, D. K. ROY, DHARMINDER, RAJAN KUMAR, SHANTANU KUMAR AND HANSRAJ HANS**
Department of Agronomy, Faculty of Agriculture,
Rajendra Agricultural University, Pusa - 848 125, Samastipur, Bihar, INDIA
e-mail: vinaypusa@gmail.com

**ABSTRACT**

A field experiment was designed in strip plot, having three rice establishment methods (broadcasting of sprouted seed on puddled bed, dry seeding in rows 20 cm apart and drum seeding of sprouted seeds on puddled bed) in main plots and eight herbicidal treatments(pre-emergenceButachlor @ 1.5 kg/ha, pre-emergenceButachlor @ 1.5 kg/ha + post-emergence Bispyribac @ 25 g/ha, pre-emergence Pretilachlor @ 0.75 kg/ha, pre-emergence Pretilachlor @ 0.75 kg/ha + post-emergence Bispyribac @ 25 g/ha, pre-emergence Pendimethalin @ 1.0 kg/ha, pre-emergence Pendimethalin @ 1.0 kg/ha + post-emergence Bispyribac @ 25 g/ha , two hand weedings at 20 and 40 DAS and weedy check) in sub plots. The weed population, dry weight and nutrient uptake clear cut shows the growth and yield pattern. The pre and post-emergence applications of Pendimethalin + Bispyribac and drum seeding of sprouted seed is best among all the treatments.

**KEY WORDS**
Drum seeding
Weed management practices
Rice yield
Direct seeded rince
Weedicide

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***Corresponding author**

## INTRODUCTION

Rice (*Oryza sativa* L.) is a leading food crop and staple food of half of the world's population. In India about 43.97 m ha of lands are under rice cultivation with production of 104.32 million tonnes and an average productivity of about 23.72 q/ha. In Bihar rice is cultivated in around 3.34 m ha with a production of 7.2 million tones and productivity of 21.58 q/ha.Direct seeded culture has become increasingly important in rice cultivation due to scarcity of farm labour, higher water requirement and higher production cost of transplanted rice (Azmi and Baki, 2007). Direct seeded rice needs only 34% of the total labour requirement and saves 27% of the total cost of the transplanted crop (Mishra and Singh, 2011). The direct seeded rice culture is subjected to greater weed competition than transplanted rice because both weed and crop seeds emerge at the same time and compete with each other for nutrient and space, resulting in loss in grain yield. It is required to avoid any loss in yield because the dry weight of weeds increases greatly from 30 DAS in dry direct-seeded rice.Direct wet seeding of rice reduces labour requirement, hastens crop maturity, increases water use efficiency (WUE). Sowing of pre-germinated rice seeds under puddled condition either manually or drum seeding method reduces the demand of water for puddling and reduces the emergence of weed flora by placing the seed, stems and stolons of weed into sub-surface. Uncontrolled weeds reduce the yield by 96% in dry direct seeded rice and 61% in wet direct-seeded rice (Maity and Mukherjee, 2008). Dry seeding with subsequent saturated soil conditions reduces the amount of water required during puddling and thus reduces overall water requirement. Herbicides are more effective in controlling the weeds and hereby improving the total energy required for rice cultivation (Singh *et al.*, 2014). Though, the conventional method of manual weeding is widely practiced, herbicides are more efficient in timely control of weeds in direct seeded rice. Chemical weeding preferably the use of pre-emergence herbicide is vital for effective and cost-efficient weed control in such condition, where weeds compete with the main crop right since the date of germination. Gogoi (1995) also summed up that the loss in grain yield due to weeds may be to the tunes of 20 to 95 per cent.

Hence, the present research was planned to study the influence of pre-emergence and new post-emergence herbicides on weed flora, crop yield, nutrient uptake by weeds and crop in direct seeded rice under different crop establishment methods.

## MATERIALS AND METHODS

A field experiment was conducted during Kharif season 2012 at research farm of Rajendra Agricultural University Bihar, Pusa. The aforesaid is situated on the southern bank of the river *Budhi Gandak* in Samastipur district at 25.59° North

latitude and 84.40° East longitude with an altitude of 52.3 m above the mean sea level (MSL). The soil of the experimental plot was clay loam with pH 8.79 and organic carbon 0.40%. The test variety under proposed research was Prabhat. The fertility status of the soil was low in available nitrogen (203.2 kg/ha), phosphorus (17 kg $P_2O_5$ /ha) and potassium (101.7 kg $K_2O$/ha). The factors under study comprised three establishment methods i.e. $E_1$-Wet seeded (broadcasting of sprouted seeds under puddled condition), $E_2$ - Dry seeded in rows at 20 cm apart, $E_3$ - Drum seeded puddled condition in main plots and 8 herbicidal treatments on direct seeded rice i.e. $W_1$- Butachlor @ 1.5 kg /ha (pre-emergence), $W_2$- Butachlor(pre-emergence) @ 1.5 kg /ha *fb* Bispyribac @ 25 g/ ha (Post emergence). $W_3$- Pretilachlor @ 0.75 kg /ha (pre-emergence), $W_4$- Pretilachlor @ 0.75 kg /ha (pre-emergence) *fb* Bispyribac @ 25 g/ha (Post emergence ), $W_5$- Pendimethalin @ 1.0 kg/ha (pre-emergence), $W_6$- Pendimethalin @ 1.0 kg/ha (pre-emergence) *fb* Bispyribac @ 25 g/ha (Post emergence ), $W_7$- Hand weeding at 20 & 40 DAS, $W_8$- weedy check in sub-plots in strip plot design with three replications.The fertilizer dose viz. 100-60-40 kg N - $P_2O_5$ - $K_2O$/ha were applied in experimental field. Nitrogen was applied through urea and $P_2O_5$ as DAP whereas $K_2O$ was applied through MOP (Singh *et al*., 2014). Nitrogen was applied in three equal splits (sowing time, active tillering stage and panicle initiation stage). Single basal dose of P and K was applied along with N in three equal splits. Herbicides were applied through knap-sac sprayer fitted with flat fan nozzle.

The harvest index was calculated by using the formula as described by Singh and Stockopf (1971).

$$\text{Harvest index (\%)} \quad \frac{\text{Economic yield (grain yield)}}{\text{Biological yield (grain straw yield)}} \quad 100$$

## RESULTS AND DISCUSSION

### Effect on weeds

Both weed population and bio-mass accumulation per unit area were less in sole pre-emergence application than the control weedy check. The combination of pre and post application of herbicides were more effective in comparison with their sole application. Similarly, two hand weedings was next only to pre-emergence application Pendimethalin + Bispyribac. As in case of other characters single pre-emergence application of Pretilachlor was superior to other single applications of Butachlor and Pendimethalin. But, in case of pre-post combinations of Pendimethalin + Bispyribac was quite ahead of the two other combinations. Quite in league with the weed population and weed biomass, the weed control efficiency was the best in Pendimethalin + Bispyribac (71.67%), followed by 2 HW (65.83%), Pretilachlor + Bispyribac (65.06%), Butachlor + Bispyribac (57.61), Pretilachlor alone (54.08), Pendimethalin in alone (46.50) and Butachlor alone (42.27%). The efficacy of herbicides and their combination are interplay of weed flora present under varying moisture regimes and establishment methods as explained by Singh and Paikra (2014). The combination capable of covering the maximum diversity of weed flora performed comparatively better. The results as regards to weed population and their bio-mass accumulation are in close conformity with the results reported earlier by Verma *et al*. (2015) Singh and Tongpong (2002) and Ravi Shankar *et al*. (2008).

### Effect on crop

Number of panicles/$m^2$ was the maximum under Pendimethalin application followed by post-emergence herbicide Byspyribac application which was closely followed by 2 hand weedings. Important point to make a note here lies in the fact that pre-emergence application of Pretilachlor had higher panicles per unit area than pre-emergence application of Pendimethalin. But, when these two treatments were supplemented with Bispyribac as post - emergence application, the Pendimethalin + Bispyribac significantly superior than Pretilachlor + Bispyribac. Pendimethalin + Bispyribac combination also out classed Butachlor + Bispyribac with a big margin. The length of panicle also gave quite a similar result as in case of panicle/$m^2$. In case of number of grains per panicle, it was not only Pretilachlor but also the pre - emergence application of Butachlor, which had significantly higher

**Table 1: Effect of crop establishment and weed control methods on growth, yield attributes, yield and economics of direct seeded rice.**

| Treatments | Plant height (cm) | No. of panicles /$m^2$ | Length of panicle (cm) | No of grains/ panicle | 1000 grain weight (g) | Grain yield (q/ha) | Straw yield (q/ha) |
|---|---|---|---|---|---|---|---|
| Wet seeded (broadcasting of sprouted seeds under puddled condition) | 61.55 | 211.12 | 18.05 | 94.62 | 19.45 | 32.70 | 47.29 |
| Dry seeded in rows at 20 cm apart | 58.42 | 187.75 | 17.07 | 80.75 | 18.90 | 29.56 | 44.74 |
| Drum seeded in puddled condition | 63.73 | 231.62 | 18.66 | 113.33 | 20.08 | 35.58 | 49.71 |
| SEm ± | 0.20 | 0.45 | 0.06 | 0.36 | 0.10 | 0.91 | 0.90 |
| LSD (P = 0.05) | 0.81 | 1.80 | 0.24 | 1.43 | 0.40 | 3.57 | 3.55 |
| Butachlor 1.5 kg/ha ( pre -emergence) | 60.50 | 202.00 | 17.63 | 92.66 | 19.30 | 31.63 | 43.93 |
| Butachlor 1.5 kg/ha *fb*ispyribac 25 g/ha | 62.00 | 218.00 | 18.30 | 98.55 | 19.73 | 34.36 | 48.64 |
| Prtilachlor 0.75 kg/ha (pre-emergenc) | 61.36 | 212.33 | 18.13 | 97.33 | 19.46 | 33.60 | 47.26 |
| Prtilachlor 0.75 kg/ha *fb*ispyribac 25 g/ha | 62.66 | 224.66 | 18.50 | 104.00 | 19.83 | 35.35 | 51.29 |
| Pendimethalin 1.0 kg/ha (pre -emergence) | 59.86 | 202.00 | 17.73 | 87.33 | 19.16 | 32.26 | 46.04 |
| Pendimethalin 1.0 kg/ha *fb* Bispyribac 25 g/ha | 63.20 | 230.00 | 18.73 | 110.66 | 19.93 | 35.55 | 52.57 |
| Hand weeding at 20 and 40 DAS | 62.96 | 227.00 | 18.53 | 108.66 | 19.96 | 35.36 | 51.62 |
| Weedy check | 57.33 | 165.33 | 15.86 | 70.66 | 18.43 | 22.80 | 36.63 |
| SEm ± | 0.37 | 1.06 | 0.14 | 0.70 | 0.13 | 0.94 | 1.07 |
| LSD (p = 0.05) | 1.13 | 3.22 | 0.42 | 2.14 | 0.40 | 2.87 | 3.27 |

**Table 2: Effect of crop establishment and weed control methods on weed counting, weed dry weight and weed control efficiency**

| Treatments | Weed count (No./m²) 30 DAS | 60 DAS | 90 DAS | Weed dry weight (g/m²) 30 DAS | 60 DAS | 90 DAS | Weed control efficiency (%) |
|---|---|---|---|---|---|---|---|
| Wet seeded (broadcasting of sprouted seeds under puddled condition) | 39.87 | 152.37 | 161.50 | 12.89 | 106.22 | 124.91 | - |
| Dry seeded in rows at 20 cm apart | 51.12 | 219.00 | 281.75 | 15.48 | 177.84 | 190.76 | - |
| Drum seeded in puddled condition | 28.62 | 87.50 | 100.37 | 10.25 | 72.01 | 87.97 | - |
| SEm ± | 0.70 | 0.76 | 0.33 | 0.42 | 0.55 | 0.36 | - |
| LSD (P = 0.05) | 2.77 | 2.99 | 1.31 | 1.67 | 2.17 | 1.44 | - |
| Butachlor 1.5 kg/ha ( pre -emergence) | 43.66 | 172.33 | 227.66 | 13.37 | 140.06 | 156.55 | 42.27 |
| Butachlor 1.5 kg/ha *fb* Bispyribac 25 g/ha | 34.66 | 134.66 | 149.00 | 12.06 | 96.40 | 114.93 | 57.61 |
| Prtilachlor 0.75 kg/ha (pre-emergenc) | 37.00 | 148.00 | 168.00 | 12.64 | 108.88 | 124.51 | 54.08 |
| Prtilachlor 0.75 kg/ha *fb* Bispyribac 25 g/ha | 31.33 | 116.00 | 115.33 | 11.48 | 80.07 | 94.73 | 65.06 |
| Pendimethalin 1.0 kg/ha (pre -emergence) | 41.33 | 180.66 | 208.33 | 13.83 | 132.67 | 145.07 | 46.50 |
| Pendimethalin 1.0 kg/ha *fb* Bispyribac 25 g/ha | 27.00 | 94.33 | 85.33 | 10.57 | 64.63 | 76.82 | 71.67 |
| Hand weeding at 20 and 40 DAS | 30.00 | 107.33 | 114.66 | 11.12 | 79.11 | 92.63 | 65.83 |
| Weedy check | 74.00 | 270.33 | 318.33 | 17.91 | 247.71 | 271.16 | - |
| SEm ± | 0.60 | 0.70 | 0.71 | 0.71 | 0.75 | 0.36 | - |
| LSD (p = 0.05) | 1.84 | 2.12 | 2.17 | 2.16 | 2.29 | 1.09 | - |

**Table 3: Effect of crop establishment and weed control treatments on N, P and K uptake by crop and weeds.**

| Treatments | Nutrient uptake by crop (kg/ha) | | | Nutrient uptake by weeds (kg/ha) | | |
|---|---|---|---|---|---|---|
| | N | P | K | N | P | K |
| Wet seeded (broadcasting of sprouted seeds under puddled condition) | 74.78 | 21.24 | 115.62 | 17.69 | 4.03 | 25.15 |
| Dry seeded in rows at 20 cm apart | 70.36 | 20.08 | 108.31 | 20.94 | 4.52 | 29.94 |
| Drum seeded in puddled condition | 79.13 | 22.48 | 122.64 | 14.27 | 3.40 | 20.15 |
| SEm ± | 0.92 | 0.25 | 2.33 | 0.60 | 0.08 | 0.78 |
| LSD (P = 0.05) | 3.62 | 0.99 | 9.13 | 2.37 | 0.35 | 3.08 |
| Butachlor 1.5 kg/ha ( pre -emergence) | 70.38 | 20.02 | 107.53 | 18.23 | 3.93 | 26.00 |
| Butachlor 1.5 kg/ha *fb* Bispyribac 25 g/ha | 78.78 | 22.15 | 119.74 | 16.63 | 3.89 | 23.61 |
| Prtilachlor 0.75 kg/ha (pre-emergenc) | 76.34 | 21.54 | 116.07 | 17.39 | 4.00 | 24.66 |
| Prtilachlor 0.75 kg/ha *fb* Bispyribac 25 g/ha | 82.46 | 23.29 | 126.41 | 15.95 | 3.74 | 22.52 |
| Pendimethalin 1.0 kg/ha (pre-emergence) | 73.23 | 20.71 | 112.33 | 18.84 | 4.33 | 26.92 |
| Pendimethalin 1.0 kg/ha *fb* Bispyribac 25 g/ha | 83.17 | 23.63 | 129.07 | 14.76 | 3.50 | 20.74 |
| Hand weeding at 20 and 40 DAS | 82.25 | 23.33 | 127.02 | 15.43 | 3.67 | 21.79 |
| Weedy check | 51.42 | 15.47 | 86.05 | 23.83 | 4.80 | 34.40 |
| SEm ± | 2.09 | 0.48 | 2.80 | 0.96 | 0.22 | 1.37 |
| LSD (p = 0.05) | 6.36 | 1.46 | 8.49 | 2.93 | 0.69 | 4.18 |

number of grains per panicle than pre-emergence application of Pendimethalin. Quite amazingly when all the three pre-emergence applications were supplemented with post-emergence application of Bispyribac the Pendimethalin combination went ahead from Butachlor and Pretilachlor application. In regard to 1000-grain weight the results although followed the same trend, but this time Butachlor @ 1.5 kg /ha (pre-emergence), Pretilachlor @ 0.75 kg /ha (pre-emergence) and Pendimethalin @ 1.0 kg/ha (pre-emergence) at one hand and Butachlor (pre-emergence) @ 1.5 kg /ha *fb* Bispyribac @ 25 g/ha (Post emergence ), Pretilachlor @ 0.75 kg /ha (pre-emergence) *fb* Bispyribac @ 25 g/ha (Post emergence ) and Pendimethalin @ 1.0 kg/ha (pre-emergence) *fb* Bispyribac @ 25 g/ha (Post emergence ) at the other fared equally good.As witnessed in all growth and yield attributes, the grain and straw yields under pre-emergence Pendimethalin + post - emergence Bispyribac were the maximum again. However, their differences with other weed management treatments narrow as reflected though the fact that Butachlor + Bispyribac as well as Pretilachlor + Bispyribac were statistically alike with Pendimethalin + Bispyribac. However, the straw yield again was exactly on the lines of all other yield attributing characters. The grain and straw yields further consolidated the greater effectiveness of Pendimethalin in combination with Bispyribac. Butachlor and Pretilachlor are the herbicides specific to wet land rice. Whereas, Pendimethalin is more or less an omni influensive herbicide (Singh *et al*. 2014). However, the combination of Pendimethalin with Bispyribac again a specific rice herbicide may be capable of suppressing wider range of weeds which are always expected there in direct seeded crop sown either in wet or dry condition. This explains the greater efficacy of Pendimethalin + Bispyribac even under the conditions that Pretilachlor and Butachlor are more effective to Pendimethalin in their sole application. Lower harvest index under weedy check condition may be explained on the basis that the menace of weeds go on increasing with increase in age. Hence, the vegetative growth was affected comparatively less than the reproductive growth of rice plants lowering the

harvest index. These results was in coordination with the earlier findings of Tamilselvan and Budhar (2002), Jayadeva *et al*. (2009) and Pramanick *et a*l. (2014).

**Nutrients depletion by different weeds**

Uptake of nitrogen, $P_2O_5$ and $K_2O$ were the maximum under drum seeding followed by wet seeding, in which sprouted seeds were sown on puddled bed by broadcast methods. The least uptake of N, $P_2O_5$ and $K_2O$ were recorded in the plots of dry seed beds sown in lines. On the contrary, the N, $P_2O_5$ and $K_2O$ uptake by weeds was a complete reversal of treatments. The weeds in dry seeded plots took up significantly the maximum; while the treatments with drum seeding in wet beds exhibited the least uptake by weeds. There is not much to explain the behaviour of treatments as crop uptake is directly a function of biological yield. The plots giving higher biological yields exhibited higher nutrient uptake and so on in other cases. Similarly, as the dry seeded plots offered greater opportunity to weeds to come up and grow, their weeds took up a lion's share of nutrients from the plots. On the other hand puddling is well known to suppress weeds particularly of broad leaved group hence; weeds there did not get congenial conditions for their growth and development. (De Datta, 1981; Chatterjee and Maity, 1981). Hence, the nutrient uptake by weeds under wet seed bed was comparatively low. Amongst the two wet seed bed again the nutrient uptake by weeds under broadcast method was higher. The possible reason may be the expected error in uniformity of seed placement in broadcast method. Where ever weed seeds and plants got more space they grew at a faster rate suppressing crop plants. This finding was totally in league with those shown earlier by Mukherjee and Maity (2010) and Gaurav *et al*. (2015).

**Nutrients uptake by crop**

Nutrient uptake in terms of N, $P_2O_5$ and $K_2O$ by crop plant was the maximum under application of Pendimethalin followed by Bispyribac. Two hand weeding was close on the heels of Pendimethalin @ 1.0 kg/ha (pre-emergence) *fb* Bispyribac @ 25 g/ha (Post emergence). Amongst the herbicidal applications, double applications (pre and post emergence) were superior to their corresponding single application (pre-emergence). Amongst the three pre-emergence applications, Pretilachlor was ahead of others in uptake of nutrients by crop plant. Reverse was the position in case of nutrient removal by weeds. The treatment making crop plants to take up more nutrients restricted weeds to the minimum removal. The protein content in rice grain was a reflection of crop nutrient uptake. This result is also in agreement with earlier results advocated by Kumar *et al*. (2010).

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