



Effect of Chemical to Herb Control on Performance of Sesame (*Sesamum indicum*) under Irrigated Conditions

Lipsa Patnaik¹, Rahul Adhikary^{1*} and M. Devender Reddy¹

¹M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, 761211, Odisha, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author LP and RA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors LP and RA managed the analyses of the study. Authors LP and DR managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Weed management greatly influences on weed infestation and yield of sesame under irrigated condition. An experiment was conducted at Bagusala farm, M.S. Swaminathan School of Agriculture, CUTM, Paralakhemundi, Odisha to find out the effectiveness of pre and post emergence herbicides on performance of summer sesame under irrigated conditions. The soil of experimental site was sandy clay loam in texture, slightly acidic in reaction with pH of 6.4. The experiment was laid out in randomize block design with three replications, assigning twelve treatments combinations of chemical application irrigated sesamum cultivation. The yield with hand weeding at 20 and 40 DAS was comparable with Pendimethalin @ 500 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60g a.i ha⁻¹ at 20 DAS, Imazethapyr @ 60g a.i ha⁻¹ at 20 DAS, Oxadiargyl 80wp @ 60g a.i ha⁻¹ 3 DAS and Oxadiargyl @ 40 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20 DAS and significantly superior over all other treatments. The weed number observed in all chemical weed control treatments was significantly lower than un-weeded control. Application of herbicides

*Corresponding author: E-mail: rahul.adhikary@cutm.ac.in;

was found to be effective in reduction of weed population in summer sesame under irrigated conditions. The weeds can be effectively controlled through application herbicides in sesame grown under irrigated conditions during summer season.

Keywords: Sesame; crop yield; weed control; irrigated condition.

1. INTRODUCTION

In India, Sesame (*Sesamum indicum* L.) occupies an area of 19.42 lakh ha with a production of 0.58 million tons and productivity of 303 Kg/ha. This accounts respectively 6.1 and 2.8 percent of area and production of oil seeds in India [1]. In Odisha, sesame is cultivated in an area of 260.62 thousand per ha (33.8 % of the total oil seed area of Odisha) and it is cultivated in all districts of the state during *kharif* (June and August), pre *Rabi* (September and October) and summer under irrigated conditions (January and March). The area under *kharif* is 196.8 thousand ha and 63.82 thousand ha and during *rabi* summer. The irrigated sesame crop suffers due to weeds and the conventional method of hand weeding is effective. Weeds can be controlled by physical, mechanical, cultural and chemical methods and their combinations. Hand weeding at 15 and 30 DAS recorded lowest weed population and high weed control efficiency [2] or hand weeding + hoeing at 20 and 30 days after sowing gave higher weed control efficiency [3]. The hand weeding which is a conventional method but due to increase in wages (skilled labour daily wages rupees 376.30) and unavailability of labour, more time consuming, laborious and not feasible every time due to unfavourable weather conditions, to face this condition the best method of weed control is through use of chemicals which will be effective and economical. They reported that the initial period of crop weed competition is up to 50 days after sowing [4] and between 2 to 3 weeks and 15 to 30 DAS [5]. Under irrigated conditions, the crop suffers highly due to weeds during initial stages (Bennett et al., 2003). Weed management through chemicals will be of great use in reducing the cost of weed control and helps in obtaining higher seed yield. In order to find out the relative efficiency of herbicides for control of different weed species and their intensity in sesame during summer under irrigated conditions in southern Odisha, an experiment was conducted in summer of 2020.

2. MATERIALS AND METHODS

The field experiment was carried out during summer of 2020 at Bagusala farm of Swaminathan School of Agriculture, CUTM, Paralakhemundi, Odisha.

2.1. Soil and Climate

The soil of experimental site was sandy clay loam in texture, slightly acidic in reaction with pH of 6.4. The temperature during crop season varied from 29.70⁰C to 38.69⁰C and average minimum temperature ranged from 18.05⁰C to 25.43⁰C. The total rainfall of 124.7 mm was received during the crop growing period. The experiment was laid out in randomized block design with three replications. The sesame variety YLM -17 was sown on 25 February 2020 at a spacing of 30 cm between rows and 15 cm between plants using 5 kg seed per ha. The crop was fertilized with 60 kg N, 30 kg P₂O₅ and 30 kg K₂O per ha. There by N and entire dose of P₂O₅ and K₂O was applied at sowing and remaining N was applied as band placement at 20 DAS. The N, P₂O₅ and K₂O was applied through urea, single super phosphate and MOP respectively.

2.2 Herbicide Application

There were 12 treatments of which ten treatments were herbicide combinations. Pendimethalin @ 750 g a.i ha⁻¹ at 3 DAS, Pendimethalin @ 500 g a.i ha⁻¹ at 3 DAS, Oxadiargyl 80WP @ 60 g a.i ha⁻¹ at 3 DAS, Oxadiargyl 80WP @ 40 g a.i ha⁻¹ at 3 DAS, Quizalofop @ 50 g a.i ha⁻¹ at 20 DAS, Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS, Pendimethalin @ 500 g a.i ha⁻¹ at 3 DAS + Quizalofop @ 50 g a.i ha⁻¹ at 20 DAS, Pendimethalin @ 500 g/ha at 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS, Oxadiargyl @ 40 g a.i ha⁻¹ at 3 DAS + Quizalofop @ 50 g a.i ha⁻¹ at 20 DAS, Oxadiargyl @ 40 g a.i ha⁻¹ at 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS and

one treatment of hand weeding at 20 and 40 DAS and control (no weeding).

2.3 Weed Control Efficiency

Weed control efficiency of different weed control treatments were estimated on the basis of weed dry weight by using the formula given below.

$$\text{Weed control efficiency (WCE) in } = \frac{(x-y)}{x} \times 100$$

Where,

x= weed dry matter production in weedy plot

y= weed dry matter production in treated plot

2.4 Weed Index

Weed index was calculated by using following formula and expressed in percentage

$$\text{Weed index (W.I)} = \frac{(a-b)}{a} \times 100$$

Where,

a= grain yield of the best treatment

b= grain yield of the treatment for which index is computed

2.5 Yield Parameter

Random sampling technique was followed to study the various agronomic characters like plant height, number of capsules per plant, length of capsule, number of seeds per capsule, seed number per plant, plant dry weight, seed weight per plant, 1000- seed weight. Five plants selected randomly in each plot as sample plants for recording above observations. The herbicides were applied as per treatments by using hand operated knap sack sprayer fitted with flat fan nozzle at a spray volume of 500 l/ha. Three irrigations were applied at critical stages of crop. From each plot weed count was taken at 20, 40 and 60 DAS and harvest from 50 cm X 50 cm quadrat. Species wise weed count was done and further categorized into narrow and broad leaved weeds.

2.6 Statistical Analysis

The weed count was recorded from 1m x 1m area and it was converted to square root transformation and analyzed statistically using SPSS software. The information data generated from the present investigation were analyzed as per the statistical procedure proposed by Gomez and Gomez [6] with statistical

techniques of growth analysis for agronomic crops.

3. RESULTS AND DISCUSSION

The grassy weed flora observed in summer sesame were - *Cynodon dactylon*, *Chloris barbata*, *Elusine indica*, *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, Sedges- *Cyperus difformis*, *Cyperus iria*, *Cyperus rotundus*, and Broad-leaved weeds- *Chenopodium album*, *Cleosia argentea*, *Amaranthus viridis*, *Portulaca oleracea*, *Cardiospermum halicacabum*.

The weed control treatments significantly influenced the growth and yield of summer sesame. The seed yield with hand weeding at 20 and 40 DAS was comparable with Pendimethalin @500 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ at 20DAS, Imazethapyr @ 60 g/ha at 20 DAS, Oxadiargyl 80wp @ 60 g/ha 3 DAS and Oxadiargyl @ 40 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20DAS (Table 1.). It has been observed that the weed dry weight in these chemical treatments was comparable and lower than that under unweeded control. Application of these herbicides has reduced the weed population as compared to unweeded control. However, two hand weeding at 20 and 40 DAS reduces the weed population significantly lower as compared to chemical weed control.

The weed control efficiency was higher in hand weeding at 20 and 40 DAS (74.2%) and it was followed by application of Pendimethalin @ 500 and 750g at 3 DAS (28.5%). Almost similar weed control efficiency was observed with application of Pendimethalin @ 500 g a.i ha⁻¹ at 3 DAS + Imazethapyr @ 60g/ha at 20 DAS (10.4%) in Table 1. Further, the weed index was lower with application of Pendimethalin @ 500g/ha at 3 DAS + post emergence application of Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS (Table 1.). The weed Index in this treatment was followed by application of Oxadiargyl @ 80wp @ 60g a.i ha⁻¹ at 3 DAS (0.17) and Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS (0.12). The weed index was directly related to the reduction in yield due to weed population and weed dry weight. This can be attributed to higher seed yield in the treatments Hand weeding and Pendimethalin @ 500 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ at 20 DAS, Imazethapyr @ 60 g/ha at 20DAS, Oxadiargyl 80wp @ 60 g/ha 3 DAS

and Oxadiargyl @ 40 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20DAS treatments. Similar results were reported by other scientists [7,8]. The weed growth and weed number had negative correlation with seed yield which indicate that the higher weed population of weeds and weed growth had adverse effect on crop growth and thereby on yield (Table 2 and Fig. 1.).

At harvest, the dry matter of sesamum in Hand weeding at 20 DAS and 40 DAS was higher and comparable with Pendimethalin @500 g/ha 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20 DAS, Oxadiargyl 80wp @ 60 g a.i ha⁻¹ 3 DAS, Oxadiargyl @ 40 g/ha 3 DAS + Imazethapyr @ 60 g/ha 20 DAS, and Oxadiargyl @ 40 g a.i ha⁻¹ 3 DAS + Quizalofop @ 50 g a.i ha⁻¹ 20 DAS. The results indicate that the combination of pre and post emergence application of herbicides-controlled weeds effectively and resulted higher crop dry matter production in these treatments. There was positive correlation between dry matter production and seed yield indicating the increased dry matter production result in improved seed yields.

The pod number was significantly higher with Hand weeding 20 DAS and 40 DAS and that

received Pendimethalin @ 500 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20 DAS and Oxadiargyl @ 40 g/ha 3 DAS + Imazethapyr @ 60 g/ha 20 DAS as compared to other treatments shows in Table 1. It was observed that the number of seeds per plant was higher with hand weeding, application of Oxadiargyl @ 40 g/ha 3 DAS + Imazethapyr@ 60 g a.i ha⁻¹ 20 DAS, Pendimethalin @ 500 g a.i ha⁻¹ 3 DAS + Imazethapyr @ 60 g a.i ha⁻¹ 20 DAS, Pendimethalin@ 500 g/ha 3 DAS + Quizalofop @ 50g 20 DAS and Oxadiargyl 80wp @ 40 g/ha 3 DAS. The improved yield attributing characters pod number per plant and seed number per pod due to the result of reduced weed weed competition because of desired level weed control treatments of Hand weeding and herbicide application. These two yield attributes were the major seed yield contributing characters which had positive correlation with seed yield. Hence, these two yield attributes had positive influence in improving the seed yield in Hand weeding and in treatment combination of pre and post emergence herbicides. Similar results of improvement in seed yield due to enhanced pod number and seeds per pod were reported by Sheroran et al. [9] and Bhadauria et al. [10].

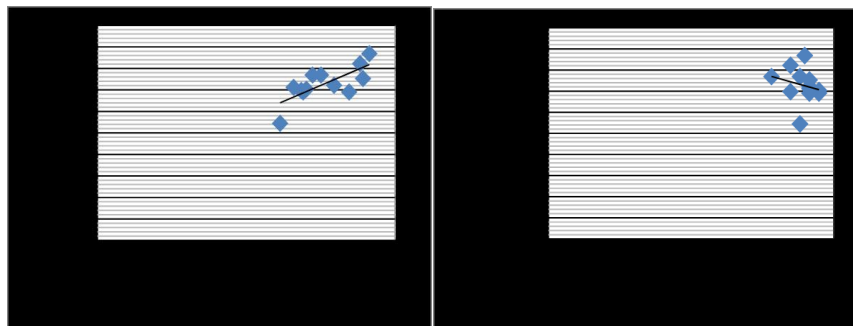


Fig. 1. Correlation graph between grain yield vs. seeds per plant and pod length of sesamum

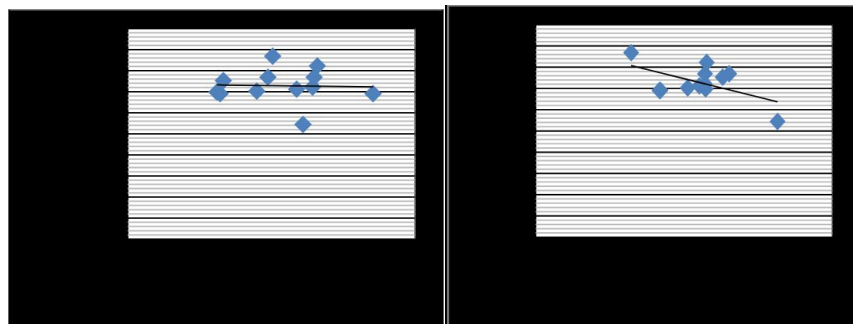


Fig. 2. Correlation between grain yield vs. plant height and weed dry weight of sesamum

Table 1. Effect of weed control treatments on growth and yield parameters of summer sesa

Treatments	Weed control efficiency, (%) at Harvest	Weed index	Plant dry weight, (g) at harvest	Number of pods per Plant	Number of seeds Per Plant	Seed Weight Per Plant, (g)	1000 Seed Weight, (g)	Seed Yield, kg/ha	Straw Yield, kg/ha	Dry matter at Harvest (Seed+ Stover), kg/ha	Harvest Index, (%)
Pendimethalin @ 750 g/ha at 3DAS	28.5	0.21	115.1	33.9	2422	5.7	2.4	345	3004	3349	10.31
Pendimethalin @ 500 g/ha at 3DAS	23.7	0.19	112.2	33.3	2458	5.6	2.3	352	3153	3505	10.03
Oxadiagyl 80wp @ 60 g/ha at 3DAS	16.6	0.12	139.1	37.3	2631	5.7	2.2	385	3426	3810	10.09
Oxadiagyl 80wp @ 40 g/ha at 3DAS	10.2	0.17	128.1	33	2785	6.5	2.4	361	3139	3500	10.31
Quizolfop @ 50 g/ha at 20DAS	44.1	0.20	120.5	37.9	2398	5.2	2.2	349	3036	3385	10.31
Imazethapyr @ 60 g/ha at 20DAS	49.3	0.12	112.3	39.9	2532	5.7	2.3	385	3346	3730	10.31
Pendimethalin @ 500 g/ha at 3DAS + Quizolfop @ 50 g/ha at 20DAS	18.0	0.21	115.9	40.3	2962	6.3	2.2	345	3023	3369	10.25
Pendimethalin @500 g/ha at 3DAS + Imazethapyr @ 60g/ ha at 20DAS	10.4	0.05	129.1	53.7	3091	6.7	2.2	411	3625	4037	10.19
Oxadiargyl @ 40 g/ ha at 3DAS + Quizolfop @ 50 g/ha at 20DAS	20.4	0.18	135.6	38.7	2309	5.4	2.4	356	3098	3455	10.31
Oxadiargyl @ 40 g/ha at 3DAS + Imazethapyr @ 60 g/ha at 20DAS	28.8	0.13	137.2	49.5	3125	6.9	2.2	377	3276	3653	10.31
Hand weeding 20 DAS and 40 DAS	74.2	0.00	144.1	51	3200	7.3	2.3	434	3779	4213	10.31
Control (No Weeding)	0	0.37	102.3	30.3	2150	4.3	2.0	272	2363	2635	10.33
SEm ±	-	-	5.32	2.59	170.35	0.4	0.07	38	168.88	188.73	-
CD 5%	-	-	15.6	7.6	499.7	1.3	NS	62	495.35	553.57	-

Table 2. Correlation between grain yield vs. growth and yield attributes of sesamum grown during summer at different doses of herbicides.

Seed yield, kg/ha vs.	Calculated r value	Significance
Plant height, cm	0.001	NS
Number of Pods Per Plant	0.611	**
Pod Length, cm	0.049	NS
Number of Seeds Per Pod	0.239	NS
Number of seeds Per Plant	0.549	**
Seed Weight Per Plant, g	0.664	**
Plant Dry Weight, g	0.557	**
Weed Dry Weight, g	0.299	NS
Weed Flora 0.5m x 0.5m	0.525	**
Table r value at 5% : 0.329 and 1% : 0.424		* Significance at 5% ** Significance at 1%

The seed yield in the un-weeded plot was considerably low and it was inferior to all other weed control treatments. The higher number of weeds, weed growth and lower weed control efficiency was observed with un-weeded control (Table 1.). The crop experienced stress due to weeds competition which ultimately resulted lesser plant dry weight, pod number per plant and seed number per pod (Table 1.). The poor growth of crop and resultant yield attributes caused reduction in yield as compared to all other herbicide treatments. Further, these yield attributes had positive correlation with seed yield which shows that the lower yield in un-weeded control was due to lower yield attributes like pod number and seed per pod (Table 2. and Fig 2). Similar results were reported by other scientists [7,8].

These results shows that the herbicide application gives comparable yield as that of hand weeding with less cost of cultivation. The combination of pre-emergence herbicides like pendimethalin and oxadiargyl at 3 DAS at lower dose with post emergence herbicide imazethapyr at 20 DAS results in similar yield as that of hand weeding. Further, the post emergence application of Imazethapyr at 80 g a.i ha⁻¹ at 20 DAS or preemergence application of Oxadiargyl at 60 g a.i ha⁻¹ at 3 DAS also gives similar yields of Hand weeding.

4. CONCLUSION

From the above discussion, it can be concluded that in summer sesame under irrigated conditions, application of Pendimethalin @ 500g a.i. ha⁻¹ 3 DAS + Imazethapyr @ 60g a.i. ha⁻¹ at 20 DAS (411 kg ha⁻¹), Imazethapyr @ 60g a.i. ha⁻¹ at 20 DAS

(385 kg ha⁻¹), Oxadiargyl 80wp @ 60g a.i. ha⁻¹ at 3 DAS (385 kg ha⁻¹) and Oxadiargyl @ 40g a.i. ha⁻¹ at 3 DAS + Imazethapyr @ 60g a.i. ha⁻¹ at 20 DAS (377 kg ha⁻¹) results in comparable seed yield as that of hand weeding at 20 and 40 DAS.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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