

Weed Control Efficiency of different Herbicides and their Economics in the various Weed Management Practices of Transplanted Rice under North Eastern Central Plain Zone of Odisha

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Abstract -A field experiment was conducted during kharif seasons of 2008-09 and 2009-10 in sandy loam neutral soil of up-medium land with assured irrigation facility at Regional Research and Technology Transfer Station (OUAT) Ranital, Bhadrak to study the weed control efficiency of different herbicides along with economics involved in the various weed management practice of transplanted rice. The experiment was started during kharif 2008 in transplanted rice and all the recommended package of practices except weed management was adopted during the course of investigation. The bio-efficacy of five different types of herbicides was evaluated along with hand weeding against weedy check in transplanted rice with a randomized block design replicated three times. In spite of superiority in reducing grass weed, Oxadiargyl @ 100 g a.i ha⁻¹ exhibited more severe but not lasting (Rating - 3) symptoms of toxicity on rice crop. Almix treatment exhibited maximum growth, yield attributes and yield more rice than all other treatments. Because of higher biological yield in comparison to the cost of cultivation, Almix was found to be more economic and remunerative in realizing maximum benefit cost ratio (3.349). Despite giving higher grain yield than PSE, Pretilachlor, Oxadiargyl and HW Twice proved to be less economic due to higher cost involvement.

I. INTRODUCTION

Rice is the staple food of more than 60 percent of world's population. About 90 percent of all rice grown in the world is produced and consumed in the Asia region. Rice is a supreme commodity to mankind, because rice is truly life, culture, tradition and a means of livelihood to millions. In recognition to these important traits, the United Nations declared the year 2004 as the International Year of Rice. After China, India contributes 21.5 per cent of global rice production. Rice occupies a pivotal place in Indian agriculture and is grown on more than 44 million hectares and accounts for about 43 per cent of total food grain production in the country. Odisha expect to produce around 7 million

tonne o rice, which is about 6.7 percent of country's total out put.

Weeds are one of the most important agricultural pests which reduced the grain yield in transplanted rice by 16-48 percent and yield loss up to 90 percent is not unheard of. This loss is therefore a serious threat for the food deficit. Weed management in transplanted rice is accompanied by mechanical, cultural, chemical methods and combination of two or, more of these practices. Though hand weeding is very effective; but it is tedious, time consuming and expensive. Chemicals inform of herbicides are the good substitute for mechanical as well as manual method of weed control. During the past three decades, the agro-chemical industry has produced a range of herbicides for weed control in various crops. But in this investigation weed control efficiency of different herbicides have been tested along with their economics involved during Kharif season.

II. MATERIALS AND METHODS

The field experiment was conducted at Regional Research and Technology Transfer Station (OUAT) Ranital, Bhadrak, Odisha during Kharif season 2008-09. The rice variety was Swarna. The experimental field was medium land with good irrigation and drainage facilities and the soil was sandy loam and clay loam in texture with pH 6.8. The experimental area comes under sub-tropical humid climate and situated just South of the Tropic of Cancer. The experimeny was laid out at Randomized Block Design (RBD) having seven treatments with three replications. The treatments comprised unweeded control, hand weeding at 21 and 42 days after transplanting (DAT), Butachlor@1.25Kg ha⁻¹, Pretilachlor@0.5Kg ha⁻¹, were applied at 3 DAT where Oxadiargyl @0.1Kg ha⁻¹ and Metsulfuron methyl + Chlorimuron ethyl@ 6g ha⁻¹ applied at 5 DAT and Pyrazosulfuronethyl(PSE) @ 30g ha⁻¹ at 10 DAT by a

knapsack sprayer fitted with a nozzle-WFN with 500L water per hectare.

Weed control efficiency (WCE %)

It denotes the efficiency of the applied weed management treatments for comparison purpose. The WCE of different weed management treatments were calculated using the following formula:

$$\text{WCE} = \frac{\text{Dry matter of weeds in control plot} - \text{Dry matter of weeds in treated plot}}{\text{Dry matter of weeds in control plot}} \times 100$$

Economic analysis

Cost of various inputs and crop management practices in producing the crops including the treatment cost and the price of the produce were estimated as per available market price. Cost of cultivation, gross and net return of the crop for various treatments was then calculated.

III. RESULTS AND DISCUSSION

Weed control efficiency of different treatments

Weed control efficiencies of different treatments different growth stages have been presented from Tables - 1 to 3

The highest weed control efficiency of grass weeds was observed with Oxadiargyl at all stages of crop growth, which was closely followed by PSE. Pretilachlor offered higher weed control efficiency than Almix and HW Twice but lesser than PSE. In case of sedge weed, highest weed control efficiency was observed with Almix at all stages of crop growth followed by PSE and Oxadiargyl. Pretilachlor offered higher weed control efficiency than HW twice but less than PSE. However, at harvest Butachlor showed the lowest weed control efficiency against sedge weeds (30.64 %) but the highest value recorded with Almix (86.46%). The weed control efficiency followed similar trend of variation for broadleaf and total weeds. At harvest, the lowest weed control efficiency was noticed in Butachlor (44.38%)

against broadleaf weeds and Almix gave the maximum value (91.98%). While considering total weed, the highest weed control efficiency was noticed in Almix (87.32 %), followed by Oxadiargyl (85.40%), PSE (84.41 %). The lower value was observed in Butachlor (45.39%).

Comparing the efficiency of different treatments in controlling the total weed biomass, it was observed that Almix was most effective herbicide registering the lowest weed biomass among all. At harvest it exhibited 86.0, 74.1, 69.9, 39.9, 16.8, 11.8 lesser weed biomass than weed check, Butachlor, HW twice, Pretilachlor, PSE, Oxadiargyl, respectively. Rao (2000) found that Pyrazosulfuron ethyl @ 30 g a.i.ha⁻¹ being a sulfonyl urea group of herbicides, able to effectively control different weeds present in cultivated rice field, irrespective of aquatic, semi-aquatic or non-aquatic nature of weed flora. The better weed control ability of Almix @ 6 g a.i.ha⁻¹ among all treatments may be attributed to its alliance of sulfonyl urea group.

The weed control efficiency also exhibited the superiority of Almix by exerting around 86 percent weed control efficiency at 3 dates of observations, 30, 60 DAT and at harvest. This was closely followed by Oxadiargyl (around 85 per cent) and PSE (around 84 percent). Pretilachlor treatment recorded around 76 percent value which was better than Butachlor (around 45 percent).

Table 1 Weed control efficiency of different treatments at 30 DAT

| Treatments | Grass | | | Sedge | | | Broadleaf | | | Total Weed | | |
|-------------------|-------|-------|--------|-------|-------|--------|-----------|-------|--------|------------|-------|--------|
| | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled |
| T1 (Check) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| T2 (Butachlor) | 57.29 | 44.65 | 50.97 | 44.24 | 17.16 | 30.70 | 42.82 | 45.75 | 44.28 | 48.44 | 40.43 | 44.43 |
| T3 (Pretilachlor) | 71.88 | 68.55 | 70.22 | 54.55 | 79.10 | 66.82 | 78.16 | 82.79 | 80.47 | 68.53 | 79.12 | 73.83 |
| T4 (Oxadiargyl) | 82.23 | 82.39 | 82.31 | 60.30 | 91.79 | 76.05 | 85.34 | 93.25 | 89.30 | 76.40 | 90.69 | 83.54 |
| T5 (PSE) | 74.27 | 79.87 | 77.07 | 62.73 | 89.85 | 76.29 | 83.91 | 92.59 | 88.25 | 73.84 | 89.41 | 81.63 |
| T6 (Almix) | 68.97 | 66.67 | 67.82 | 79.39 | 95.52 | 87.46 | 86.21 | 98.26 | 92.23 | 77.91 | 91.09 | 84.50 |
| T7 (HW Twice) | 58.89 | 62.89 | 60.89 | 46.06 | 66.42 | 56.24 | 64.66 | 37.47 | 51.06 | 56.78 | 48.01 | 52.39 |

Table 2 Weed control efficiency of different treatments at 60 DAT

| Treatments | Grass | | | Sedge | | | Broadleaf | | | Total Weed | | |
|-------------------|-------|-------|--------|-------|-------|--------|-----------|-------|--------|------------|-------|--------|
| | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled |
| T1 (Check) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| T2 (Butachlor) | 57.19 | 44.85 | 51.02 | 44.23 | 17.21 | 30.72 | 42.90 | 45.81 | 44.36 | 48.46 | 41.00 | 44.73 |
| T3 (Pretilachlor) | 79.43 | 79.04 | 79.23 | 56.90 | 80.47 | 68.68 | 84.23 | 83.00 | 83.61 | 74.56 | 81.78 | 78.17 |
| T4 (Oxadiargyl) | 82.34 | 87.10 | 84.72 | 60.30 | 91.81 | 76.06 | 85.33 | 95.40 | 90.36 | 76.99 | 93.13 | 85.06 |
| T5 (PSE) | 81.09 | 86.76 | 83.93 | 63.71 | 90.42 | 77.06 | 83.44 | 95.04 | 89.24 | 76.86 | 92.61 | 84.74 |
| T6 (Almix) | 72.47 | 77.21 | 74.84 | 78.83 | 95.35 | 87.09 | 85.17 | 98.70 | 91.94 | 78.73 | 93.78 | 86.25 |
| T7 (HW Twice) | 58.70 | 62.87 | 60.78 | 46.12 | 66.51 | 56.32 | 64.67 | 37.43 | 51.05 | 57.13 | 47.30 | 52.21 |

Table 3 Weed control efficiency of different treatments at harvest

| Treatments | Grass | | | Sedge | | | Broadleaf | | | Total Weed | | |
|-------------------|-------|-------|--------|-------|-------|--------|-----------|-------|--------|------------|-------|--------|
| | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled | 2008 | 2009 | Pooled |
| T1 (Check) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| T2 (Butachlor) | 57.24 | 44.74 | 50.99 | 44.18 | 17.27 | 30.73 | 42.92 | 45.83 | 44.38 | 49.24 | 41.54 | 45.39 |
| T3 (Pretilachlor) | 78.29 | 75.26 | 76.78 | 57.30 | 80.00 | 68.65 | 82.64 | 81.67 | 82.15 | 74.51 | 79.87 | 77.19 |
| T4 (Oxadiargyl) | 82.35 | 87.11 | 84.73 | 60.44 | 91.82 | 76.13 | 85.42 | 95.42 | 90.42 | 77.91 | 92.88 | 85.40 |
| T5 (PSE) | 82.02 | 86.58 | 84.30 | 64.14 | 90.45 | 77.30 | 80.00 | 94.38 | 87.19 | 76.90 | 91.92 | 84.41 |
| T6 (Almix) | 74.34 | 86.32 | 80.33 | 85.03 | 95.45 | 90.24 | 81.94 | 98.54 | 90.24 | 79.52 | 95.13 | 87.32 |
| T7 (HW Twice) | 58.77 | 62.89 | 60.83 | 46.21 | 66.36 | 56.29 | 64.72 | 37.40 | 51.06 | 57.62 | 47.69 | 52.65 |

Economics of different chemical weed management treatments

It is evident from Table – 4 that among all treatments, CME + MSM (Almix) showed maximum net return (Rs. 47478.00 ha⁻¹) with a benefit cost ratio of 3.076 in the year 2008. Butachlor, Pretilachlor, Oxadiargyl and HW twice realized comparable benefit cost ratio in comparison to PSE (benefit cost ratio 2.906). Weedy check given a lowest net return of Rs 37396.00 with a benefit cost ratio of 2.548.

Table – 4: Economics of different treatments-2008

| Treatments | Cost of cultivation | Cost of produce | Benefit: cost ratio |
|-------------------------------|---------------------|-----------------|---------------------|
| T ₁ (Weed check) | 14676.00 | 37396.00 | 2.548 |
| T ₂ (Butachlor) | 15316.00 | 41211.00 | 2.691 |
| T ₃ (Pretilachlor) | 15226.00 | 42151.00 | 2.768 |
| T ₄ (Oxadiargyl) | 15483.00 | 42988.00 | 2.776 |
| T ₅ (PSE) | 15416.00 | 44795.00 | 2.906 |
| T ₆ (CME+MSM) | 15435.00 | 47478.00 | 3.076 |
| T ₇ (HW) | 16776.00 | 45905.00 | 2.736 |

Similarly from Table - 5 it is clear that among all treatments CME + MSM (Almix) realized maximum gross return (Rs. 56454.00 ha⁻¹) with a benefit cost ratio of 3.622 in the year 2009. The corresponding figure is lowest for weedy check with a benefit cost ratio of 2.938. Pretilachlor, PSE and Oxadiargyl were gave gross return of Rs. 49739.00, Rs. 50220.00 and Rs. 50357.00 respectively with corresponding benefit cost ratio of 3.235, 3.226 and 3.221 as compared to Butachlor (benefit cost ratio 3.114).

Table – 5: Economics of different treatments-2009

| Treatments | Cost of cultivation | Cost of produce | Benefit cost ratio |
|-------------------------------|---------------------|-----------------|--------------------|
| T ₁ (Weed check) | 14826.00 | 43559.00 | 2.938 |
| T ₂ (Butachlor) | 15466.00 | 48158.00 | 3.114 |
| T ₃ (Pretilachlor) | 15376.00 | 49739.00 | 3.235 |
| T ₄ (Oxadiargyl) | 15633.00 | 50357.00 | 3.221 |
| T ₅ (PSE) | 15566.00 | 50220.00 | 3.226 |
| T ₆ (CME+MSM) | 15585.00 | 56454.00 | 3.622 |
| T ₇ (HW) | 16926.00 | 52972.00 | 3.130 |

Table – 6: Economics of different treatments (Average of two years)

| Treatments | Cost of cultivation | Cost of produce | Benefit cost ratio |
|-------------------------------|---------------------|-----------------|--------------------|
| T ₁ (Weed check) | 14751.00 | 40477.50 | 2.743 |
| T ₂ (Butachlor) | 15391.00 | 44684.50 | 2.902 |
| T ₃ (Pretilachlor) | 15301.00 | 45945.00 | 3.002 |
| T ₄ (Oxadiargyl) | 15558.00 | 46672.50 | 2.999 |
| T ₅ (PSE) | 15491.00 | 47507.50 | 3.066 |
| T ₆ (CME+MSM) | 15510.00 | 51966.00 | 3.349 |
| T ₇ (HW) | 16851.00 | 49438.50 | 2.933 |

The average data presented in Table - 6 revealed that among all the chemical treatments, maximum gross return (Rs. 51966.00 ha⁻¹) was obtained from CME + MSM (Almix) treatment with a benefit cost ratio of 3.349. Lowest gross returned was found with Weedy Check with a benefit cost ratio of 2.743. PSE, Pretilachlor and Oxadiargyl gave a gross return of Rs. 47507.50, Rs. 45945.00 and Rs. 46672.50, respectively with corresponding benefit cost ratio of 3.066, 3.002 and 2.999, respectively, which were higher than HW Twice (2.933) and Butachlor (2.902).

CONCLUSION

Considering the effects of herbicides on total weed, Almix expressed highest weed control efficiency followed by Oxadiargyl and PSE, respectively. Among all chemical treatments next to Almix, PSE produced higher grain yield than Oxadiargyl, Pretilachlor and Butachlor. HW twice recorded lower grain yield than Almix but higher than all other chemical treatments. Among the five different herbicides used in transplanted rice, CME + MSM (Almix) was found to be more economic and remunerative in realizing maximum gross return with benefit cost ratio of 3.349, which was even higher than HW twice (2.933). The lowest gross returned was found with Weedy check with a benefit cost ratio of 2.743. Almix showed 5.11, 9.38, 11.34,

13.10 and 16.29 percent higher return over Hand Weeding, PSE, Oxadiargyl, Pretilachlor and Butachlor respectively..

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