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# Impact of nitrogen and weed management practices on direct seeded puddled rice in Imphal, Manipur

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ABSTRACT

The present experiment was carried out during *kharif* and pre-*kharif* season of two consecutive years to find out the suitable scheduling of nitrogen application and effective weed management method in direct-seeded puddled rice. Application of any scheduled nitrogen treatment on plant height, number of effective tillers/m$^2$,number of filled grain/panicle and yield of grains and straw results a positive improvement. Among different nitrogen treatments, the maximum grain yield (40.78q/ha in *kharif* and 37.95 q/ha in pre-*kharif*) were recorded by application of nitrogen25% at basal, 50% at active tillering and 25% at panicle initiation ($N_2$) which were at par with the treatment $N_1$ i.e., 50% at basal, 25% at active tillering and 25% at panicle initiation ($N_1$).Removal of weeds by any treatment showed effective reduction of weed competition in rice. It was seen that the different levels of weed management significantly reduced weed population, dry weight, Weed Control Efficiency (WCE) and consequently Weed Index in all stages of the crop. Among the weed management treatments, application of pretilachlor @ 0.75 kg 4 DAS followed by HW at 30 DAS was found to be the most efficient weed management practice because it showed a maximum reduction of weed population as compared to other treatments. The highest weed density, weeddry weight and lowest weed index were observed in unweeded control plot which was significantly inferior to all the weeding treatments. The highest WCE was recorded at 90 DAS with 87.76% during *kharif* and 89.47% during pre-*kharif* by application of pretilachlor @ 0.75 kg 4 DAS followed by HW at 30 DAS followed by application of butachlor @ 1.5 kg followed by HW at 30 DAS in both seasons of experimentation. The highest net profit (Rs 40140.45/ha) and cost-benefit ratio (1:2.94) were recorded with the treatments 50% at basal, 25% at active tillering and 25% at panicle initiation + pretilachlor @ 0.75 kg 4 DAS followed by HW ($N_2W_3$) and minimum from unweeded control in both seasons.

## 1. Introduction

Rice is the main staple food of the vast populations of south Asia, where about 90% of the world's rice is grown. In India rice occupies about 45 million ha with a total production of about 84 million tonnes. Although it occupies the second position in production the productivity (2915 kg/ha) is very low i.e., 10$^{th}$ in global ranking (F.A.O. Production Year Book, 1997). It is, therefore, vitally important to increase the yield/ha by application of the latest advanced technologies. Yield loss due to weeds was higher in direct-seeded puddled rice and less in transplanted rice as reported by Mukhopadhyay (1983).Weeds are major competitors for nitrogen in direct-seeded rice. The nitrogen use efficiency by rice crop versus weeds may be altered by the split application of nitrogen at different stages. Weed control also facilitates higher absorption of applied nutrients, thus increasing the efficiency of fertilizer application to crops (Amarjit *et. al.*, 2006). In order to achieve desired targets of

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rice production, there is a need to work out effective weed management practices and nitrogen management schedules. Information on nitrogen and weed management practices on direct-seeded puddled rice is meager for Manipur. Therefore the present study was carried out.

## 2. Materials and Methods

The field experiment was conducted during *kharif* and pre-*kharif* season of two years on the Agricultural Farm, College of Agriculture, Central Agricultural University, Imphal. The experiment waslaid out in Factorial Randomised Block Design with three replications. The treatments comprised of application of the recommended 60 Kg N in rice under three scheduled ($N_1$ = 50:25:25 percent at three stages of the crop i.e., basal, active tillering and panicle initiation, $N_2$ = 25:50:25 percent at basal, active tillering and panicle initiation, $N_3$ = 25:25:25:25 percent at four stages of the crop, i.e., basal, active tillering, panicle initiation and first flowering) and eight levels of weed management ($W_1$ = 0.75 kg pretilachlor 4 days after sowing (DAS); $W_2$ = 1.5 kg butachlor 7 DAS; $W_3$ = 0.75 kg pretilachlor 4 DAS followed by hand weeding 30 DAS; $W_4$ = 1.5 kg butachlor 7 DAS followed by hand weeding 30 DAS; $W_5$ = 0.75 kg pretilachlor 4 DAS followed by 0.75 kg ai of 2,4-D EE at 30 DAS; $W_6$ = 1.5 kg butachlor 7 DAS followed by 0.75 kg ai of 2,4-D EE at 30 DAS; $W_7$ = Rotary weeding twice, $W_8$ = Unweeded control). The weed densityandweed dry weight was recorded in each plot by placing a quadrate of $0.25m^2$ at 60 and 90DAS. The weed control efficiency and weed index were calculated by the formula Mani *et.al.*, 1973 and Gill and Kumar, 1969, respectively.

The soil was clay in texture with a soil pH of 5.1 containing 384.35 $kgha^{-1}$ available N, 29.24 kg $ha^{-1}$ available and 339.25kg $ha^{-1}$ available K with an organic carbon content of 3.67%.

$$\text{Weed control efficiency} = \frac{w_1 - w_2}{w_1} \times 100$$

Where, $W_1$ = dry weight of weeds in unweeded control plots and $W_2$ = dry weight of weeds in treated plots.

$$\text{Weed Index (WI)} = \frac{x-y}{x} \times 100$$

Where, *x* = seed yield from minimum weed plot and y = seed yield from the treatment for which weed index is to be worked out.

## 3. Result and Discussion

***Weed Density, Weed dry weight, WCI and WI***

The weed population was higher in the first year than in the second year. The pre-dominant weeds in the experimental field were *Echinocloacolonum*, *Sagitariasagitifolia* and *Cyperus* species. The data on the total weed population revealed that weed management practices significantly reduced weed population. The maximum weed density was observed in unweeded control plot. The result was corroborated with Kathirvelan and Vaiyapuri, 2003. Among the weed management treatment, application of Pretilachlor @ 0.75kg/ha 4DAS followed by HW at 30DAS resulted in the highest reduction of total weed population in both the seasons and was significantly superior to all the other weed management treatments. Similar findings were also reported by Mahajan *et.al.,*(2003) and Jayashree and Reddy (2003). It was also observed that application of nitrogen have no significant influenced on weed population at 60 DAS however, it have a significant effect at 90 DAS. This may be due to vigorous growth and development of weeds owing to higher uptake of nutrients by weeds. Similar results were reported by Roy and Mishra, (1999).

Similar trend as in case of total weed population was observed for weed dry weight. Pretilachlor @ 0.75kg 4 DAS followed by HW at 30 DAS show consistently the lowest dry weight during both the season followed by treatment receiving butachlor 1.5kg 4DAS followed by hand weeding 30DAS. The highest weed dry weight was observed in control owing to greater competitive ability. Similar results were reported by Jayashree and Reddy (2003). Among nitrogen scheduled the minimum weed dry weight was recorded with the treatment receiving nitrogen 25% at basal, 50% at active tillering, 25% at panicle initiation which were significantly lower than the rest of the treatment. This is found in conformity with Sharma *et. al.,* (2007).

Weed control efficiency (WCE) was calculated based on weed dry weight of treated plot recorded at 60 and 90 DAS as compared to the weed dry weight in unweeded control treatment and the same was expressed in percentage. The different weed management treatment showed that all the treatment increases weed control efficiency. The highest WCE for *kharif* and pre- *kharif* season were recorded under the treatment Pretilachlor @ 0.75kg 4DASfollowed byHW at 30DAS ($W_3$) in both the years in all the dates of observation. The minimum WCE was recorded under rotary weeding twice ($W_7$) in both the season in all the dates of observation. This was mainly due to a decrease in the dry weight of weeds with better management practices which increased the weed control efficiency. Singh and Tripathy (2007) also recorded similar results.

The weed management treatment decreased weed index and increase weed control efficiency, compared with unweeded control as reported by Singh and Tripathi, 2007.Pre-emergence application of Pretilachlor @0.75kg 4DAS followed by HW at 30DAS showed effective influence for decreasing maximum weed index. The trend of reduction of weed density and weed dry weight is reflected remarkably in the weed index. Thus, the plot receiving Pretilachlor @ 0.75kg 4DAS followed by 0.75 kg 2,4-D at 30DAS and butachlor 1.5kg 7DAS followed by hand weeding at 30 DAS also reduced weed index considerably and was superior among the rest of the treatment.

***Growth and Yield attributes***

In this investigation the general crop growth regarding plant height was good but different treatments did not differ significantly revealing that the results of plant height had no significant contribution towards yield. Among the nitrogen treatment scheduled, plant height was maximum at nitrogen 25:50:25% at basal, active tillering and panicle initiation. Prasad *et. al.,* (1999) also reported the same result.

The number of effective tillers is one of the important aspects of yield attributes. The higher the number of tillers with filled grains (effective tillers), the higher is the yield of crops. The number of effective tillers/$m^2$at harvest recorded during *kharif* and pre-*kharif* season revealed that all weed management treatments differ significantly over control. Application of Pretilachlor @ 0.75kg at 4DAS followed by HWat 30 DAS was observed to have the highest pooled mean value (46.03 in *kharif* and 39.5 in pre-*kharif*). Among the nitrogen scheduled 25:50:25% at basal, active tillering and panicle initiation produced a maximum number of effective tillers. This may be due to better absorption of nutrients by crops, timely and effective control of weeds. This finding conforms with Singh and Singh (1999) who also reported a similar result.

In this investigation weed management treatment resulted significant difference in the number of filled grains /panicle over control. Application of Pretilachlor @ 0.75kg at 4DAS followed by HW 30DAS was found effective in producing a number of filled grains/panicle. The crop receiving nitrogen 25% at basal, 50% at active tillering and 25% at panicle initiation was found to be the most suitable schedule of nitrogen treatment during both *kharif* and pre-*kharif* experiments (Reddy and Reddy,2002).

It was observed that among yield attribute factors 1000 grains weight did not influence the seedyield, since the treatment have no significant effect on 1000 grain weight. Significant effect of nitrogen and weed management on harvest index was recorded in both the years however no significant effect was found during the *kharif* season of the second year. The highest (49.06%) harvest index was found in $W_3$ treatment and the lowest (44.45%) under $W_8$ during *kharif* season of the second year whereas during pre-*kharif* maximum harvest index was found under $W_1$ (43.24%) and the lowest was observed under $W_8$ (40.77%).There was a significant change in harvest index during *kharif* and pre-*kharif*.

***Residual NPK, N uptake and yield***

It was found that available nitrogen and phosphorus were not significantly influenced by nitrogen treatment scheduled however potassium was found statistically significant in both years. It was also noted that weed management practices did not differ significantly on residual nitrogen and phosphorus but significantly influenced and increase residual potassium.

It was found that nitrogen removal by weeds increased with an increased in the number of weeds and dry weight. Shad and De Datta (1988) also reported similar results. The weed management treatment on removal of nitrogen by weeds was found significantly different from each other but application of pretilachlor at 0.75 kg 4DAS followed by 2, 4-D 0.75kg at 30 DAS recorded significantly minimum removal of N by weeds compared with maximum uptake of nitrogen (59.51kg/ha *kharif*, 77.32 kg/ha pre-*kharif)* under control. The next best treatment was with the application of butachlor 1.5kg +2,4-D 0.75kg at 30 DAS during both years. Application of pretilachlor @ 0.75kg at 4 DAS followed by HWat 30 DAS manifested higher uptake of nitrogen and superior as compared to rest of the treatment for increasing nitrogen uptake in rice grain and straw under direct-seeded puddled condition. Uptake of nitrogen in straw during *kharif* season showed significant difference in rice straw and grain during both years while uptake of straw during *kharif* uptake of nitrogen by rice straw and grain was maximum in $W_3$ treatment and lowest under $W_8$ during both the years of *kharif* and pre-*kharif.* Application of pretilachlor @ 0.75kg at 4 DAS followed by HW at 30 DAS manifested higher uptake of nitrogen and superior as compared to rest of the treatment for increasing nitrogen uptake in rice grain and straw under direct-seeded puddled condition. The highest order of interaction was recorded in $N_2W_3$ treatment.

The straw yield was found significantly influence by different weed management treatments. All weed management treatment improved straw yield over control in both years (Singh *et. al.,*2008).Application of Pretilachlor @ 0.75kg at 4 DAS followed byHW at 30 DAS ~~was~~ recorded the highest straw yield and minimum was recordedunder control. Nitrogen exhibits significant difference in both *kharif* and pre-*kharif.* $N_3$ produces the maximum straw yield and $N_1$ scheduled recorded the minimum. The highest yield under this treatment may be due to better control of weeds, leading to greater availability of nutrients ultimately improved straw yield.

Different levels of weed management significantly affect grain yield. Maximum yield was recorded by application of Pretilachlor @ 0.75kg 4DAS followed by HW 30DAS in both years. Among nitrogen scheduled application of nitrogen at basal 25%, active tillering 50% and panicle initiation 25% performed as good as application of 50% at basal, 25% at active tillering, 25% at panicle initiation for yield. This might be due to the high availability of nutrients at distinct physiological phases would have supported better assimilation of photosynthates towards the grain. Upadhyay and Tripathi (2000) also reported similar result.

***Economics***

In direct-seeded rice pre emergence application of pretilachlor @ 0.75kg at 4 DAS followed byHW at 30 DAS and nitrogen scheduled at 25% basal, 50% at active tillering and 25% at panicle initiation gave the maximum benefit-cost ratio (2.94), hence proved more remunerative than other weed management treatments. The total net profit was obtained from this treatment is Rs. 40140.45/ha. The minimum net return (Rs. 29025.05) and benefit ratio (2.36) were obtained from unweeded control during *kharif* experiment due to low yield and high cost of cultivation. Similar results were found under pre-*kharif* season.

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**Table 1.** Weed density/m2 , dry weight (g/m2 and weed control efficiency(%) as influenced by nitrogen and weed management in direct seeded puddled rice

| Treatment | Weed density/m2 | | | | Dry weight(g/m2) | | | | Weed control efficiency (%) | | | | | | | | Weed index (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kharif | | Prekharif | | Kharif | | Prekharif | | 60DAS | | 90DAS | | 60DAS | | 90DAS | | Kharif | Prekharif |
| | 60DAS | 90DAS | 60DAS | 90DAS | 60DAS | 90DAS | 60DAS | 90DAS | 2005 | 2006 | 2005 | 2006 | 2006 | 2007 | 2006 | 2007 | | |
| **Nitrogen Scheduled** | | | | | | | | | | | | | | | | | | |
| **$N_1$** | 43.99 | 38.22 | 41.21 | 37.68 | 19.85 | 13.11 | 37.85 | 11.97 | - | - | - | - | - | - | - | - | - | - |
| **$N_2$** | 44.35 | 38.76 | 41.20 | 38.03 | 20.71 | 13.23 | 37.71 | 12.20 | - | - | - | - | - | - | - | - | - | |
| **$N_3$** | 43.76 | 37.78 | 40.93 | 37.22 | 19.30 | 12.63 | 36.89 | 11.49 | - | - | - | - | - | - | - | - | - | - |
| **SEm (±)** | **0.18** | **0.18** | **0.18** | **0.22** | **0.41** | **0.11** | **0.23** | **0.14** | - | - | - | - | - | - | - | - | - | - |
| **CD (5%)** | **NS** | **0.35** | **NS** | **0.44** | **0.81** | **0.22** | **0.45** | **0.27** | - | - | - | - | - | - | - | - | - | - |
| **Weed management** | | | | | | | | | | | | | | | | | | |
| **$W_1$** | 42.27 | 36.38 | 37.9 | 36.29 | 19.84 | 13.93 | 42.30 | 11.84 | 50.37 | 67.12 | 56.56 | 67.76 | 75.59 | 72.99 | 51.07 | 60.05 | 6.19 | 8.82 |
| **$W_2$** | 44.44 | 38.21 | 39.16 | 37.55 | 12.15 | 14.5 | 44.19 | 12.91 | 46.34 | 55.12 | 51.81 | 56.98 | 73.52 | 64.10 | 47.00 | 53.62 | 6.51 | 9.68 |
| **$W_3$** | 35.94 | 31.44 | 34.85 | 30.24 | 10.44 | 9.65 | 25.26 | 8.23 | 84.61 | 87.88 | 86.94 | 88.59 | 89.10 | 89.85 | 86.69 | 86.64 | - | - |
| **$W_4$** | 36.83 | 32.27 | 35.37 | 32.70 | 13.71 | 10.06 | 25.76 | 9.17 | 79.10 | 84.45 | 80.86 | 84.86 | 87.30 | 86.16 | 68.15 | 77.11 | 3.45 | 5.03 |
| **$W_5$** | 38.05 | 33.22 | 36.20 | 33.43 | 15.89 | 10.11 | 31.08 | 9.39 | 75.43 | 76.38 | 77.65 | 77.84 | 84.37 | 80.55 | 65.87 | 71.83 | 2.39 | 6.9 |
| **$W_6$** | 40.27 | 34.77 | 36.74 | 34.69 | 18.59 | 13.41 | 37.16 | 11.46 | 59.15 | 73.85 | 61.61 | 75.62 | 80.98 | 78.53 | 58.38 | 67.05 | 4.46 | 7.87 |
| **$W_7$** | 47.49 | 40.88 | 42.63 | 39.79 | 25.78 | 15.56 | 45.89 | 14.12 | 41.17 | 40.69 | 47.35 | 41.91 | 58.60 | 51.45 | 41.09 | 42.67 | 5.22 | 8.91 |
| **$W_8$** | 66.66 | 58.88 | 66.05 | 56.46 | 33.23 | 16.71 | 48.26 | 17.99 | - | - | - | - | - | - | - | - | - | - |
| **SEm (±)** | **1.26** | **4.45** | **0.60** | **0.84** | **6.27** | **2.61** | **1.66** | **1.05** | - | - | - | - | - | - | - | - | - | - |
| **CD (5%)** | **2.49** | **8.81** | **1.20** | **1.66** | **12.41** | **5.16** | **3.28** | **2.07** | - | - | - | - | - | - | - | - | | |

**Table 2.** Growth and Yield attributes of direct seeded puddled rice as influenced by nitrogen and weed management (pooled mean)

| Treatment | Plant height(cm) | | | | | | | | Effective tillers/m$^2$ | | No. of filled grains/panicle | | 1000 grain weight (g) | | Harvest Index (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kharif | | | | Pre-kharif | | | | Kharif | Pre-kharif | Kharif | Pre-kharif | Kharif | Pre-kharif | Kharif | Pre-kharif |
| | Days after transplanting | | | | | | | | | | | | | | | |
| | 30 | 60 | 90 | 120 | 30 | 60 | 90 | 120 | | | | | | | | |
| **Nitrogen Scheduled** | | | | | | | | | | | | | | | | |
| **N$_1$** | 41.52 | 79.59 | 89.11 | 94.23 | 31.95 | 60.96 | 78.62 | 83.67 | 43.20 | 35.74 | 101.89 | 69.86 | 20.02 | 19.70 | 47.41 | 36.80 |
| **N$_2$** | 41.64 | 80.08 | 89.54 | 94.95 | 32.14 | 61.29 | 78.82 | 84.01 | 44.11 | 36.57 | 102.82 | 70.29 | 20.08 | 19.96 | 47.28 | 37.20 |
| **N$_3$** | 40.89 | 78.74 | 87.45 | 93.6 | 31.65 | 60.13 | 77.95 | 83.08 | 42.17 | 35.09 | 49.97 | 69.37 | 19.91 | 19.70 | 47.39 | 36.63 |
| **SEm (±)** | 0.21 | 0.44 | 0.22 | 0.3 | 0.10 | 0.22 | 0.30 | 0.15 | 0.90 | 0.39 | 0.89 | 0.12 | 1.11 | 1.39 | 0.23 | 0.32 |
| **CD (5%)** | 0.41 | 0.87 | 0.44 | 0.59 | 0.21 | 0.44 | 0.49 | 0.59 | NS | 0.77 | 1.77 | 0.23 | NS | NS | NS | 0.32 |
| **Weed management** | | | | | | | | | | | | | | | | |
| **W$_1$** | 41.13 | 77.85 | 88.1 | 93.78 | 31.53 | 59.09 | 78.43 | 82.20 | 42.07 | 34.35 | 97.92 | 69.05 | 20.21 | 18.99 | 47.98 | 36.87 |
| **W$_2$** | 41.07 | 77.5 | 87.96 | 93.75 | 31.46 | 59.48 | 77.88 | 82.99 | 41.57 | 32.96 | 96.93 | 68.84 | 20.16 | 18.99 | 47.94 | 36.95 |
| **W$_3$** | 42.12 | 83.03 | 90.3 | 95.42 | 32.53 | 63.42 | 80.33 | 87.24 | 46.03 | 39.35 | 110.69 | 74.11 | 20.87 | 19.01 | 48.62 | 37.80 |
| **W$_4$** | 41.96 | 81.9 | 89.7 | 95 | 32.46 | 62.75 | 79.96 | 85.06 | 44.05 | 37.40 | 106.74 | 72.0 | 20.76 | 18.90 | 47.59 | 37.69 |
| **W$_5$** | 41.68 | 81.37 | 89.79 | 94.94 | 32.19 | 62.52 | 79.63 | 84.18 | 45.15 | 38.34 | 107.80 | 73.30 | 20.67 | 18.91 | 47.58 | 36.26 |
| **W$_6$** | 41.61 | 79.47 | 89.11 | 94.42 | 32.10 | 62.23 | 78.60 | 83.96 | 43.10 | 36.56 | 103.01 | 71.39 | 20.23 | 18.90 | 47.54 | 37.36 |
| **W$_7$** | 40.92 | 78.67 | 88.19 | 93.85 | 31.66 | 60.00 | 78.18 | 81.94 | 42.40 | 35.72 | 100.32 | 69.17 | 20.16 | 18.92 | 48.60 | 36.31 |
| **W$_8$** | 40.31 | 75.84 | 86.45 | 92.9 | 31.40 | 56.84 | 75.89 | 81.14 | 40.92 | 31.72 | 89.08 | 60.59 | 18.96 | 18.49 | 44.24 | 36.12 |
| **SEm (±)** | 0.32 | 1.52 | 0.36 | 0.29 | 0.16 | 0.83 | 0.27 | 0.93 | 1.2 | 0.38 | 3.90 | 1.87 | 1.63 | 1.69 | 0.68 | 1.10 |
| **CD (5%)** | 0.63 | 3.00 | 0.71 | 0.57 | 0.33 | 1.64 | 0.53 | 1.84 | 2.38 | 0.75 | 7.73 | 3.70 | NS | NS | 1.34 | 0.21 |

**Table 3.** Residual NPK (kg/ha) , N uptake (q/ha) and yield in direct seeded puddled rice as influenced by nitrogen and weed management (pooled mean)

| Treatment | Residual NPK(kg/ha) | | | | | | N uptake (q/ha) | | | | | | Straw yield(q/ha) | | Grain yield(q/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kharif | | | Pre kharif | | | Kharif | Pre kharif | Kharif | Pre kharif | Kharif | Pre kharif | Kharif | Pre kharif | Kharif | Pre kharif |
| | N | P | K | N | P | K | Weeds | | straw | | grain | | | | | |
| **Nitrogen Scheduled** | | | | | | | | | | | | | | | | |
| **$N_1$** | 320.63 | 21.13 | 298.92 | 318.05 | 18.58 | 301.61 | 21.61 | 27.37 | 25.62 | 22.62 | 45.46 | 43.43 | 44.73 | 54.35 | 40.37 | 36.97 |
| **$N_2$** | 321.09 | 21.31 | 299.68 | 318.42 | 18.64 | 302.23 | 23.30 | 31.70 | 26.16 | 23.16 | 46.35 | 44.03 | 45.27 | 54.73 | 40.78 | 37.95 |
| **$N_3$** | 320.89 | 21.11 | 299.33 | 318.06 | 18.44 | 302.07 | 21.00 | 26.76 | 26.58 | 23.58 | 46.45 | 44.43 | 44.12 | 53.69 | 39.89 | 36.37 |
| **SEm (±)** | 0.20 | 0.15 | 0.23 | 0.15 | 0.16 | 0.14 | 0.31 | 0.85 | 0.19 | 0.52 | 0.53 | 0.30 | 0.10 | 0.07 | 0.23 | 0.20 |
| **CD (5%)** | NS | NS | 0.46 | NS | NS | 0.25 | 0.62 | 1.70 | 0.38 | NS | 1.06 | 0.60 | 0.21 | 0.13 | 0.47 | 0.40 |
| **Weed management** | | | | | | | | | | | | | | | | |
| **$W_1$** | 319.28 | 20.98 | 297.58 | 316.62 | 18.32 | 300.23 | 17.91 | 22.43 | 25.76 | 22.76 | 46.04 | 44.04 | 43.68 | 53.45 | 40.31 | 36.95 |
| **$W_2$** | 321.04 | 21.17 | 300.84 | 318.26 | 18.50 | 303.17 | 19.65 | 22.04 | 25.62 | 22.62 | 46.42 | 44.42 | 43.65 | 53.60 | 40.18 | 36.59 |
| **$W_3$** | 322.52 | 21.81 | 305.34 | 319.47 | 19.14 | 308.01 | 14.09 | 25.16 | 27.73 | 24.73 | 48.17 | 44.87 | 47.27 | 58.21 | 43.10 | 40.51 |
| **$W_4$** | 322.07 | 21.40 | 302.85 | 319.40 | 18.73 | 305.52 | 11.47 | 17.74 | 26.75 | 23.75 | 47.15 | 44.82 | 45.76 | 55.44 | 41.55 | 38.46 |
| **$W_5$** | 320.92 | 21.43 | 302.63 | 318.17 | 18.76 | 305.29 | 8.17 | 7.45 | 27.56 | 24.56 | 47.57 | 44.57 | 46.19 | 56.40 | 42.01 | 37.73 |
| **$W_6$** | 321.72 | 21.34 | 302.64 | 319.03 | 18.67 | 305.37 | 8.63 | 7.11 | 26.35 | 23.35 | 46.96 | 44.96 | 45.30 | 54.82 | 41.09 | 37.33 |
| **$W_7$** | 320.69 | 21.06 | 293.88 | 318.43 | 18.39 | 296.77 | 36.34 | 49.64 | 24.80 | 21.80 | 46.71 | 44.71 | 43.09 | 54.86 | 40.83 | 36.91 |
| **$W_8$** | 318.71 | 20.26 | 288.77 | 316.06 | 17.91 | 291.44 | 59.51 | 77.32 | 24.40 | 21.40 | 39.67 | 36.78 | 42.70 | 47.27 | 33.72 | 31.50 |
| **SEm (±)** | 0.10 | 0.24 | 0.37 | 0.25 | 0.26 | 0.23 | 0.51 | 0.14 | 0.31 | 0.84 | 0.86 | 0.50 | 0.74 | 0.21 | 6.87 | 1.69 |
| **CD (5%)** | 0.20 | 0.48 | 0.74 | 0.50 | 0.56 | 0.46 | 1.02 | 2.81 | 0.62 | 1.68 | 1.72 | 1.00 | 1.46 | 0.41 | 1.73 | 3.34 |

**Table 4.** Economic returns of direct seeded puddled rice as influenced by nitrogen and weed management (pooled mean)

| Treat ments | Cost/ha (`) | | | Net profit | | | | | | Cost benefit ratio | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Kharif | | | Prekharif | | | Kharif | | | | | |
| | $N_1$ | $N_2$ | $N_3$ | $N_1$ | $N_2$ | $N_3$ | $N_1$ | $N_2$ | $N_3$ | $N_1$ | $N_2$ | $N_3$ | $N_1$ | $N_2$ | $N_3$ |
| $W_1$ | 13555.75 | 13555.75 | 13555.75 | 33179.45 | 30069.05 | 36263.05 | 33179.45 | 33040.25 | 32559.45 | 1:2.69 | 1:2.72 | 1:2.67 | 1:2.44 | 1:2.43 | 1:2.40 |
| $W_2$ | 13226.80 | 13226.80 | 13226.80 | 32064.8 | 36923.05 | 36464.40 | 32064.8 | 33863.2 | 32547.6 | 1:2.75 | 1:2.81 | 1:2.75 | 1:2.42 | 1:2.56 | 1:2.46 |
| $W_3$ | 14097.55 | 14097.55 | 14097.55 | 38032.85 | 37252.00 | 38925.05 | 38032.85 | 37634.45 | 34861.25 | 1:2.80 | 1:2.94 | 1:2.76 | 1:2.69 | 1:2.66 | 1:2.47 |
| $W_4$ | 13768.60 | 13768.60 | 13768.60 | 32785.8 | 40140.45 | 37658.00 | 32785.8 | 35777.8 | 35223.8 | 1:2.72 | 1:2.80 | 1:2.73 | 1:2.38 | 1:2.59 | 1:2.55 |
| $W_5$ | 13942.75 | 13942.75 | 13942.75 | 34419.25 | 38625.40 | 37332.85 | 34419.25 | 33637.25 | 32724.05 | 1:2.76 | 1:2.80 | 1:2.67 | 1:2.46 | 1:2.41 | 1:2.34 |
| $W_6$ | 13613.80 | 13613.80 | 13613.80 | 33508.2 | 39123.25 | 37051.80 | 33508.2 | 35846.6 | 30783.0 | 1:2.76 | 1:2.77 | 1:2.72 | 1:2.46 | 1:2.63 | 1:2.26 |
| $W_7$ | 12955.90 | 12955.90 | 12955.90 | 32591.3 | 37814.60 | 36972.50 | 32591.3 | 34714.9 | 33296.9 | 1:2.74 | 1:2.84 | 1:2.85 | 1:2.51 | 1:2.67 | 1:2.57 |
| $W_8$ | 12269.75 | 12269.75 | 12269.75 | 28328.25 | 38112.90 | 29025.05 | 28328.25 | 27021.45 | 26926.25 | 1:2.45 | 1:2.49 | 1:2.36 | 1:2.30 | 1:2.20 | 1:2.19 |