Effect of Weed Management Practices on Growth and Economics of Transplanted Rice under Sodic Soil

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Abstract

Field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirapalli, Tamil Nadu during rabi 2016-2017 to evaluate the weed management practices in transplanted rice under sodic soil. The experiment consisted of 12 treatments laid out in Randomized Complete Block Design with three replications consisting of three pre-emergence herbicides integrated with post emergence herbicides and one hand weeding at 40 DAT, two early post emergence herbicides and one post emergence herbicide, hand weeding twice at 20 and 40 DAT, compared with weed free and unweeded check. The weed flora of the experimental site consisted of Cynodon dactylon, Echinochloa colona and Panicum repens in grasses, Cyperus rotundus and Cyperus difformis in sedges and Ammannia baccifera, Ipomoea aquatica and Marsilea quadrifolia in broad leaved weeds. Grasses were found to be predominant category followed by sedges and broad leaved weeds. The results revealed that pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT followed by hand weeding on 40 DAT recorded significantly higher grain and straw yield (4987 kg ha\(^{-1}\) and 6841 kg ha\(^{-1}\)) which remained at par with weed free check (4798 and 6741 kg ha\(^{-1}\)). In terms of economics, highest net returns (Rs. 47765 ha\(^{-1}\)) and B: C ratio (2.49) was realized compared to that weed free check (Rs. 42640 ha\(^{-1}\)) and B: C ratio (2.25).

Keywords
Weed density, Weed control efficiency, Weed index, Grain yield, Straw yield and Benefit Cost ratio.

Introduction

Rice is cultivated in a very wide range of ecosystems from irrigated to shallow lowlands, mid-deep lowlands and deep water to uplands. Transplanting is the major method of rice cultivation in India. Weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Out of losses due to various biotic stresses, weeds are known to account for nearly one third. Transplanted rice is particularly infested by heterogeneous types of weed flora under lowland ecosystem, which reduces yield up to 48 per cent with an annual loss of 15 million tonnes due to weed competition. Prevention of weed competition and provision of weed free environment at critical period of rice growth is necessary for successful rice production (Murali and Gowthami, 2017). Weed competition is one of the prime yield limiting constraints in rice resulting in yield reduction of 28-45 per cent (Maheshwari et al., 2015). Manual weeding although effective and most common practice of weed control in transplanted rice, raising
cost of labour and their non-availability in time lead to the search for alternative methods. Herbicides offer the most effective, economical and practical way of weed management (Sureshkumar and Durairaj, 2016). So, there is a need to evaluate the effect of new herbicides on growth and economics of transplanted rice under sodic soil condition in order to gain profitability and for providing wider options to farmers.

**Materials and Methods**

An experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli during rabi 2016-2017. The soil of the experimental field was sandy clay loam in texture with pH of 8.8.

The experiment was laid out in randomized complete block design with twelve treatments were T1- pre emergence application of butachlor at 1.5 kg a.i. ha\(^{-1}\) on 3 days after transplanting (DAT) followed by (fb) hand weeding on 40 DAT, T2- pre emergence application of pyrazosulfuron ethyl at 25 g a.i. ha\(^{-1}\) on 3 DAT fb hand weeding on 40 DAT, T3- pre emergence application of pyrazosulfuron ethyl at 25 g a.i. ha\(^{-1}\) on 3 DAT fb early post emergence application of bispyribac sodium at 25 g a.i. ha\(^{-1}\) on 8-12 DAT, T4- pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT fb hand weeding on 40 DAT, T5- pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT fb early post emergence application of bispyribac sodium at 25 g a.i. ha\(^{-1}\) on 8-12 DAT, T6- pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT fb post emergence application of 2,4-D sodium salt at 80 g a.i. ha\(^{-1}\) on 25-30 DAT, T7- early post emergence application of bispyribac sodium at 25 g a.i. ha\(^{-1}\) on 8-12 DAT fb post emergence application of 2,4-D sodium salt at 80 g a.i. ha\(^{-1}\) on 25-30 DAT, T8- early post emergence application of oxadiargyl at 80 g a.i. ha\(^{-1}\) on 8-12 DAT fb post emergence application of 2,4-D sodium salt at 80 g a.i. ha\(^{-1}\) on 25-30 DAT, T9- hand weeding twice at 20 fb 40 DAT, T10- unweeded check, T11- weed free check and replicated thrice.

The pre emergence herbicides were applied at 3 DAT as sand mix application and the early post emergence application were applied at 8-12 DAT and post emergence application were applied at 30 DAT through knap sack sprayer using a sprayer volume of 500 L ha\(^{-1}\).

The data on weed density and dry weight were recorded at 20, 40 and 60 DAT and were subjected to square root x+0.5 transformation before statistical analysis to normalize their distribution.

The growth and yield attributes like number of productive tillers per square metre, number of filled grains per panicle, test weight were recorded at the time of harvesting and threshing were recorded at the time of maturity. Economics of different treatments was calculated taking into account of the prevailing market prices of inputs and output.

**Results and Discussion**

The weed flora consisted of *Cynodon dactylon*, *Echinochloa colona* and *Panicum repens* in grasses, *Cyperus rotundus* and *Cyperus difformis* in sedges and *Ammannia baccifera*, *Ipomoea aquatica* and *Marsilea quadrifolia* in broad leaved weeds. Grasses were found to be the predominant category followed by sedges and broad leaved weeds.
Table 1 Effect of different weed management practices on weed density, weed dry weight and weed control efficiency of transplanted rice under sodic soil

| Treatments                                      | Weed density (no. m⁻²) | Weed dry weight (g. m⁻²) | Weed control efficiency (%) |
|-------------------------------------------------|------------------------|--------------------------|-----------------------------|
|                                                  | 40 DAT | 60 DAT | 40 DAT | 60 DAT | 40 DAT | 60 DAT |
| T₁ - PE Butachlor fb HW on 40 DAT                | 4.88  (23.3) | 4.30  (18.0) | 2.32  (4.9) | 3.30  (10.4) | 82.0 | 77.9 |
| T₂ - PE PSE fb HW on 40 DAT                      | 5.90  (34.3) | 4.95  (24.0) | 2.39  (5.2) | 3.08  (9.0) | 73.5 | 70.5 |
| T₃ - PE PSE fb EPOE Bispyribac                   | 5.64  (31.3) | 5.36  (28.7) | 2.39  (5.2) | 2.96  (8.3) | 75.8 | 64.8 |
| T₄ - PE Bensulf + Pretila fb HW on 40 DAT        | 2.59  (6.3) | 3.19  (9.7) | 1.85  (3.0) | 2.16  (4.2) | 95.1 | 88.1 |
| T₅ - PE Bensulf + Pretila fb EPOE Bispyribac    | 6.72  (44.7) | 5.70  (32.0) | 2.57  (6.1) | 2.61  (6.3) | 65.5 | 60.7 |
| T₆ - PE PSE fb POE 2,4-D Na salt                 | 5.99  (35.3) | 5.21  (26.7) | 2.44  (5.5) | 4.47  (19.5) | 72.7 | 67.2 |
| T₇ - PE Bensulf + Pretila fb POE 2,4 -D Na salt  | 3.53  (12.0) | 3.76  (13.7) | 1.66  (2.3) | 2.50  (5.8) | 90.7 | 83.2 |
| T₈ - POE Bispyribac fb POE 2,4 -D Na salt        | 4.81  (22.7) | 3.88  (14.7) | 2.23  (4.5) | 2.80  (7.3) | 82.5 | 82.0 |
| T₉ -EPOE Oxadiargyl fb POE 2,4 -D Na salt        | 7.84  (61.0) | 6.54  (42.3) | 3.14  (9.3) | 4.88  (23.4) | 52.8 | 48.0 |
| T₁₀ -Hand weeding at 20 and 40 DAT               | 3.24  (10.0) | 3.49  (11.7) | 1.69  (2.4) | 2.22  (4.5) | 92.3 | 85.7 |
| T₁₁ - Unweeded check                             | 11.39 (129.3) | 9.04  (81.3) | 4.14  (16.7) | 5.84  (33.6) | -    | -    |
| T₁₂ - Weed free check                            | 3.26  (10.7) | 3.13  (9.3) | 1.31  (1.3) | 1.30  (1.5) | -    | -    |

SE d      0.30  0.26  0.16  0.18  -  -
CD (P = 0.05)  0.62  0.53  0.33  0.38  -  -

The data were transformed to √ x + 0.5. The figures in the parenthesis are original values.

Table 2 Effect of different weed management practices on yield contributing characters of transplanted rice under sodic soil

| Treatments                                      | No. of productive tillers (m⁻²) | No. of grains panicle⁻¹ | Grain yield (kg ha⁻¹) |
|-------------------------------------------------|----------------------------------|-------------------------|-----------------------|
| T₁ - PE Butachlor fb HW on 40 DAT                | 338                             | 188                     | 4215                  |
| T₂ - PE PSE fb HW on 40 DAT                      | 294                             | 157                     | 4502                  |
| T₃ - PE PSE fb EPOE Bispyribac                   | 255                             | 173                     | 4299                  |
| T₄ - PE Bensulf + Pretila fb HW on 40 DAT        | 385                             | 182                     | 4987                  |
| T₅ - PE Bensulf + Pretila fb EPOE Bispyribac    | 284                             | 180                     | 4199                  |
| T₆ - PE PSE fb POE 2,4-D Na salt                 | 251                             | 155                     | 4088                  |
| T₇ - PE PSE fb POE 2,4 -D Na salt                | 342                             | 163                     | 4532                  |
| T₈ - POE Bispyribac fb POE 2,4 -D Na salt        | 264                             | 156                     | 3435                  |
| T₉ -EPOE Oxadiargyl fb POE 2,4 -D Na salt        | 246                             | 192                     | 4046                  |
| T₁₀ -Hand weeding at 20 and 40 DAT               | 298                             | 188                     | 4405                  |
| T₁₁ - Unweeded check                             | 239                             | 112                     | 2943                  |
| T₁₂ - Weed free check                            | 330                             | 158                     | 4798                  |

SE d      25  10  209
CD (P = 0.05)  53  22  433

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### Table 3: Economics of weed management

| Treatments                                      | Total variable cost (₹ ha⁻¹) | Gross return (₹ ha⁻¹) | Net return (₹ ha⁻¹) | B:C ratio |
|------------------------------------------------|------------------------------|-----------------------|---------------------|-----------|
| T₁ - PE Butachlor fb HW on 40 DAT               | 31219                        | 67440                 | 36221               | 2.16      |
| T₂ - PE PSE fb HW on 40 DAT                    | 32399                        | 72032                 | 39633               | 2.22      |
| T₃ - PE PSE fb EPOE Bispyribac                 | 34133                        | 68784                 | 34651               | 2.02      |
| T₄ - PE Bensulf + Pretila fb HW on 40 DAT      | 32027                        | 79792                 | 47765               | 2.49      |
| T₅ - PE Bensulf + Pretila fb EPOE Bispyribac   | 36048                        | 67184                 | 31136               | 1.86      |
| T₆ - PE PSE fb POE 2,4-D Na salt               | 31138                        | 65408                 | 34270               | 2.10      |
| T₇ - PE Bensulf + Pretila fb POE 2,4 -D Na salt| 35088                        | 72512                 | 37424               | 2.07      |
| T₈ - EPOE Bispyribac fb POE 2,4 -D Na salt     | 30418                        | 54960                 | 24542               | 1.81      |
| T₉ - EPOE Oxadiargyl fb POE 2,4 -D Na salt     | 31048                        | 64736                 | 33688               | 2.09      |
| T₁₀ - Hand weeding at 20 and 40 DAT            | 36418                        | 70480                 | 34062               | 1.94      |
| T₁₁ - Unweeded check                           | 28803                        | 47088                 | 18285               | 1.63      |
| T₁₂ - Weed free check                         | 34128                        | 76768                 | 42640               | 2.25      |

**Fig. 1.** Effect of weed management practices on number of productive tillers (m⁻²) in transplanted rice under sodic soil
Fig. 2. Effect of weed management practices on number of grains panicle\(^{-1}\) in transplanted rice under sodic soil

Fig. 3. Effect of weed management practices on grain yield (Kg ha\(^{-1}\)) in transplanted rice under sodic soil
The data presented in Table 1 on density and dry weight of weeds revealed that all the weed control treatments reduced the weed dry weight significantly from that of unweeded treatment. Among the weed control treatments, the lowest weed density and weed dry weight were registered in pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT \(fb\) hand weeding on 40 DAT (T\(_4\)) and 60 DAT. It was comparable with weed free check (T\(_{12}\)). The highest weed density and dry weight recorded with unweeded check (T\(_{11}\)) for all the stages (Fig. 4). Higher weed control efficiency was registered with bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT \(fb\) hand weeding on 40 DAT (T\(_4\)).

**Effect on yield**

A perusal of the data in Table 2, further revealed that among the herbicide treatments, number of productive tillers m\(^{-2}\) (385) (Fig. 1) and the highest grain yield (4987 kg ha\(^{-1}\)) were obtained with pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT \(fb\) hand weeding on 40 DAT (T\(_4\)) and it was on par with weed free check (T\(_{12}\)) (4798 kg ha\(^{-1}\)) with the weed control efficiency (95.1 \%) on 40 DAT. The minimum grain yield and straw yield were observed in weedy check with a yield loss of 40.9\% and 35.9\%, respectively as compared to T\(_4\) (Fig. 3). An increase in yield of 69.4\% over weedy check was observed in case of T\(_4\), Abdhullah (2011), Uma et al., (2014) and Charan Teja (2015) also recorded the highest grain yield with bensulfuron methyl + pretilachlor. This was due to lesser weed competition and better uptake of nutrients by the crop. Yield attributes and grain yield was the lowest in unweeded check (T\(_{11}\)).

**Effect on economics**

The data in Table 3 indicated that hand weeding is expensive due to high labour cost but use of herbicides was cheaper in cost and effective in
controlling the weeds and reducing total energy required for rice cultivation. Similar findings were reported by Srinivasan and Chaudhary (1993).

The highest gross returns (Rs. 89,597 ha\(^{-1}\)) were observed with \(T_{11}\). While the lowest gross returns (Rs. 55,839 ha\(^{-1}\)) as observed with weedy check. The gross returns followed similar trend as that of grain yield. The highest benefit cost ratio (1.91) was observed with \(T_{11}\) and was followed by \(T_{10}\) which showed almost the same ratio. All herbicide treatments registered higher benefit cost ratio over weedy check which recorded markedly higher than that observed with hand weeding at 20 and 40 DAT (1.65). The highest benefit cost ratio (BCR) obtained by \(T_{11}\) might be due to higher grain yield in this treatment compared to other treatments. The lower BCR in hand weeding treatment was mainly because of higher labour cost involved in hand weeding. Therefore, the higher cost involved in manual weeding was not compensated by the additional grain yield obtained in hand weeding resulting in lower BCR (1.65).

From this study, it could be concluded that under transplanted rice in sodic soil, pre emergence application of bensulfuron methyl + pretilachlor at 60 + 600 g a.i. ha\(^{-1}\) on 3 DAT fb hand weeding on 40 DAT (\(T_4\)) resulted in increased yield attributes and nutrient uptake by rice. This has reflected in increased grain and straw yield. The same treatment has shown broad spectrum of weed control, higher net return and BCR. This was followed by weed free check (\(T_{12}\)).

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