

Effect of pre emergence herbicides on growth and yield in transplanted rice (*Oryza sativa* L.) var ADT 43 in Cauvery delta zone of Tamil nadu

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Abstract

It is well recognized that increase in crop yield is due to better plant growth, with less crop weed competition for nutrients, space, water and sunlight. Transplanted rice faces diverse type of weeds and it reduces the yield up to 40%. Therefore, a field experiment was conducted at experimental farm of Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India during *kharif* 2021-22 to study the effect of pre emergence herbicides on growth and uptake of nutrients in rice under system of rice intensification. The experiment was laid out in a randomized block design with three replications. There were eight treatments viz., T₁ - Unweeded control, T₂- Hand weeding twice at 20 and 40 DAT, T₃- Conoweeding twice at 20 and 40 DAT, T₄- Butachlor 50 EC @ 1.25 kg ai ha⁻¹ on 3 DAT, T₅- Thiobencarb 50 EC @ 1.8 kg ai ha⁻¹ on 3 DAT, T₆- Pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT, T₇- Oxadiazon 2G @ 0.75 kg ai ha⁻¹ on 3 DAT and T₈- Pyrazosulfuron ethyl 10 WP @ 0.5 kg ai ha⁻¹ on 3 DAT. The experimental findings revealed that application of pre emergence herbicide pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT was found to be most productive and economic among the chemical treatments than manual weeding and cono weeding, in terms of plant height (48.5, 76.8 and 83.8 cm), leaf area index (5.43), dry matter production (3834, 7420 and 12910 kg/ha), number of tillers (18.6) resulting in higher grain and straw yield (5347.6 and 6893.6 kg/ha). The application of pre emergence herbicides significantly controlled the weed growth in vegetative stage of rice effectively.

Key words : Pretilachlor, pre emergence rice, leaf area index, System of Rice Intensification

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In India, rice (*Oryza sativa* L.) accounts for around 45% of all food grain output. India is the world's second largest producer of Rice. In India, the total area under rice cultivation is 43.66 million hectares with production of 127.93 million tonnes and productivity of 2809 kg/ha (2021-22)²². In Tamil Nadu, rice cultivated in area of 1.92 million hectares with production of 7.2 million tones and the productivity of 3809 (kg/ha)². Reducing crop loss due to weed competition is one of the most crucial way to boost rice output. Weeds are dynamic and factors such as soil, climate, cropping, and management affect their composition and level of competition. The connection between two or more species in which the supply of a growth factor is less than their total demand is known as crop weed competition. When growth factor falls below their combined demand, competition does not arise. When there is an abundance of the growth factor, competition does not exist. Yet, it begins right away when there is a lack of development factors. Weeds consume more nutrients than crop plants, develop more quickly, and start utilizing nutrients earlier than crop plants. For 30 to 50 days, weed competition decreased rice crop production by 62 to 65 percent²³. Weed control after the critical period could result in loss of yield. Weeds not only reduce rice production but also have an adverse effect on rice grain quality. It has been reported that poaceae as the most important weed family in rice¹⁹. 37% grasses, 33% sedges, and 30% broad-leaved weeds made up the weed flora in rice⁷. As a result, weed management is crucial to get the best rice output possible. Weeds can be eliminated in three different ways: manually, mechanically,

and chemically. The most efficient approach is hand weeding, however because of high labour costs and labour shortages during agricultural enterprises' busiest times, timely weeding is impossible. Moreover, the mechanical approach of weed treatment is laborious, expensive, time-consuming, and does not completely eradicate weeds. Within the first few weeks after the crop is transplanted, herbicidal weed control emerges as a competitive and viable method to manage weeds in transplanted rice⁵.

There are several pre and post emergent herbicides with varying levels of selectivity and modes of action, and chemical weed control is growing in popularity. Herbicides are efficient against weed species, however the majority of them target a limited number of weed species¹¹.

As a result, a suitable and affordable weed management technology must be created for the sustainable rice farming. The final decision about any weed management tactics will be largely based on their efficacy and cost. Early on in the rice crop's life cycle, pre-emergence herbicide use has been found to be effective¹⁷. In addition to being simple to use, pre-emergence herbicides continue to be most commonly used by farmers to accomplish efficient weed management at an early stage³. It also showed that a combination of various groups of herbicides with various modes of action must be used in order to suppress weeds throughout the crucial phase of crop weed and prevent the development of resistance¹. The use of low dose, high effectiveness herbicides to manage weeds is a recent trend in herbicide use. These herbicides not only use less herbicide overall per unit area, but also make

application simpler and more cost-effective for farmers. So, the purpose of the current study was to ascertain the effect of pre-emergence herbicides on the growth and development of transplanted rice.

Experimental site :

An experiment was conducted at wetland block, field no. Q7, Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India (Fig. 1) during *kharif* 2021-22. The Experimental Farm is geographically located at 11°24' North latitude and 79°44' East longitude and at an altitude of +5.79m above mean sea level. It comes under agro-climatic zone–Cauvery delta zone of Tamil Nadu. Climate of Chidambaram is humid tropic, the crop received a rainfall of 285.5 mm distributed over 18 rainy days. The maximum and minimum temperature during planting season is 34.82°C and 24.52°C, respectively. The relative humidity is 84.6% and total evaporation of 54.1

mm was recorded during the cropping period. The experimental field soil was clay loamy in texture with pH 7.1, low in organic carbon (0.75%) with available nitrogen (248.2 kg/ha), phosphorus (22.2 kg/ha) and potassium (290.5 kg/ha).

The experiment was laid out in a randomized block design with three replications. There were eight treatments viz., T₁ - Unweeded control, T₂- Hand weeding twice at 20 and 40 DAT, T₃- Conoweeding twice at 20 and 40 DAT, T₄- Butachlor 50 EC @ 1.25 kg ai ha⁻¹ on 3 DAT, T₅- Thiobencarb 50 EC @ 1.8 kg ai ha⁻¹ on 3 DAT, T₆- Pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT, T₇- Oxadiazon 2G @ 0.75 kg ai ha⁻¹ on 3 DAT and T₈- Pyrazosulfuron ethyl 10 WP @ 0.5 kg ai ha⁻¹ on 3 DAT. The rice variety ADT 43 (short duration) was used in the study. Raised bed nursery for SRI planting was prepared. The SRI method involved 14 days of old single



Fig. 1. Geographical location of experimental site in Chidambaram, Tamil Nadu, India

seedling/hill with a spacing of 25 × 25 cm. The transplanting of seedlings was done in first week of July in a plot size of 5 × 4 m². The recommended dose of fertilizers was applied for specific treatments through urea, single super phosphate (SSP) and muriate of potash (MOP) respectively. While full dosage of phosphorus and potassium was applied at the time of transplanting to specified treatments. 50% N as a basal and remaining 50% N was applied in two splits at 30 and 60 DAT as top dressing in all treatments according to Crop production guide⁴. The experimental plot was irrigated at 3-5 cm depth and maintained throughout the cropping period up to 10 days prior to harvest. Weed control was done by hand weeding and cono weeder twice at 20 and 40 days after transplanting (DAT). The pre emergence herbicides were sprayed at 3-5 days after transplanting (DAT) with knapsack sprayer.

Biometric observations :

Five sample plants were selected within the net plot area at random and tagged. These plants were utilized to take all biometric observations at different stages of crop. Plant height was measured and recorded at 30, 60 DAT and at harvest. Leaf area index was estimated at flowering stage. Dry matter production was recorded by collecting five plant samples during active tillering, panicle initiation and flowering stages. The plant samples were initially dried in shade before dried in hot air oven at 80°C ± 5°C for 48 h to achieve uniform weights and expressed in kg/ha. The matured crop was harvested and grains were cleaned and dried at 14% moisture level, the yield was recorded and computed

as kg/ha. After threshing of grains, the straw was sun-dried and expressed in kg/ha.

Statistical analysis

All the experimental data was analyzed by using SPSS Statistical tool 21.0⁶. To draw the statistical findings, the critical difference was worked out at 0.05% probability level.

Plant height :

One of the crucial morphological aspects of a crop that is impacted by the environment and management elements is plant height. The pre emergence application of herbicides had extensive impact on plant height at vegetative, flowering and maturity stages of crop are shown in Table-1. Among the weed control treatments, higher plant height of 52.8, 80.2 and 88.7 cm respectively, was observed at 30, 60 DAT and at harvest stage, with conoweeding twice at 20 and 40 DAT (T₃). This was on par with chemical treatment (T₆) pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT recorded the plant height of 48.5, 76.8 and 83.8 cm respectively. The least plant height of 28.7, 55.2 and 72.4 cm respectively, was observed under unweeded control (T₁). Higher plant height was mainly due to lesser crop weed competition, resulting in higher availability of plant nutrients which increased the growth characters of transplanted rice under system of rice intensification. This is in line with the findings¹⁶. Lower plant height was observed in unweeded control (T₁). In particular, weeds are fierce competitors for nutrients and space during the active development phase, which is when the majority of critical physiological

processes, such as nutrition intake and growth, take place. Effective weed management may have prevented weeds from absorbing nutrients, enhancing the growth of the rice crop. A similar result was reported^{10,13}.

Leaf area index (LAI) :

Data on leaf area index of rice recorded at flowering stage were influenced by the treatments and are furnished in Table-1. Leaf area index of rice at flowering stage was significantly influenced by the treatments, higher LAI of 5.84 was observed with conoweeding twice at 20 and 40 DAT (T₃). This was on par with hand weeding twice at 20 and 40 DAT (T₂) recorded the LAI of 5.62 and (T₆) pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT (5.43). The least LAI of 3.64 was recorded in unweeded control (T₁). Effective weed control during the early phases of crop growth would have provided a favourable environment for crop growth with the least amount of stress owing to biotic factors like decreased weed competition, which in turn led to more leaves and, ultimately, a higher leaf area index. This is line with the findings²⁰. The least leaf area index was recorded in unweeded control. It might due to higher weed competition and less nutrient availability to rice crop. It also reported that least leaf area index values in weedy check²⁵.

Dry matter production (DMP) :

Data on DMP of rice recorded at active tillering, panicle initiation and flowering stages are furnished in Table-1. Dry matter production of rice at active tillering, flowering and at harvest stage was significantly influenced

by the treatments. The higher DMP of 5918, 9614 and 14920 kg/ha respectively, was observed with conoweeding twice at 20 and 40 DAT (T₃). This was on par with chemical treatment (T₆) pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT, which recorded the DMP of 3834, 7420 and 12910 kg/ha, respectively. The least DMP of 2230, 4510 and 5624 kg/ha respectively, was observed under unweeded control (T₁). Thus, the highest nutrient removal by the weeds resulted in the lowest number of tillers m⁻², least plant height and the least value of plant dry matter production¹⁸. Herbicides applied prior to the emergence of the crop helped suppress weeds and improved crop development and nutrient utilisation, which resulted in the maximum dry matter yield. Effective weed management throughout the crucial competition periods led to better LAI and sustained nutrient availability lasting all the way through the crop. This might have caused the crop to accumulate more dry matter, which was inversely correlated with the dry weight of weeds. The results found similar with the findings of Manjunatha *et al.*,⁹.

Yield and yield parameters :

The yield and yield parameters of paddy were significantly influenced by the application of nano urea and are presented in Table-1.

Number of productive tillers per Hill and number of filled grains per panicle :

The number of productive tillers per hill (20.8) and the number of filled grains per panicle (128.4) were significantly higher in treatment (T₃) conoweeding twice at 20 and

40 DAT, which was on par with the chemical treatment (T₆) pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT recorded the number of productive tillers per hill (18.6) and the number of filled grains per panicle (120.2) respectively. The lower number of productive tillers per hill (9.6) and the number of filled grains per panicle (78.6) was recorded under unweeded control (T₁), due to severe competition of weeds on crops for nutrients and space²⁴. This could be due to the weed-free environment provided by conoweeding and pre-emergence herbicide applications, which allowed the crop to absorb the necessary amount of nutrients and significantly improved photosynthesis and assimilate partitioning to the sink, which ultimately had a positive impact on higher

values of yield-attributing characters. These findings are in line with the reports^{12,14,21}.

Grain and straw yield :

The data on the grain and straw yield of rice are furnished in Fig. 2. Significantly higher grain and straw yield of rice 5804.5 and 7140.8 kg/ha respectively, was observed with conoweeding twice at 20 and 40 DAT (T₃), which was on par with the chemical treatment (T₆) pretilachlor 50 EC @ 0.5 kg ai ha⁻¹ on 3 DAT recorded the grain and straw yield of rice 5347.6 and 6893.6 kg/ha, respectively. The treatment (T₁) recorded the lowest grain and straw yield of 2138.2 and 3428.5 kg/ha, respectively. This might due to the weeds

Table-1. Effect of weed management practices on plant growth parameters and yield attributes in rice under SRI

Treat-ments	Plant height (cm)			Leaf area index	Dry matter production (kg/ha)			No. of tillers/hill	No. of filled grains panicle
	30 DAT	60 DAT	Harvest		30 DAT	60 DAT	Harvest		
T ₁	28.7	55.2	72.4	3.64	2230	4510	5624	9.6	78.6
T ₂	51.5	78.5	85.5	5.62	4702	8320	13415	19.9	125.6
T ₃	52.8	80.2	88.7	5.84	5918	9614	14920	20.8	128.4
T ₄	45.6	72.8	80.3	4.99	3120	6825	10562	15.5	112.3
T ₅	41.2	68.7	75.2	4.12	2522	5260	8827	12.3	92.6
T ₆	48.5	76.8	83.8	5.43	3834	7420	12910	18.6	120.2
T ₇	44.8	71.5	78.7	4.25	2826	6540	9290	14.2	100.4
T ₈	46.9	75.3	82.2	5.05	3324	7332	11622	16.8	118.5
S.Em	0.88	0.97	1.03	0.09	54.08	105.42	208.57	0.17	1.33
CD (p=0.05)	2.67	2.94	3.13	0.29	164.03	149.09	294.96	0.52	4.03

*DAT- Days after Transplanting

absorbed more nutrient and moisture faster than crop and smothered the crop plants leading to poor growth and development which ultimately resulted in reduced yield^{8,26}. Increased nutrient availability and subsequent improved nutrient uptake by the crop would have aided in better expression of initial vigour and establishment of the crop, which in turn would have resulted in higher tiller number, leaf area index, and dry matter production, as well as increased source and sink capacities, which in turn would have improved the yield attributes

and reflected in higher grain and straw yield. This is in line with the findings of Negalur *et al.*,¹² & Sathya *et al.*,¹⁵.

The positive correlation (Fig. 3) with high level of significance was found among the number of filled grains and grain yield. It indicated that the increase in yield parameters like filled grains helped in increasing the grain yield significantly in a positive manner. The increase in grain yield was due to effective weed control through herbicides application with right

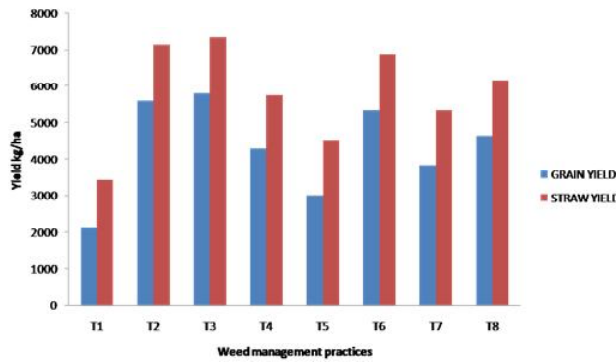


Fig. 2. Effect of weed management practices on grain yield and straw yield (kg/ha) in rice under SRI

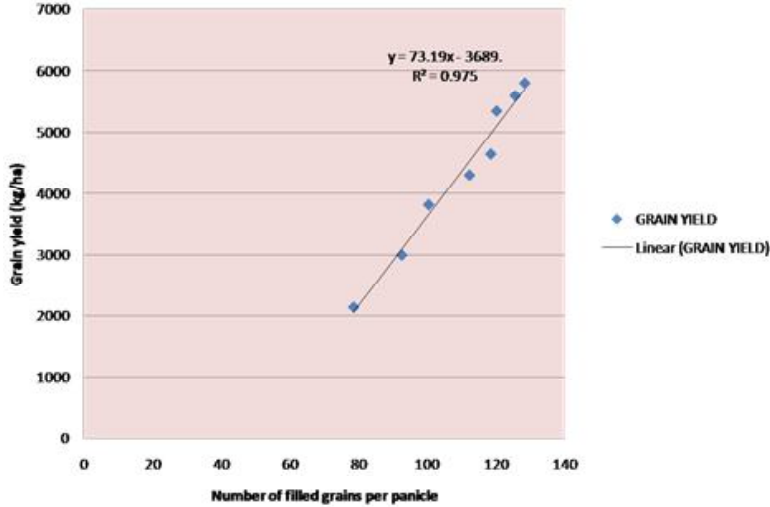


Fig. 3. Correlation between number of filled grains per panicle and grain yield of rice

concentration at right time.

Based on the results, the weed management techniques had a substantial impact on plant growth indices and yield attributes. It may be concluded that application of pretilachlor @ 0.5 kg ai/ha at 3-5 DAT is economical and could safely be used to control weed flora during vegetative growth in rice under system of rice intensification method of cultivation.

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Conflict of Interest

Conflict of Interest Declared None.

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