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Production potential of transplanted rice as influenced by pre and post emergence herbicides

V. Rajendra Prasath
Ph.D. Scholar in Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India
*Corresponding author email: rajeear101@gmail.com

S. Ramesh
Associate Professor of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India

A. Sundari
Professor of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India

M. V. Sriramachandrasekharan
Professor of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India

***Abstract*---**A study was designed on the way to evaluate and identify the pre and post emergence herbicide combinations in transplanted rice variety 'ASD 16' during February-May 2020 at the Experimental Farm, Department of Agronomy, Annamalai University, Tamil Nadu, India. The experiment was laid out in randomized block design with three replications and fourteen treatments. The treatment details includes sequential application of pre and post emergence herbicide viz., pre-emergence herbicides (butachlor, pretilachor and pyrazosulfuron ethyl) and post emergence herbicides (bispyribac sodium, metsulfuron methyl + chlorimuron ethyl, fenoxaprop-p-ethyl and triafamone + ethoxysulfuron), hand weeding twice (20 and 40 DAT) and unweeded control plot. All the weed management practices were found to be significantly influenced the weed biometrics, growth attributes, grain and straw yields of transplanted rice. The result of the study clearly showed that hand weeding twice at 20 and 40 days after transplanting (DAT) significantly registered lesser weed dry matter production, weed index, maximum weed control index (WCI), higher growth attributes viz., plant height, number of tillers hill-1, DMP, grain and straw yields. However, which was statistically on par

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with application of pyrazosulfuron ethyl 20 g ha-1 PE at 3 DAT followed by bispyribac sodium 25 g ha-1 PoE at 20 DAT and pyrazosulfuron ethyl 20 g ha-1 PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha-1 PoE at 20 DAT. It was followed by pretilachor 500 g ha-1 PE at 3 DAT fb bispyribac sodium 25 g ha-1 PoE at 20 DAT and pretilachor 500 g ha-1 PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha-1 PoE at 20 DAT. Among the herbicide combinations the least performance was observed under butachlor 1.25 kg ha-1 PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha-1 PoE at 20 DAT. From the results of the field study, based on economics, it can be concluded that application of pyrazosulfuron ethyl 20 g ha-1 PE at 3 DAT followed by bispyribac sodium 25 g ha-1 PoE at 20 DAT was found to be an agronomically sound, economically viable and efficient weed management practice for augmenting higher grain yield of rice.

***Keywords*---**herbicides, pre and post emergence, weed control index, rice, grain yield.

Introduction

Rice is the staple food for nearly half of the world's population, most of who live in developing countries. Rice is the major sources of calories for 40 per cent of the world's population. Globally rice is cultivated in an area of 162.06 million hectares with the production of 500 million tonnes and productivity of 3.1 t ha^{-1} (Anonymous, 2019). In India rice has cultivated an area of 43.86 million hectares and production of 104.80 million tonnes with a productivity of 2.4 t ha^{-1} (Anonymous, 2019). In Tamil Nadu, rice is cultivated in an area of 1.85 million hectares with a production of 6.95 million tonnes and with the productivity of 3.7 t ha^{-1} (Ministry of Agriculture, 2019). However, the yield is lower, as compared to the average productivity of rice producing countries such as Japan (6.50 t ha^{-1}), China (6.70 t ha^{-1}), Egypt (7.50 t ha^{-1}) and Israel (5.50 t ha^{-1}) (USDA, 2019). The low yield of rice under Indian conditions may be attributes by number of factors among them weeds rank as prime enemy. Presence of weeds reduces the photosynthetic efficiency, dry matter production and distribution to economical parts and there by reduces sink capacity of crop resulting in poor grain yield. Thus the extent of reduction in grain yield of rice has been reported to be in the range 28 to 45 percent depending on type of weed species in standing crop (Naik *et al.*, 2019). To minimize the yield losses due to weeds, several weed control methods available such as mechanical, cultural, chemical and biological methods. In Tamil Nadu, traditional hand weeding is the most efficient and widely adopted practice of weed control. But it is back breaking, labour intensive, time consuming and costly due to high rates which narrowed down the profits of the cultivation.

Keeping in view of these limitations, the use of the best way which gives a quick and cost effective solution of the numerous weed problems in rice field and which has gained an important position over conventional methods. Application of pre emergence herbicide alone is not sufficient to give effective weed control for keeping the weeds free condition up to threshold level. Under this circumstances application of pre emergence followed by post emergence herbicide remains only the viable option for weed control in transplanted rice. However, the continuous use of same herbicides (or) herbicides having the same mode of action may lead to resistance problem in weeds. Keeping all these in view, a study entitled to evaluate and identify the pre and post emergence herbicide combinations for weed control in transplanted rice.

Materials and Methods

Field experiment was conducted at the Experimental farm, Department of Agronomy, Annamalai University, Cuddalore district, Tamil Nadu during (February – May) 2020 to evaluate and identify the pre and post emergence herbicide combinations for weed management in transplanted rice. The experimental farm is geographically located at 11 ^{0} 24’ North latitude and 79^{0} 44’ East longitude and at an altitude of +5.79 m above mean sea level. The soil of the experimental field is clay loam in texture. The nutrient status of the soil was low in available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in randomized block design with three replications and fourteen treatments. The treatment details are *viz.* Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_1), Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT (T_2), Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1} PoE at 20 DAT (T_3), Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_4), Pretilachor 500 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_5), Pretilachor 500 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT (T_6), Pretilachor 500 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1} PoE at 20 DAT (T_7), Pretilachor 500 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_8), Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_9), Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT (T_{10}), Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1} PoE at 20 DAT (T_{11}), Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_{12}), Hand weeding twice (20 and 40 DAT) (T_{13}) and Unweeded control plot (T_{14}). As per the treatment schedule required quantity of pre and post emergence herbicides were sprayed with knapsack sprayer fitted with a flat fan nozzle using 500 liters of water ha^{-1}. Pre emergence herbicides *viz.*, butachlor, pretilachor and pyrazosulfuron ethyl were sprayed on 3 DAT and post emergence herbicides *viz.*, bispyribac sodium, metsulfuron methyl + chlorimuron ethyl, fenoxaprop-p-ethyl and triafamone + ethoxysulfuron were sprayed on 20 DAT. Need based plant protection measures were taken up based on the economic threshold level of pest and disease. Twenty one days old rice seedlings were transplanted with three seedlings hill^{-1} and adopt a spacing of 15 x 10 cm. The rice variety ‘ASD-16’ was chosen for the study. The fertilizers were applied to the experimental field as per recommended manurial schedule of 120 Kg N, 40 Kg P_2O_5 and 40 Kg K_2O ha^{-1}. The entire dose of P_2O_5, half dose of N and K_2O was applied as basal. Remaining half dose of N and K_2O was top dressed with equal splits at maximum tillering and panicle primordial initiation stages.

Weed dry matter production

In the sampling area of each plot, a quadrat of size 0.25 m^2 was placed and the weeds falling within the frames of quadrat were removed, oven dried at 80˚C ± 5℃ for 48 hours and the dry weight was recorded and expressed in g m^{-2}. Weed dry matter production was recorded at 60 DAT of crop.

Weed control index (per cent)

Weed control index were worked out for 60 DAT. The control index (per cent) of each weed management practices was computed by using the following formula (Mishra and Tosh, 1979).

$$\text{WCI (per cent)} = \frac{(WDM_C - WDM_T)}{WDM_C} \times 100$$

Where, WDM_C = Weed dry matter production in the unweeded control plot,
WDM_T = Weed dry matter production in the treated plot.

Weed index

Weed index is the per cent reduction in crop yield under a particular treatment due to the presence of weeds in comparison to unweeded control plot as suggested by Gill, (1969). This is used to assess the efficacy of herbicide. Lesser the weed index, better is the efficiency of a herbicide. It is expressed in percentage and was determined with the help of following formula.

$$\text{Weed Index (\%)} = \frac{\text{Yield from the unweeded plot} - \text{Yield from the treated plot}}{\text{Yield from the unweeded free plot}} \times 100$$

Biometric observations on plant

Five plants in each plot were selected at random in border rows and tagged. These plants were used for recording all biometric observation at different stages of crop growth. Harvesting was done in each plot separately from the net plot area leaving the border rows. Grains were separated, dried, cleaned and grain yield was recorded plot wise at 12 per cent moisture content. The grain and straw yield were computed to kg ha^{-1}. The data on various characters studied during the course of investigation were statistically analyzed as suggested by Gomez and Gomez (1984). The data on weed count were subjected to square root transformation. Treatment differences, which were not significant, were denoted by NS (not significant).

Result and Discussions

Weed dry matter production (g m^{-2})

The data recorded on weed dry matter production at 60 DAT are presented in table 1. All the treatments exerted significant influence on weed biomass. At 60 DAT, hand weeding twice (20 and 40 DAT) (T_{13}) registered significantly lower weed dry matter production of (9.08 g m^{-2}). Hand weeding removed the weeds completely and created weed free conditions more favorable for the crop growth and ultimately resulted in lower dry matter production of weeds during the crop growth period. The results of the study also corroborate with the findings of Negalur *et al.*, (2017). However it was on par with pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_9). This might be due to inherent ability of the pyrazosulfuron herbicide which inhibits cell division in shoots and roots and growth by inhibiting plant enzyme acetolactase synthase, thereby, blocking branches chain of amino acid biosynthesis and hence the plant suffers. Due to this, phloem transport of the plant is hampered. A secondary effect is stunted growth on account of cessation of cell division and slow plant death (Kabdal *et al.* 2018). Besides, the same treatment consisting of bispyribac-sodium, which inhibited the plant enzyme acetolactate synthase (ALS), it was involved in biosynthesis of the branched-chain amino acids. Without these amino acids, protein synthesis and growth are inhibited, ultimately causing plant death (Kumar *et al.*, 2017). The unweeded control treatment (T_{14}) registered higher weed dry matter production of 105.57 g m^{-2} at 60 DAT. It means that if weeds were not controlled properly within critical period of crop weed competition, their density continuously remained increasing and affected crop growth by accumulation of more dry matter production of weeds. These results are in line with the findings of Ashok Naik *et al.*, (2018).

Weed Control Index (WCI)

Weed control index indicates per cent reduction in weed dry matter production by various weed control treatments over unweeded control treatment. So, the one with highest weed control index is considered to be the best treatment to control weeds. Performance of crop and yield of crop is positively correlated with weed control index. Weed control index recorded at 60 DAT, among weed management practices, higher WCI was recorded with hand weeding twice at 20 and 40 DAT (T_{13}) with 91.40 per cent. It was primarily due completely removal weeds on critical period of crop leads to recorded lower weed dry matter production on 60 DAT resulting in higher weed control index. Similar results were also reported by Kishore Kumar *et al.*, (2018). It was followed by the application of pyrazosulfuron ethyl at 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium at 25 g ha^{-1} PoE at 20 DAT (T_9) with 82.11 per cent and pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_{12}) with 81.46 per cent. This can be attributed to the better performance of pre and post applied herbicides in reducing the weed infestation throughout the cropping period due its wide spectrum activity and its combination effect, which reduces the dry matter production of weeds as opined by and Kumar *et al.*, (2017).

Weed index

Weed index indicates percent reduction in grain yield due to crop-weed competition. So, the treatment with lesser weed index is considered to be more productive in nature. Among the weed management practices, application of pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_9) recorded the least weed index value of 1.95 per cent. This was followed by the application of pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron at 60 g ha^{-1} PoE at 20 DAT (3.22 per cent) (T_{12}). The highest weed index was noted under unweeded control (T_{14}) of 60.12 per cent because of greater removal of available moisture and nutrients by the weeds and severe weed crop competition resulted into weak source and sink development along with retarded yield attributes and greater weed index. The result was conformity with Negalur *et al.*, (2017) who reported maximum yield reduction of 69.7 per cent in unweeded control.

Growth and yield attributes of rice

The dynamic weed management methods highly influenced the plant height, number of tillers hill^{-1} and plant dry matter production. At 90 DAT, highest plant height of 105.68 cm, number of tillers hill^{-1}of 11.04 and dry matter production of 12086 kg ha^{-1} were registered with hand weeding twice at 20 and 40 DAT. These might be due to better environment with increased uptake of both macro and micro nutrients by rice crop due reduced crop weed competition. Our findings were corroborated with Choudhary and Dixit (2018). However, this treatment was on par with application of pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_9) and pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_{12}) (Table 1). This might be due to effective weed control by sequential application of pre and post emergence herbicides resulted in less or nearly no crop weed competition for nutrients, light, moisture and space, which leads to effective utilization of available resources by crop, resulted in highest plant height, number of tillers and dry matter production. This result is in close conformity of Sigh *et al.*, (2018). Unweeded control plot (T_{14}) register the lowest plant height of 72.37 cm, minimum number of tillers hill^{-1} of 8 and dry matter production of 6667 kg ha^{-1}.This may be attributed due to higher weed competition and lesser input availability to plants thus reduced the growth attributes to a greater extent. Related observation was articulated by Akabar *et al.*, (2011).

Grain and Straw yields

Grain and straw yields was significantly influenced by weed control treatments compared to unweeded control have been present in Table 2. Hand weeding twice at 20 and 40 DAT (T_{13}) registered the higher grain yield of 5963 kg ha^{-1}and straw yield of 7466 kg ha^{-1}. Superiority of two hand weeding might be ascribed to absence of weed competition due to complete removal of weeds from the field and hence better crop growth and yield attributes resulting in higher grain and straw yields of rice. Similar results were also reported by Naik *et al.*, (2019). However, it was found to be at par with the application of pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT (T_9) with grain yield of 5847 kg ha^{-1} and straw yield of 7410 kg ha^{-1} and pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT (T_{12}) with grain yield of 5772 kg ha^{-1} and straw yield of 7395 kg ha^{-1}. Efficient weed control during the critical period of crop weed competition, which creates congenial environment and sustained availability of nutrients for uptake of crop that had positive influence on LAI, which contributed to higher post flowering photosynthesis and assimilate portioning to sink, might be reason for higher grain and straw yields. The above findings are similar with the earlier reports of Priya *et al.*, (2017). Among the herbicide combination, application of butachlor 1.25 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1} PoE at 20 DAT registered lesser grain and straw yields of rice. This might be due to inadequacy of sequential application of herbicides to control weeds during cropping period, which reflected lesser grain and straw yields. Similar finds have been reported by Choudhary and Dixit, (2018). The lowest grain yield of 2378 kg ha^{-1} and straw yield of 5029 kg ha^{-1} were recorded in unweeded control. This could be attributed to greater removal of nutrients by weeds and severe crop weed competition resulted in poor source and sink development with lesser yield components and yield of crop. The results are similar to the findings of Nagarajan and Chinnusamy (2010) and Kumar and Ladha (2011). Harvest index was not significantly affected by weed management practices.

Conclusion

Based on the results of the study, it can be concluded that lower weed dry matter production, weed index, maximum weed control index, higher grain and straw yields of transplanted rice was obtained with hand weeding twice at 20 and 40 DAT. However it was time consuming and labouries. Therefore sequential application of pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT followed by bispyribac sodium 25 g ha^{-1} PoE at 20 DAT or pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT followed by triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT was found promising and it can be recommended for weed control and maximizing the yield of transplanted rice.

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Table 1

Weed dry matter (g m^{-2}), weed control index (per cent), plant height (cm), no. of tillers $hill^{-1}$ and DMP (kg ha^{-1}) of transplanted rice as influenced by pre and post emergence herbicides

Treatments	Weed dry matter (g m^{-2})	WCI (per cent)*	Plant height (cm)	No. of tillers $hill^{-1}$	DMP (kg ha^{-1})
T_1- Butachlor 1.25 kg ha^{-1} PE	6.00 (35.49)	66.38	90.7	10.15	9754

at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT					
T_2 - Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	7.42 (54.57)	48.31	81.11	7.83	8173
T_3 - Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb fenoxaprop- p-ethyl 60 g ha^{-1}PoE at 20 DAT	7.44 (54.86)	48.03	80.00	7.81	8182
T_4- Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	6.10 (36.71)	65.23	89.93	10.08	9565
T_5 - Pretilachlor 500 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT	5.20 (26.55)	74.85	96.92	11.52	10981
T_6 - Pretilachlor 500 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	7.30 (52.81)	49.97	84.00	8.39	8434
T_7- Pretilachlor 500 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-	7.36 (53.73)	49.11	82.31	8.35	8313

ethyl 60 g ha^{-1} PoE at 20 DAT					
T_8- Pretilachlor 500 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	5.33 (27.96)	73.52	96.57	11.48	10930
T_9- Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT	4.40 (18.89)	82.11	103.9	13.18	11931
T_{10} – Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	6.28 (38.91)	63.15	89.67	9.75	9511
T_{11}- Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1} PoE at 20 DAT	6.46 (41.24)	60.93	88.33	9.57	9360
T_{12}- Pyrazosulfuron ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	4.48 (19.57)	81.46	103.4	12.92	11850
T_{13}- Hand weeding twice (20 and 40 DAT)	3.09 (9.08)	91.40	105.68	13.53	12086

T_{14}- Unweeded control	10.30 (105.57)	-	72.37	6.80	6667
S. Ed	0.29		2.35	0.32	342
C.D (p=0.05)	0.60		4.81	0.65	701

Figures in parentheses are original values and those outside are square root transformed x+0.5 values. Transformed values were statistically analysed; PE : Pre emergence; PoE : Post emergence; fb : followed by; DAT : Days after transplanting

Table 2
Yield (kg ha^{-1}), harvest and weed index as influenced by pre and post emergence herbicides

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest Index	Weed Index*
T_1- Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT	4455	6382	41.11	25.29
T_2 - Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	3507	5574	38.62	41.19
T_3 - Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb fenoxapro p- p-ethyl 60 g ha^{-1}PoE at 20 DAT	3528	5563	38.81	40.84
T_4- Butachlor 1.25 kg ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	4398	6230	41.38	26.26
T_5 - Pretilachlor 500 g ha^{-1} PE at 3	5306	6895	43.49	11.03

DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT				
T_6 - Pretilachlor 500 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	3780	5591	40.34	36.61
T_7- Pretilachlor 500 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-ethyl 60 g ha^{-1}PoE at 20 DAT	3651	5585	39.53	38.77
T_8- Pretilachlor 500 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	5254	6890	43.27	11.89
T_9- Pyrazosulfuron-ethyl 20 g ha^{-1} PE at 3 DAT fb bispyribac sodium 25 g ha^{-1} PoE at 20 DAT	5847	7410	44.10	1.95
T_{10} - Pyrazosulfuron-ethyl 20 g ha^{-1} PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} PoE at 20 DAT	4387	6180	41.52	26.43
T_{11}- Pyrazosulfuron-ethyl 20 g ha^{-1} PE at 3 DAT fb fenoxaprop-p-	4300	6100	41.35	27.89

ethyl 60 g ha^{-1} PoE at 20 DAT				
T_{12}- Pyrazosulfuron-ethyl 20 g ha^{-1} PE at 3 DAT fb triafamone + ethoxysulfuron 60 g ha^{-1} PoE at 20 DAT	5772	7395	43.84	3.22
T_{13}- Hand weeding twice (20 and 40 DAT)	5963	7466	44.41	0.00
T_{14}- Unweeded control	2378	5029	32.11	60.12
S. Ed	146	246	3.48	-
C.D (p=0.05)	300	505	NS	-

PE : Pre emergence; PoE : Post emergence; fb : followed by; DAT : Days after transplanting, *Data not statistically analyzed, fb – followed by