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RESEARCH ARTICLE :

Evolving suitable weed management practices for direct sown drum seeded rice in Thamirabarani command area

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SUMMARY : Field experiment was conducted at Agricultural College and Research Institute, Killikulam during Late Pishanam season (November- March) of 2016 - 2017 to evolve suitable weed management practices for direct sown drum seeded rice in Thamirabarani command area. Twelve weed management treatments were tested in Randomized Block Design replicated thrice. Broad leaved weeds were found to be the predominant category followed by grasses and sedges. All the weed control treatments significantly reduced the density and dry weight of weeds which resulted in significantly higher growth and yield of rice over unweeded control. Though the weed free check yielded significantly higher than other treatments, but it fetched higher cost of cultivation and non-availability of labourers during peak season. The results revealed that the application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE not only significantly reduced density and dry weight of weeds but also increased the grain yield of rice.

KEY WORDS :
Weed management, Direct-seeded rice, Drum seeder, Herbicides

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BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is an important and extensively cultivated food crop and feeds more than half of the world's population. The slogan "Rice is life" is most appropriate for India; as this crop plays a vital role in our national food security and is a means of livelihood for millions of rural households. Rice is one of the major contributors to the success by contributing approximately 43 per cent of total food grain production of India (Upendra *et al.*, 2013).

Transplanting rice is the traditional system of rice crop establishment and it is in vogue in many rice growing areas. Water resources, both at surface and underground, are shrinking and water may become a limiting factor in future. Due to urbanization and industrialization in our country, shortage of specialized labour for transplanting is becoming a major constraint to many rice growers for the timely transplanting and maintaining the required plant population to achieve higher productivity (Riaz *et al.*, 2007).

With increased irrigated rice areas, availability of short duration varieties, effective herbicides, non-availability and escalating cost of labour, adoption of wet seeded rice could be a viable alternative to transplanted rice. Broadcast method of sowing in wet seeded rice results in uneven distribution and poses problem during intercultural operations. Sowing by drum seeder ensures optimum plant density and facilitates inter cultural operations.

Weeds are the major biotic constraints and compete with rice for moisture, nutrients, and light. The competition is more severe in direct seeded rice since crop and weeds emerged simultaneously due to which the crop suffers at early period of growth. This in turn reduces the rice yield. The yield loss due to weeds varies from 40 to 100 per cent in direct seeded rice (Singh *et al.*, 2016).

Hence, suitable weed control strategies in direct seeded rice can be the sequential use of pre-emergence and post-emergence herbicides (Walia *et al.*, 2012) or a pre-emergence herbicide application followed by intercultural operation with mechanical weeder so that the crop is protected well against the weeds during the critical period of crop weed competition. In view of these facts, the present study was undertaken to evolve suitable weed management practices for direct sown drum seeded rice in Thamirabarani command area.

RESOURCES AND METHODS

Field experiment was conducted at Agricultural College and Research Institute, Killikulam during Late Pishanam season (November- March) of 2016 - 2017 to evolve suitable weed management practices for direct sown drum seeded rice in Thamirabarani command area. The experiment was laid out in a Randomized Block Design with three replications. It consisted of twelve treatments *viz.*, T_1- PE pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS + one cono weeding on 30 DAS, T_2 - PE pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS + POE azimsulfuron @ 30 g a.i. ha^{-1} on 30 DAS, T_3 - PE pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS + POE bispyribac sodium @ 25 ga.i. ha^{-1}on 30 DAS, T_4 - PE anilofos@ 375 g a.i. ha^{-1}on 3 DAS + one cono weeding on 30 DAS, T_5 - PE anilofos @ 375 g a.i. ha^{-1}on 3 DAS + POE azimsulfuron @ 30 g a.i. ha^{-1} on 30 DAS, T_6 - PE anilofos @ 375 g a.i. ha^{-1}on 3 DAS + POE bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS, T_7 - PE pendimethalin @ 1000 g a.i. ha^{-1}on 3 DAS + one cono weeding on 30 DAS, T_8 - PE pendimethalin @ 1000 g a.i. ha^{-1}on 3 DAS + POE azimsulfuron @ 30 g a.i. ha^{-1}on 30 DAS, T_9 - PE pendimethalin @ 1000 g a.i. ha^{-1}on 3 DAS + POE bispyribac sodium @ 25 g a.i. ha^{-1}on 30 DAS, T_{10} - Two conoweedings on 15 and 30 DAS, T_{11} - Weed free check and T_{12} - Unweeded control. Rice ASD 16 was used as a test variety.

The recommended seed rate of 60 kg ha^{-1} of dry paddy seeds were soaked in water for 24 hours and incubated overnight to induce sprouting. Afterwards, the seeds were treated with biofertilizers. Sowing was done under slushy condition using drum seeder with 20 cm inter row spacing. Herbicides were applied at appropriate time as stated in the treatment schedule.The crop was irrigated as and when required.Weed density, weed dry weight, growth and yield of rice were recorded.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Weed flora :

The weed flora found in the experimental field mainly consisted of *Echinochloa colona*, *Cynodon dactylon*, *Dinebra retroflexa* and *Leptochloa chinensis* under grasses, *Cyperus difformis* and *Cyperus rotundus* under sedges and *Celosia argentia*, *Eclipta alba*, *Ludwigia perennis*, *Marsilea quadrifolia*, *Sphaeranthus indicus* and *Stachytarpheta jamaicensis* under broad - leaved weeds. These results were in agreement with the findings of Prameela *et al*. (2014) and Hossain *et al*. (2016).In this study, broad-leaved weeds dominated the weed flora. The next dominant weed category was grasses followed by sedges.

Total weed density :

Significant variation on the total weed density were observed due to the adoption of different weed management practices at all stages of observation *viz.*, 15,30 and 45 DAS (Table 1). Among the various weed management practices, weed free check recorded zero weed density at all stages of observation. This might be due to effective destruction of weeds by hand weeding, so that the weed density was decreased.This is in conformity with the findings of Upasani and Barla (2014)

and Singh *et al*. (2016). At 15 DAS, this treatment was followed by the application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE which significantly reduced the

Table 1 : Effect of different weed management practices on total weed density (No. m^{-2}),total dry weight of weeds (g m^{-2}) and weed control efficiency (%) in direct sown drum seeded rice

Treatments	Total weed density (No. m^{-2})			Total dry weight of weeds (g m^{-2})			WCE*
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	(%)
T_1 - PE Pretilachlor @ 750 g a.i. ha^{-1} + one Cono weeding	4.8 (2.30)	36.1(6.01)	7.5 (2.83)	7.6 (2.85)	55.7 (7.47)	12.49 (3.50)	93.2
T_2 - PE Pretilachlor @ 750 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	4.9 (2.32)	39.1(6.25)	26.5(5.15)	8.7 (3.04)	61.3 (7.83)	42.84 (6.5)	78.1
T_3 - PE Pretilachlor @ 750 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	3.8 (2.07)	32.2(5.67)	0.46(0.97)	5.7 (2.49)	48.1 (6.94)	1.1(1.30)	98.2
T_4 - PE Anilofos @ 375 g a.i. ha^{-1} + one Cono weeding	10.8 (3.29)	49.2 (7.01)	18.2 (4.27)	16.7 (4.09)	77.5 (8.8)	31.85 (5.6)	79.2
T_5 - PE Anilofos @ 375 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	11.3 (3.36)	51.3 (7.16)	29.3 (5.42)	18.0 (4.25)	83.2 (9.12)	47.13 (6.90)	72.1
T_6 - PE Anilofos @ 375 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	9.8 (3.21)	45.7 (6.76)	8.2 (2.95)	15.2 (3.91)	69.9 (8.36)	13.2 (3.60)	90.2
T_7 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + one Cono weeding	7.4 (2.81)	41.2 (6.42)	15.9 (3.99)	11.2 (3.35)	63.1 (7.95)	28.0 (5.30)	81.2
T_8 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	6.1 (2.57)	41.3 (6.43)	29.2 (5.40)	9.6 (3.18)	62.7 (7.92)	43.8 (6.62)	75.9
T_9 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	5.1 (2.37)	38.6 (6.21)	6.5 (2.65)	7.9 (2.91)	60.3 (7.77)	10.7 (3.27)	93.6
T_{10} - Two Conoweedings on 15 and 30 DAS	25.8 (5.08)	22.7 (4.76)	7.1 (2.76)	42.2 (6.5)	14.4 (3.81)	11.4 (3.38)	91.5
T_{11} - Weed free check	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100
T_{12} - Unweeded control	29.2 (5.41)	77.5 (8.80)	89.0 (9.43)	47.0 (6.86)	121.0 (11)	166.7(12.91)	-
S.E.±	0.12	0.18	0.13	0.15	0.21	0.19	-
C.D.(P=0.05)	0.25	0.38	0.27	0.31	0.44	0.39	-

Figure in parenthesis are $\sqrt{(x + 0.5)}$ transformed values. *Data not statistically analyzed PE- Pre-emergence POE- Post-emergence

Table 2 : Effect of different weed management practices on grain yield, straw yield (kg ha^{-1}) and harvest index of direct sown drum seeded rice

Treatments	Grain yield kg ha^{-1}	Straw yield kg ha^{-1}	Harvest index
T_1 - PE Pretilachlor @ 750 g a.i. ha^{-1} + one Cono weeding	5860	6660	0.468
T_2 - PE Pretilachlor @ 750 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	5120	5890	0.465
T_3 - PE Pretilachlor @ 750 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	6460	7250	0.471
T_4 - PE Anilofos @ 375 g a.i. ha^{-1} + one Cono weeding	5370	6150	0.466
T_5 - PE Anilofos @ 375 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	4820	5530	0.467
T_6 - PE Anilofos @ 375 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	5810	6550	0.470
T_7 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + one Cono weeding	5580	6320	0.469
T_8 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + POE Azimsulfuron @ 30 g a.i. ha^{-1}	4970	5690	0.466
T_9 - PE Pendimethalin @ 1000 g a.i. ha^{-1} + POE Bispyribac sodium @ 25 g a.i. ha^{-1}	6030	6790	0.471
T_{10} - Two Conoweedings on 15 and 30 DAS	5990	6780	0.469
T_{11} - Weed free check	6680	7510	0.471
T_{12} - Unweeded control	3640	4180	0.465
S.E.±	155	176	0.015
C.D.(P=0.05)	324	367	NS

PE- Pre-emergence POE- Post-emergence NS= Non-significant

weed density of 3.8 m^{-2}.At 30 DAS Adoption of two conoweedings on 15 DAS and 30 DAS was found to be the best treatment which lowered the total weed density of 22.7 m^{-2}. At 45 DAS also apart from weed free check, application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE significantly reduced the total weed density (0.46 m^{-2}) compared to other treatment combinations.This might be due to the control of weeds at germination phase by the application of pre-emergence herbicides and significant reduction at later growth stage as late germinating weeds were controlled by post-emergence application of herbicides. Similar findings were reported by Saha and Rao (2010) and Prameela *et al.* (2014).

Total weed dry weight :

Adoption of different weed management practices exerted significant influence on the total dry weight of weeds at all the stages of observation (Table 1). At 15, 30 and 45 DAS, total weed dry weight was zero with weed free check. At 30 DAS application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE was found to be the next best treatment with a total weed dry weight of 5.7 g m^{-2}. At 30 DAStwo conoweedings on 15 and 30 DAS recorded significantly lowest total dry weight of 14.4 g m^{-2}. At 45 DAS application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE recorded significantly lowest total dry weight of 1.1 g m^{-2}.In this treatment, application of herbicides at both early and later stages checked the weeds effectively resulting in lesser weed density and lesser weed dry weight as reported by Walia *et al*.(2012) and Upasani and Barla (2014).

Weed control efficiency :

Weed control efficiency indicates the magnitude of effective reduction of weed density by weed control treatments over weedy check. This was highly influenced by different weed control treatments (Table1). Among the weed management practices, application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE registered more reduction of weed density and resulted in higher WCE (98.2 %). It was mainly due to the better control of weed upto critical stage by the above treatment combination resulting in lower weed densities. Similar results have been reported by Prameela *et al*.(2014) and Nayak *et al*. (2014).

Yield :

Weed free check had a favourable effect on the grain and straw yield (Table 2). The economic yield in the weed free treatment was found superior over all other treatments. This result was supported by Upasani and Barla (2014) and Singh *et al.* (2016). Among the different treatment combinations tried, weed free check significantly recorded highest grain yield and straw yield (6680 and 7510 kg ha^{-1}, respectively). This treatment was followed by the application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE+ bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE (6460 and 7250 kg ha^{-1}).The percentage of yield increase due to weed free check and application of pretilachlor @ 750 g a.i. ha^{-1} on 8 DAS as PE + bispyribac sodium @ 25 g a.i. ha^{-1} on 30 DAS as POE were 83.5 and 77.4 per cent over unweeded control. This was achieved by the way of effective early and later weed control through pre and post-emergence herbicides which prevented the crop-weed competition. The increase in yield was mainly attributed to better control of weeds throughout the crop growth resulting in better availability of nutrients, moisture and light to the crop growth .This was reflected through increased leaf area, DMP, which contributed to more number of productive tillers m^{-2}, number of filled grains $panicle^{-1}$, test weight and higher yield. Earlier findings by Walia *et al*. (2012) and Kumaran *et al.* (2013) agreed with the present findings.

Conclusion :

From the above results, it could be concluded that application of pretilachlor @ 750 g a.i. ha^{-1}on 8 DAS as PE+ bispyribac sodium @ 25 g a.i. ha^{-1}on 30 DAS as POE was found to be the suitable and economical weed management practice for achieving higher productivity and profitability of direct sown drum seeded rice in Thamirabarani command area.

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