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Effect of pyriftalid + bensulfuron-methyl herbicide on transplanted summer rice under red and lateritic soil of West Bengal

K Mondal, GC Malik, K Jana and M Banerjee

Abstract
Boro rice is cultivated in waterlogged, low-lying or medium lands with irrigation facilities. It is a winter season, photo-insensitive, transplanted rice cultivated with assured irrigation and modern inputs. This gives the farmers a chance to grow a *rabi* season crop which normally they could not grow. Like several other modern inputs, weed management plays an important role. With the view of weed management, a field experiment was conducted during summer season of 2016 at farmer's field of Lohagarh village, Sriniketan, India, which lies in the sub-humid and sub-tropical lateritic belt of West Bengal to study the effect of Pyriftalid + Bensulfuron methyl herbicide on transplanted summer rice. The experiment consisted of nine treatments namely Weedy Check (T_1), Weed Free (T_2), Pyriftalid + Bensulfuron Methyl @ 300ml/ha at 9 DAT (T_3), Pyriftalid + Bensulfuron Methyl @ 375ml/ha at 9 DAT (T_4), Pyriftalid + Bensulfuron Methyl @ 450ml/ha at 9 DAT (T_5), Pyriftalid + Bensulfuron Methyl @ 900ml/ha at 9 DAT (T_6), Pyriftalid 25% SC @ 600ml/ha at 9 DAT (T_7), Bensulfuron Methyl 60% DF @ 100g/ha at 20 DAT (T_8), Pretilachlor 6% + Bensulfuron 0.6% @ 10Kg/ha 3 DAT (T_9) which was laid out in randomized block design with three replications.
The results showed that the application of Pyriftalid + Bensulfuron Methyl @ 450ml/ha at 9 DAT (T_5), Pyriftalid + Bensulfuron Methyl @ 900ml/ha at 9 DAT (T_6) were essential for improving growth attributes, yield components and productivity of summer rice. In some cases, the above treatments along with Pretilachlor 6% + Bensulfuron 0.6% @ 10Kg/ha at 3 DAT (T_9) efficiently controlled the grassy and non-grassy weeds. Pyriftalid + Bensulfuron Methyl @ 450ml/ha at 9 DAT (T_5) provided higher net return with high return per rupee invested. The result clearly indicated that by practicing of different weed management techniques, there was reduced infestation of weeds in summer rice and increased grain yield. The study recommends the application of Pyriftalid + Bensulfuron Methyl @ 450ml/ha at 9 DAT (T_5) for good growth, higher productivity (6.18 t/ha) of summer rice.

Keywords: Bensulfuron methyl, *Boro* rice, pyriftalid, weed management

Introduction
Rice (*Oryza sativa* L.), the staple cereal crop of India plays a key role in food security. It is the most widely cultivated crop not only in the world but also the staple food of India, Moreover, this country has the largest area under rice cultivation, as it is one of the principal food crops. Rice seeds have elements of protein, starch, oil, salt and fibre in them which are very much needed by the human body. With 43.86 million hectares, India ranks number one globally in paddy area and with 104.80 million tonnes stands next only to China. In West Bengal, the area and production under rice during 2014-15 were 5.39 million hectares which is 12.28% of the total acreage in India and 14.71 million tonnes respectively (Anonymous, 2014-15) [2].

Rice grows in the state in 3 different season's *viz*., *Aus* (autumn rice), *Aman* (winter rice) and *Boro* (summer rice).
Although, *boro* rice cultivation has been an old practice in deep water areas, it is only recently that it has emerged as a major breakthrough in enhancing rice productivity, not only in traditional, but also in non-traditional *boro* rice areas with assured irrigation and modern inputs. The credit primarily goes to the farmer's own initiatives in adopting its cultivation in a big way. Weeds are often called out of place and out of time. They are unwanted, prolific, competitive and often harmful to the crop ecology. They occur in every rice field in the world. There are several reasons for its low productivity but the infestation of weeds is one of the most important causes for low yield of rice in India.
The general method of hand weeding as practiced by the farmers is labour intensive, time taking and expensive. Moreover in *Kharif* season, due to continuous rains the manual weeding is problematic and uneconomic. In these situations the herbicides are very effective for controlling weeds. Selective new generation herbicides are needed to ensure profitability and yield advantage over farmers practice. In this scenario, early post-emergence herbicides like ready mix product of Pyriftalid + Bensulfuron-methyl appear to offer alternate possibility. Pyriftalid act as an Acetolactate synthase (ALS) inhibitor, which reduce the rate of cell division and inhibits the plant cell growth causing death of plant. It controls all annual grass species including *Echinochloa spp.* On the other hand, Bensulfuron-Methyl act as a selective, systemic, absorbed through foliage & roots, inhibit plant amino acid synthesis or, acid hydroxy acid synthesis (AHAS) inhibitor which mainly control sedges and broad leaves weeds in rice field.

Materials and Methodology

A field experiment was conducted at the Farmer's field of Lohagarh village, Bolpur, Birbhum during summer season of 2016. The farm is situated at 23.68° North latitude and 87.64° East longitude and at an average altitude of 58.9 m above the mean sea level (MSL) in western part of South Bengal. This farm is located in the sub humid, subtropical belt.
The trail was laid out in Randomized Block Design with nine treatments and each treatment was replicated three times with the variety MTU-1010. Observation on yield attributing character e.g. number of effective tiller/m^2, number of grain/panicle, test weight, grain yield and straw yield were recorded at certain intervals. The experimental data were analyzed statistically and presented in tables.

Result and Discussion

Weed flora

The dominating weed flora observed in the experimental field were *Cyperus difformis*, *Cyperus iria* among the sedges, *Echinochloa colona, Cynodon dactylon*, *Panicum repen* and rice off type among grasses, and *Marsilea quadrifolia*, *Ludwigia parviflora* and *Commelina benghalensis* among broad-leaved weeds.
Statistical analysis of the data indicated that different weed management practices exerted significant effect on number of effective tillers/m^2, number of grain /panicle, test weight, grain yield, straw yield and harvest index.
The maximum number of effective tillers/m^2 recorded at maturity was (466) T_2 treatment which is weed free, and among the herbicides T_5 (452.90) treatment show maximum number of effective tiller/m^2. The decrease in the number of tillers/m^2 from the panicle initiation stage to maturity is attributed to the death of some young tillers due to competition for moisture, light, nutrient and assimilates between developing panicles and young tillers.
The highest number of grains per panicles was produced in the T_2 plot (119.52). The T_4, T_5 and T_6, treatments were statistically at par with T_2 treatment. The lowest number of grains per panicles was recorded from the weedy check (T_1) plot. The results are in conformity with the findings of Kathirvelan, and Vaiyapuri, (2004) [3] they reported that Grain yield losses amounted to 69.9% due to uncontrolled weed growth as compared to hand weeding (20 and 40 DAT). The possible reason for higher yield and yield attributing characters in these treatments was reduced crop-weed competition. None of the herbicide treatments could produce grain yield comparable to hand weeding 20 and 40 DAT.
The test weight is a stable character and does not vary much due to different management practices. Results of this study also indicated that test weight was a very stable character and did not vary much by varying the weed management practices.
The highest grain yield was obtained in the weed free (T_2) plot with a record yield of 5.53 t/ha. Pyriftalid + Bensulfuron methyl @ 375 ml/ha (T_4), Pyriftalid + Bensulfuron methyl @ 450 ml/ha (T_5), Pyriftalid + Bensulfuron methyl @ 900 ml/ha (T_6), and Pretilachlor 6% + Bensulfuron methyl 660 DF @ 10kg/ha (T_9) were statistically at par with T_2 treatment. However, a lowest yield was recorded in the weedy check (T_1) plot. The present findings are in close association with the findings of Saha *et al.* (2009) [7], Ramachandra *et al.* (2014) [6]. According to the findings of Saha *et al*. (2009) [7] it revealed that on an average, there was more than 45% reduction in the grain yield of rice due to competition within weedy plots. All the herbicide treated plots produced grain yields significantly more than the weedy plots. The highest grain yield of rice was obtained in hand weeding twice this was due to the fact that the less competition for moisture, light and nutrient uptake by the crop plants. The higher assimilation of photosynthesis in herbicides treated plots may be the reason for higher yield.
The highest straw yield was recorded in the weed free (T_2) plot. All the treatments were statistically at par with T_2 treatment. The lowest straw yield was observed in case of T_1 treatment. The results are in conformity with the findings of Rahaman *et al.* (2006) [5], Ali *et al.* (2010) [1].

Weed control efficiency (WCE)

The observations on Weed Control Efficiency recorded at 30, 45 and 60 days after transplanting (DAT) were analyzed statistically and presented in the Table.
At all the growth stages, 30, 45 and 60 DAT, highest weed control efficiency values were observed in weed free (T_2) treatment. At 30 DAT, Pyriftalid + Bensulfuron Methyl 375ml/ha 9 DAT (T_4), Pyriftalid + Bensulfuron Methyl 450ml/ha 9 DAT (T_5), Pyriftalid + Bensulfuron Methyl 900ml/ha 9 DAT (T_6) and Pretilachlor 6% + Bensulfuron 0.6% 10Kg/ha 3 DAT (T_9) treatment were statistically at par with weed free (T_2) treatment.
While in 45 DAT, Pyriftalid + Bensulfuron Methyl 450ml/ha 9 DAT (T_5), Pyriftalid + Bensulfuron Methyl 900ml/ha 9 DAT (T_6) and Pretilachlor 6% + Bensulfuron 0.6% 10Kg/ha 3 DAT (T_9) treatment were statistically at par with weed free (T_2) treatment due to lower weed density as well as lower weed dry weight.
But, in case of 60 DAT observation, T_2 treatment having higher side of weed control efficiency values was statistically

at par with Pyriftalid + Bensulfuron Methyl 900ml/ha 9 DAT (T_6). Lowest weed control efficiency was observed in case of weedy check (T_1) treatment.

The results are in conformity with the findings of different experiment carried out by Singh *et al.* (2010) [8], Yakadri (2013) [9], Mishra and Dash (2013) [4]. Based on research findings, Mishra and Das concluded that higher weed control efficiency (WCE) was found in all the demonstrated plots of herbicide applications over farmers' practice in all the stages of observations. The WCE varied from 68-84% at 60 DAT depending on the floral composition, density and growth of weeds at different locations. The grain and straw yield was increased from 23-42% and 18-26%, respectively over farmers' practice in different herbicides applied fields at different locations, depending on the growth and intensity of weed populations.

Table 1: Effect of weed management on yield attributing character in summer rice

Treatments	No. of effective tiller/m^2	No. of Grain/panicle	1000 grain weight	Grain yield	Straw yield
T_1: Weedy check	327.43	67.19	21.05	3.46	4.76
T_2: Weed free	466.00	119.52	22.21	5.53	6.41
T_3: Pyriftalid + Bensulfuron Methyl @ 300ml/ha 9 DAT	440.23	98.29	22.07	5.02	5.96
T_4: Pyriftalid + Bensulfuron Methyl @ 375ml/ha 9 DAT	447.10	102.64	21.76	5.14	6.03
T_5: Pyriftalid + Bensulfuron Methyl @ 450ml/ha 9 DAT	452.90	108.08	21.95	5.29	6.18
T_6: Pyriftalid + Bensulfuron Methyl @ 900ml/ha 9 DAT	424.10	106.75	21.64	5.28	6.14
T_7: Pyriftalid 25% SC @ 600ml/ha 9DAT	409.30	83.71	21.87	4.47	5.61
T_8: Bensulfuron Methyl 60% DF @ 100g/ha 20 DAT	419.00	91.31	21.87	4.48	5.63
T_9: Pretilachlor 6% + Bensulfuron 0.6%@ 10Kg/ha 3 DAT	448.37	94.21	22.04	4.96	5.9
S.Em (±)	1.15	6.34	0.48	0.22	0.30
CD at 5%	3.34	18.39	NS	0.65	0.87
CV (%)	9.67	11.34	3.82	7.93	8.86

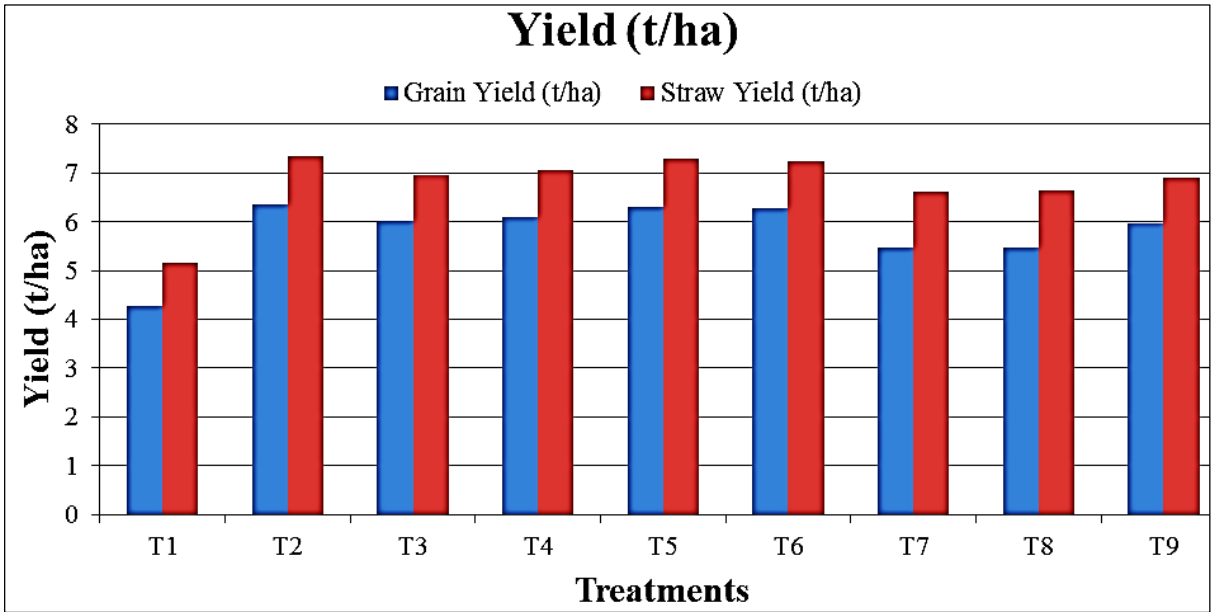

Fig 1: Effect of weed management on yield (t/ha) in transplanted summer rice

Table 2: Effect of weed management on WCE in transplanted summer rice

Treatments	Weed Control Efficiency (%)		
	30 DAT	45 DAT	60 DAT
T_1: Weedy check	0	0	0
T_2: Weed free	100	100	100
T_3: Pyriftalid + Bensulfuron Methyl @ 300ml/ha 9 DAT	87.46	82.76	84.67
T_4: Pyriftalid + Bensulfuron Methyl @ 375ml/ha 9 DAT	90.42	86.49	85.42
T_5: Pyriftalid + Bensulfuron Methyl @ 450ml/ha 9 DAT	91.43	90.86	88.05
T_6: Pyriftalid + Bensulfuron Methyl @ 900ml/ha 9 DAT	92.64	90.97	89.93
T_7: Pyriftalid 25% SC @ 600ml/ha 9 DAT	85.39	85.91	85.16
T_8: Bensulfuron Methyl 60% DF @100g/ha 20 DAT	88.03	86.11	85.66
T_9: Pretilachlor 6% + Bensulfuron 0.6% @ 10Kg/ha 3 DAT	90.57	89.59	87.82
S.Em(±)	4.07	3.81	4.05
CD at 5%	11.82	11.06	11.74
CV (%)	8.75	8.34	8.93

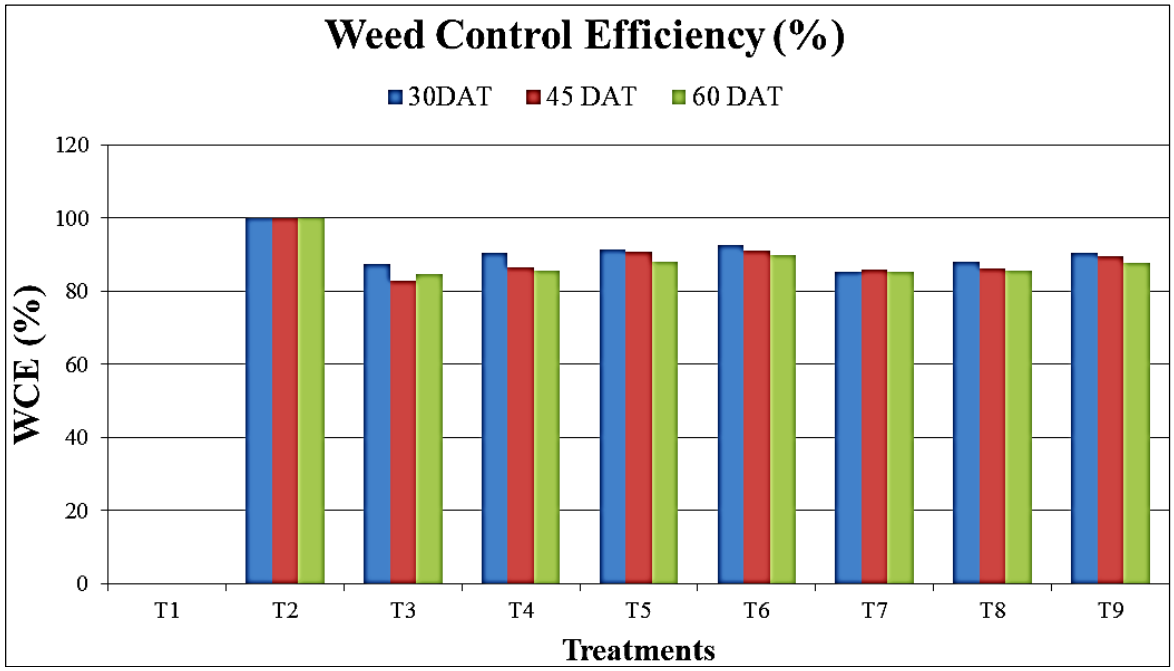

Fig 2: Effect of weed management on WCE in transplanted summer rice

Conclusion

Generally the potential of summer rice can be harvested with better agro techniques where a special emphasis is always given on the weed management. The different weed management practices in summer rice involving application of Pyriftalid + Bensulfuron Methyl 375ml/ha @ 9 DAT (T_4), Pyriftalid + Bensulfuron Methyl 450ml/ha @ 9 DAT (T_5) treatments, Pyriftalid + Bensulfuron Methyl 900ml/ha @ 9 DAT (T_6) treatment were essential for improving its growth attributes, yield components and productivity due to lesser influence of weed infestation in terms of weed population and dry weight.

The results clearly indicated the need of different weed management practices to reduce the influence of weed in summer rice cultivation. The study recommends the use of Pyriftalid + Bensulfuron Methyl 450ml/ha @ 9 DAT (T_5) for better growth, higher productivity and greater profit of summer rice.

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