RESEARCH ARTICLE

Effect of Pre and Early Post Emergence Herbicidal Activity on Weed Flora and Yield of Irrigated Sesame (*Sesamum indicum* L.)

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ABSTRACT

The experimental site was carried out at Agricultural College and Research Institute, TNAU, Coimbatore, during Rabi season of 2018-19 to evaluate the pre and post-emergence herbicides on weed control and yield of irrigated sesame (*Sesamum indicum* L.). The experiment was laid out in Randomized Complete Block Design with three replications. The results of the experiment concluded that application of pendimethalin at 750g ha^{-1} as pre-emergence followed by one-hand weeding at 30 days after sowing documented lower total weed density and higher weed control efficiency compared to other treatments and also found superior seed yield (843 kg ha^{-1}). In addition, non-availability of pre-emergence herbicide at the appropriate time, application of early post- emergence of imazythapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} with hand weeding on 40 days after sowing was found to be better than hand weeding twice at 20 and 40 days after sowing.

Keywords: *Sesame; Weed control; Pre-emergence; Early post-emergence*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is a notable conventional oilseed crop cultivated in almost every tropical, subtropical, Asian, and African region (Iwo *et al*., 2002). India ranks first in the sesame cultivated area and second place in production. It contributes 14.74 per cent of the world area and 12.78 per cent of the world production respectively and is the largest (40 per cent) sesame exporter in the world. In India, 1.73 million ha of sesame was grown with a production of 7.69 lakh tonnes per year and an average productivity of 413 kg ha^{-1} (Anonymous, 2019). In Tamil Nadu it is cultivated in an area of approximately 0.56 lakh ha with the production of 0.35 lakh tonnes and average productivity of 621 kg ha^{-1}. West Bengal is marked as the highest productivity region and an average yield of sesame was recorded as 951 kg ha^{-1} in India. Lesser productivity was accounted due to the presence of weeds, insects, pests, and disease. Among these, yield losses due to weeds have been one of the major limiting factors in sesame crop accounting for a 50 per cent reduction (Dhaka *et al*., 2015). Weeds have competed for light, moisture, and nutrients with a crop. Babiker *et al*. (2014) observed that weed-free fields for 2 to 6 weeks after sowing by using an appropriate weed control method increased the seed yield in sesame up to 40 per cent. This result correlated with Mizan *et al.* (2009) on sesame crop. Hence, emphasis should be given to adopt suitable weed management techniques to control the weeds during the critical period of the sesame crop. Weeds can be effectively managed by various measures like preventive, cultural, mechanical, chemical, and biological methods. Though manual weeding is effective and eco-friendly, considering the present labour scarcity and wages that was a more expensive, tedious, and time-consuming led to the search for alternative methods. So, the chemical methods of weed control had a better alternative solution in concerned with favorable and effective methods as they are quick in action, selective in nature, cost-effective, time saving, labour saving, and efficient approach to weed reduction at a critical period of crop weed competition. In this view, the present investigation existed with different alternative herbicides and compared with recommended practices to catch the most effective weed management option for sesame crop to enhance the productivity of sesame crop at lower cost.

MATERIAL AND METHODS

The experimental trial was carried out in western region of Tamil Nadu during the period of Rabi season from December 2018 to March 2019 at Agricultural College and Research Institute, Coimbatore. It is located at 11°N latitude and 77°E longitude and at an altitude of 426.7 meters above the Mean Sea Level (MSL). The soil condition of the study trail was Sandy Clay loam in texture and alkaline in reaction with low nitrogen (192 kg ha^{-1}), phosphorous (7.32 kg ha^{-1}) and high potassium (686 kg ha^{-1}). The gross and net plot sizes were adopted as 4.5 x 4.5 m and 3.9 x 3.9 m, respectively. The certified sesame seed of VRI 2 variety was sown at the seed rate of 5 Kg ha^{-1} with the recommended spacing of 30cm between rows and 30cm between plants on 4th December of 2018. Gap filling was done one week after sowing and thinning was done twice at 12 and 20 DAS to maintain the plant population. The recommended fertilizer dose of 25:23:23 kg ha^{-1} was applied to the crop in the form of urea, single super phosphate, and murate of potash fertilizers to meet the fertilizer requirement of sesame. At basal half of N and full P and K fertilizers were applied through broadcasting and the remaining N was applied at the flowering stage as a split dose.

The experimental site was laid out in a Randomized Complete Block design with eleven treatments and three replications. The treatments comprised of T1 - PE pendimethalin 30 EC @ 0.75 kg a.i.ha^{-1} + HW at 30 DAS; T2 - PE pendimethalin 38.7 CS @ 0.65 kg a.i. ha^{-1} + HW at 30 DAS; T3 - PE oxyfluorfen 23.5 EC @ 200 g a.i. ha^{-1} + HW at 30 DAS; T4 - EPoE quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + HW at 40 DAS; T5 - EPoE imazethapyr 10 SL @ 75 g a.i. ha^{-1} + HW at 40 DAS; T6 - EPoE quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + imazethapyr 10 SL @ 75 g a.i. ha^{-1}; T7 - EPoE imazythapyr 35 a.e. + imazamox 35 a.e. @ 30g a.i. ha^{-1}; T8 - EPoE quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + imazethapyr 10 SL @ 75 g a.i. ha^{-1} + HW at 40 DAS; T9 - EPoE imazythapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} + HW at 40 DAS; T10 - Hand weeding at 20 and 40 DAS and T11- Unweeded control. Pendimethalin and oxyfluorfen were applied as pre-emergence at 3 DAS, whereas quizalofop-ethyl, imazethapyr, and imazamox were applied as early post-emergence at 14 DAS (3 leaf stage). All the herbicides were applied based on the schedule given in Table. 1 using hand operated knapsack sprayer mixed with 500 liters of water per hectare over the surface of the soil. All other management practices were followed by CPG guide 2012. Biometric observation of total weed density was recorded at 30, 60 DAS and harvest stage and documented the seed yield of sesame were discussed here.

Total Weed density

The total weed numbers were counted by placing a quadrant (0.5 m2) randomly in the experimental field at 30, 60 and at the harvest stage.

Weed control efficiency

The weed control efficiency, was worked out using the formula proposed by Sankaran and Mani (1974) and expressed in percentage based on weed dry weight.

$$WCE\ (\%) = \frac{DWC - DWT}{DWC} \times 100$$

Where,

WCE -Weed control efficiency in percentage
DWC -Dry weight of weeds in unweeded control plot (g m^{-2})
DWT -Dry weight of weeds in treatment plots (g m^{-2})

Seed yield (Kg ha^{-1})

The entire crop was cut off from the net plot area near the ground level to assess the sesame yield (kg ha^{-1}). Treatment wise plants were bundled after harvesting the crop and kept in a heap for drying for about a week. After uniform drying, plants were threshed plot wise. In each treatment, the seeds were winnowed and cleaned.

RESULTS AND DISCUSSION

Total weed density (numbers m^{-2})

All the treatments were significantly influenced by weed flora (Table 1). The data recorded on 30 DAS, hand weeding twice at 20 and 40 DAS (T10) recorded zero population of total weeds. It was narrowly followed by the application of pendimethalin 30 EC @ 0.75 kg ha^{-1} as pre-emergence with one hand weeding at 30 DAS (T_1) accounting for 9 numbers of total weed density m^{-2}. Compared to other treatments, higher total weed density (139 numbers m^{-2}) was recorded in unweeded control (T_{11}). The observation documented on 60 DAS showed that weed density was lesser (10 numbers m^{-2}) with the application of PE pendimethalin 30 EC fb HW at 30 DAS (T_1) which was statistically on par with EPoE application of imazethapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} fb hand weeding at 40 DAS (T_9) (11 numbers m^{-2}). However, total weed density was higher (253 numbers m^{-2}) with EPoE application of imazethapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} (T7). The treatment exhibited its statistical parity with an early post-emergence application of quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + imazethapyr 10 SL @ 75 g a.i. ha^{-1} (T_6) and unweeded control (T_{11}), accounting 242 and 233 numbers of total weed density m^{-2}, respectively. At the time of harvest, total weed density was lower with pendimethalin 30 EC @ 0.75 kg ha^{-1} as pre-emergence with one hand weeding on 30 DAS (T_1) that registered 11 numbers m-2. It was followed by spraying oxyfluorfen 23.5 EC @ 200 g a.i. ha^{-1} as PE with HW at 30 DAS (T_3) and pendimethalin 38.7 CS @ 0.65 kg a.i. ha^{-1} as PE with HW at 30 DAS (T_2). Whereas, EPoE application of quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} fb HW at 40 DAS (T_4) registered a higher total weed density of 110 numbers m^{-2} at the harvest stage. ly, Prachand *et al.* (2015) obtained a similar result, who reported that pendimethalin inhibited the cell division and growth of the emerging weeds and caused the death of weed species due to scarcity of food reserves. This is also in line with Mane *et al*. (2017). Pre-emergence application of oxyfluorfen 23.5% EC fb by one hand weeding at 30 DAS resulted in effective control of grasses, broadleaved weeds, and some extent to sedges due to a broad spectrum of weed control. With respect to imazethapyr 35 a.e. combination with 35 a.e. imazamox inhibited the acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) enzyme activity in broad leaved weeds resulting in the subsequent destruction of those weeds at 3-4 leaf stage. Similar findings were also reported by Komal *et al*. (2015). Selvakumar *et al.* (2018), reported that quizalofop ethyl is a selective chemical for the effective control of monocot weeds in broad leaved crops. Whereas in this experimental site broad leaved weeds were more dominant, so quizalofop ethyl has not controlled the weeds effectively. Similar results were obtained by Tyagi *et al.* (2013) who specified that maximum weed count was listed in unweeded control were permitted to compete for nutrients, water, and sunlight with crop throughout the growing season which was numerically topmost in weed density among all other treatments.

Weed control efficiency

All the weed management practices were significantly influenced by weed control efficiency as projected in Figure 1. Among the different weed management practices, hand weeding twice at 20 and 40 DAS (T_{10}) registered 100% weed control efficiency. Successively, WCE of 94.7 % was obtained with the application of pendimethalin 30% EC @ 75 kg a.i. kg ha^{-1} + one weeding at 30 DAS (T_1). It was closely followed by PE application of pendimethalin 38.7 CS @ 0.65 kg a.i. ha^{-1} fb hand weeding at 30 DAS (T_3), which registered 94.6% WCE. It could be due to the effective reduction of weed density in these treatments during the crop-weed competition period and attributed to an increase the weed control efficiency. The finding confirms the results obtained by Mane *et al*. (2018) who disclosed that, the integration of pre-emergence application of herbicide with hand weeding (30 DAS) offered better weed control efficiency. The lowest weed control efficiency of 20.5% was registered with the application of EPoE quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} with one HW at 40 DAS (T_4).

Seed yield (Kg ha^{-1})

The significant influence of different weed management practices on sesame seed yield was given in Figure 2. Among the different chemical based weed control options, PE pendimethalin 30 EC @ 0.75 kg a.i. ha^{-1} + HW at 30 DAS (T_1) recorded a significantly higher seed yield (833 kg ha^{-1}), which was on par with hand weeding twice at 20 and 40 DAS (812 kg ha^{-1}) (T_{10}) and PE application of pendimethalin 38.7 CS @ 0.65 kg a.i. ha^{-1} + HW at 30 DAS (T_2). Best treatments were followed by oxyfluorfen 23.5 EC @ 200 g a.i. ha^{-1} as pre-emergence herbicide fb HW at 30 DAS (T_3) and EPoE application imazethapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} + HW at 40 DAS (T_9). Lesser grain yield (278 kg ha^{-1}) was registered with the application of EPoE herbicide quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + imazethapyr 10 SL @ 75 g a.i. ha^{-1} (T_6), EPoE application of quizalofop ethyl 5 EC @ 40 g a.i. ha^{-1} + imazethapyr 10 SL @ 75 g a.i. ha^{-1} + HW at 40 DAS (T_8). Similar results were obtained by Choudhary *et al*. (2012) who reported that weed-free plots recorded 68.7 per cent higher seed yield. These findings were correlated with Yadav *et al*. (2011) who narrated that weed free plots recorded a higher seed yield of 1840 kg ha^{-1} as against 518 kg ha^{-1} in unweeded control due to reduced weed competition during the crop growth period in clusterbean. Shweta and Singh (2005) also stated that integration of pre-emergence application of pendimethalin at 0.75 kg ha-1 with one hand weeding at 40 DAS significantly reduced the weed growth up to 60 DAS over the rest of the treatments, which reflected on a positive increase of seed yield of sesame which recorded about 1.09 t ha^{-1}.

Tables

Table 1. Effect of weed management practices on total weed density (numbers m^{-2}) at 30, 60 DAS and harvest stage

Treatments	Total weed density (numbers m^{-2})		
	30 DAS	60 DAS	At harvest
T¬1	3.06 (9)	3.21 (10)	3.38 (11)
T2	6.26 (39)	4.51 (20)	5.69 (32)
T3	6.52 (42)	7.95 (63)	5.33 (28)
T4	10.27 (105)	4.93 (24)	10.50(110)
T5	9.66 (93)	5.87 (34)	7.09 (50)
T6	8.03 (64)	15.57 (242)	9.45 (89)
T7	8.97 (80)	15.91 (253)	9.51 (90)
T8	7.51 (56)	5.96 (35)	6.66 (44)
T9	9.44 (89)	3.37 (11)	7.96 (63)
T10	0.71 (0)	6.19 (38)	9.24 (85)
T11	11.81 (139)	15.28 (233)	8.57 (73)
Sed	0.360	0.369	0.350
CD (5%)	0.752	0.770	0.731

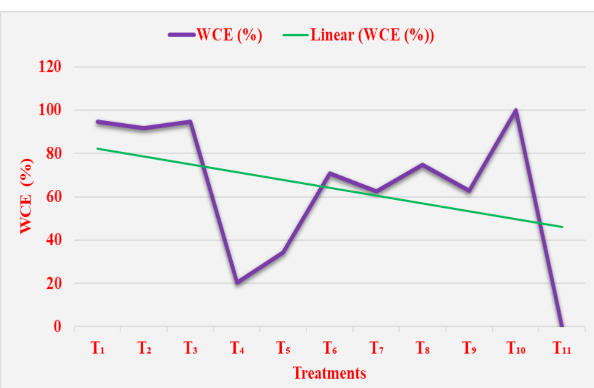

Fig. 1. Effect of weed management practices on WCE (%)

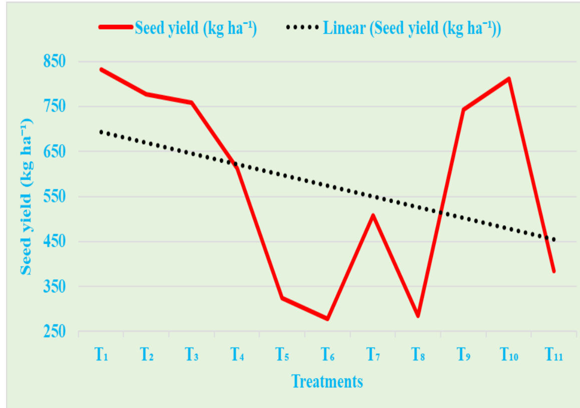

Fig. 2. Effect of weed management practices on seed yield (kg ha-1)

CONCLUSION

The study revealed that PE application of pendimethalin 30 EC @ 0.75 kg a.i. ha^{-1} followed by one-hand weeding at 30 DAS proved to be the best weed management option in terms of reduction in total weed density, effective weed control efficiency, and improved seed yield of sesame. In addition, non-availability of PE herbicide at the appropriate time, application of EPoE imazythapyr 35 a.e. + imazamox 35 a.e. @ 30 g a.i. ha^{-1} with HW on 40 DAS was better than hand weeding twice at 20 and 40 DAS.

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Competing interests

There were no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required

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