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Growth and Productivity of Sesame as Influenced by Different weed Management Practices in Red and Laterite Belt of West Bengal

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ABSTRACT

A field experiment was conducted during summer season of 2019 at Agricultural Farm, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, West Bengal to study the effect of different weed management practices on growth and productivity of sesame under red and laterite belt of West Bengal. The experiment was laid out in a randomized Block Design (RBD) with eight treatments and three replications. The treatments comprised pendimethalin 750 g/ha, butachlor 1000 g/ha, pendimethalin 750 g/ha *fb* HW at 30 DAS, butachlor 1000 g/ha *fb* HW at 30 DAS, hand weeding at 15 DAS, hand weeding at 15 and 30 DAS, weed free check and weedy check. All the weed management treatments recorded significantly lower population and dry weight of weeds than weedy check. Pendimethalin 750 g/ha and butachlor 1000 g/ha when followed by one hand weeding at 30 DAS recorded significantly lower population and dry weight of grasses, sedges and broadleaved weeds at 45 DAS than their sole application. Maximum growth parameters, yield attributes and yield were recorded with weed free check followed by pendimethalin 750 g/ha *fb* HW and the minimum values were recorded with weedy check. However, the highest return per rupee invested (2.81) was obtained under sole application of pendimethalin 750 g/ha which was significantly higher than all other weed management treatments and was statistically at par with sole application of butachlor 1000 g/ha.

Keywords Butachlor, Pendimethalin, Sesame, Weed management.

INTRODUCTION

The population of India in 2017 was 1338.68 million which is 17.74% of world's population (Anonymous 2019). The cultivated area in India under nine oilseeds during 2017-18 was 24.51 million hectares, production of 31.48 million tonnes and productivity of 1284 kg/ ha (DES 2019). Madhya Pradesh (27.87% share in all India production) is the leading total oilseed producing state followed by Rajasthan (21.47% share in all India production). Oilseed crops share 13% of area under major crops in India (DES 2019).

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The target oilseed production can be achieved either by increasing area or by increasing productivity. Sesame (*Sesamum indicum* L.), commonly known as til or gingelly, belongs to the family *Pedaliaceae.* India ranks first in the world regarding production of sesame. The area under sesame in India was 1.42 million ha with a production of 0.69 million tonnes and average productivity of 485 kg/ha (India stat 2018-19). West Bengal ranks 4th in terms of area (UP holds 1st rank), 1st in terms of both production and productivity in India. Area, production and productivity in West Bengal is 0.24 million ha, 0.23 million tonnes and 961 kg/ha, respectively (India stat 2018-19). Sesame is a high value food crop with high percentage of edible oil (about 50%). The oil is highly stable and has reducing effect on cholesterol and prevents coronary heart diseases. The crop is also known as "queen of oilseeds" due to its high quality poly-unsaturated fatty acids, excellent quality of oil, flavor, taste and softness. The sesame cake is used as organic manure as well as a good livestock feed. Moreover, it is also used as hair oil, body lotion and fixative in perfume industries. In West Bengal sesame is generally grown after harvesting of potato mostly on residual soil fertility. One of the major constraints lowering productivity of sesame is infestation due to weeds. Weeds usually grow faster than sesame plants and compete with the crop for growth resources. Soil is not only the store-house of essential plant nutrients but also a rich reservoir of weed seeds. A yield reduction to the tune of 50-75% caused by weeds in sesame due to high relative humidity and temperature coupled with early slow growth has been reported by Bhadauria *et al.* 2012. The slow growth of sesame at the earlier stages makes it vulnerable to weeds at that stage. Therefore, proper weed control measures are needed to minimise the loss caused by weeds in sesame. The period for crop-weed competition in sesame is the maximum between 15-45 DAS (Duary B. and Hazra D. 2013). The intercultural operations and hand weeding, though effective, are costly, time - consuming, laborios and also not feasible under all the situations owing to labor unavailability during peak periods. The chemical method of weed management is found to be more efficient and economical due to their quick action, selectivity, cost effectiveness and nowadays is becoming popular among the farmers. Therefore, in the present experiment, pendimethalin and butachlor were used alone and in combination with one hand weeding for weed management in sesame under red and laterite belt of West Bengal.

MATERIALS AND METHODS

Field details

The experiment was conducted during summer season (March to June) of 2019 at Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, West Bengal which was situated at 23^{0}39' N latitude and 87^{0}42'E longitude with an average altitude of 58.90 m above the mean sea level. The sand, silt and clay percentage of the soil of the experimental field were 71.4%, 16.3% and 12.3%, respectively. The pH of the soil was 5.73, EC 0.25 dS/m, organic carbon 0.39 %, available nitrogen 251 kg N/ha, available phosphorus 21.65 kg P_2O_5 /ha and available potassium 144.5 kg K_2O/ha.

Experimental details

The minimum weekly temperature varied from 11.80^{0}C to 25.10^{0}C and the maximum temperature ranged from 29.6^{0}C to 40.70^{0}C during the cropping season and the total amount rainfall received during the cropping season was 307.4 mm.

The experiment was laid out in Randomized Block Design (RBD) consisting of eight treatments and three replications. The treatments were pendimethalin 750 g/ha, butachlor 1000 g/ha, pendimethalin 750 g/ha *fb* one hand weeding at 30 DAS, butachlor 1000 g/ha *fb* one hand weeding at 30 DAS, one hand weeding at 15 DAS, two hand weedings at 15 and 30 DAS, weed free check and weedy check. The crop variety Rama was sown on 4th March at a spacing of 30 cm × 10 cm and the recommended fertilizer dose of 80 kg N/ha, 40 kg P_2O_5 /ha and 40 kg K_2O /ha was applied through urea, single super phosphate and muriate of potash, respectively. Half dose of N kg, full dose of P_2O_5 and K_2O were applied basal. Rest half N was applied at 30 DAS. The herbicide, pendimethalin and butachlor were applied pre-emergence at 1 and 3 DAS, respectively using knapsack sprayer fitted with flat fan nozzle. All other recommended package of practices were followed uniformly in all the experimental plots except weed management practices.

In case of hand weeding and weed free plots, manual removing of weeds was done by uprooting them. For recording observations on weed population, the number of different categories of weeds were counted by placing a quadrate (50 cm × 50 cm) randomly for each plot and the data was converted for 1 m² area. Weeds were removed, cleaned thoroughly in fresh water and separated category wise into grass, sedge and broadleaved weeds. After that the weeds were dried in sun and then kept in an electrical oven for 72 h maintaining a constant temperature of 65^{0}C till constant weight is achieved. After drying, weight of each category of weeds was taken and expressed in g/m². Five plants were selected randomly from each plot regarding observations on growth parameters and yield attributes. The crop was harvested when 80% of the capsules became matured. The seeds were separated, cleaned and dried in the sun for 6 consecutive days for reducing the moisture content of the seeds. Cost of various inputs and price of sesame seed were calculated as per the available market price to find out the economics of crop cultivation under different treatments. In order to find out the economics of sesame cultivation, the cost of cultivation and the gross return of all the treatments were worked out separately, from which the net return was obtained. Dividing this gross return by cost of cultivation, the return per rupee invested was calculated.

$$\text{Return per rupee invested} = \frac{\text{Gross return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Statistical tests

The data on population and dry weight of weeds were subjected to square root ($\sqrt{x+0.5}$) transformation. The significant treatment effect was judged with the help of 'F' test at the 5% level of significance.

RESULTS AND DISCUSSION

Weed flora

The weed flora of the experimental field comprised five species of grasses - *Cynodon dactylon, Dactyloctenium aegyptium, Digitaria sanguinalis, Echinochloa colona* and *Eleusine indica* ; two species of sedges - *Cyperus rotundus* and *Cyperus esculentus* ; five species of broadleaved weeds - *Alternanthera sessilis, Cleome viscosa, Euphorbia hirta, Heliotropium indicum* and *Trianthema portulacastrum*. Ambika and Sundari (2019) also were of similar view.

Table 1. Effect of weed management practices on population and dry weight of weeds at 45 DAS.

Treatments	Population (No./m²)			Dry weight (g/m²)		
	Grass	Sedge	BLW	Grass	Sedge	BLW
Pendimethalin 750 g/ha	6.47 (41.33)	6.84 (46.33)	4.38 (18.67)	4.08 (16.64)	4.68 (21.40)	4.88 (23.34)
Butachlor 1000 g/ha	6.65 (43.67)	6.96 (48)	4.49 (19.67)	4.19 (17.56)	4.44 (19.30)	5.12 (25.71)
Pendimethalin 750 g/ha *fb* HW at 30 DAS	3.72 (13.33)	3.85 (14.33)	2.97 (8.33)	1.63 (2.66)	2.25 (4.56)	1.86 (2.98)
Butachlor 1000 g/ha *fb* HW at 30 DAS	3.98 (15.33)	3.98 (15.33)	2.97 (8.33)	1.86 (3.46)	2.29 (4.74)	1.86 (2.95)
Hand weeding at 15 DAS	5.40 (28.67)	5.99 (35.33)	4.18 (17)	3.67 (13.47)	3.14 (9.36)	3.87 (14.50)
Hand weeding at 15 and 30 DAS	3.85 (14.33)	3.67 (13)	3.24 (10)	1.66 (2.76)	2.24 (4.51)	1.96 (3.34)
Weed free check	0.71 (00)	0.71 (00)	0.71 (00)	0.71 (00)	0.71 (00)	0.71 (00)
Weedy check	9.06 (81.67)	7.25 (52.00)	5.12 (25.67)	7.32 (53.58)	4.82 (22.75)	6.32 (39.53)
S.Em(±)	0.27	0.24	0.15	0.17	0.13	0.18
CD at 5%	0.82	0.71	0.43	0.49	0.39	0.52
CV(%)	9.49	8.37	7.42	9.23	8.01	9.65

Table 2. Effect of weed management practices on plant height, number of branches/plant, yield parameters, yield and economic of sesame cultivation.

Treatments	Growth parameters				Yield parameters			Yield		Economics
	Plant height (cm)		Number of branches/ plant		No. of capsules/ plant	No. of seeds/ capsule	Test weight (g)	Seed yield (kg/ha)	Stalk yield (kg/ha)	Return per rupee invested
	50 DAS	75 DAS	50 DAS	75 DAS						
Pendimethalin 750 g/ha	59.57	70.37	3.89	5.69	41.87	46.13	2.57	1086.2	2692.26	2.81
Butachlor 1000 g/ha	60.33	70.8	3.69	5.69	40.07	46.13	2.53	989.27	2527.12	2.59
Pendimethalin 750 g/ha fb HW at 30 DAS	68.67	77.1	5.67	6.78	48.60	58.20	2.63	1242.1	2781.3	2.28
Butachlor 1000 g/ha *fb* HW at 30 DAS	66.20	75.53	5.56	6.89	47.20	52.00	2.58	1179.13	2792.1	2.18
Hand weeding at 15 DAS	60.57	71.33	3.45	5.45	40.53	45.67	2.51	851.01	2225.28	1.65
Hand weeding at 15 and 30 DAS	66.67	75	5.67	6.78	47.60	53.20	2.54	1208.59	2721.03	1.79
Weed free check	72.90	83.77	6.44	7.45	55.93	57.13	2.69	1354.11	2917.19	1.37
Weedy check	49.33	59.1	2.22	3.45	34.20	35.47	2.46	505.58	1359.2	1.42
SEm (±)	2.91	3.23	0.31	0.35	1.99	2.08	0.06	44.41	104.37	0.15
CD at 5%	8.51	9.46	0.9	1.01	5.83	6.08	0.18	129.92	305.33	0.44
CV (%)	8.01	7.68	11.67	9.92	7.75	7.31	4.14	7.31	7.23	12.87

Effect on population and dry weight of weeds

At 45 DAS weed free check recorded the lowest population and dry weight of all categories of weeds whereas weedy check recorded the highest values (Table 1). Similar results were reported by Sahu *et al.* (2019), Kamini *et al*.(2019). All the treatments recorded significantly lower population and dry weight of weeds than weedy check. No significant difference was observed among pendimethalin *fb* HW, Butachlor *fb* HW and two hand weeding which significantly reduced the population and dry weight of weeds than sole application of the herbicides as well as one HW at 15 DAS. The results corroborate with the findings of Wamduda *et al*. (2012).

Effect on crop growth

Pendimethalin 750 g/ha and butachlor 1000 g/ha with one hand weeding at 30 DAS were at par with two HWs in recording growth parameters such as plant height and number of branches per plant at both 50 and 75 DAS. Sole application of pendimethalin and butachlor recorded significantly lower no. of branches/ plant than when they were combined with one hand weeding. Similarly, one hand weeding at 15 DAS recorded significantly lower no branches/plant than two hand weeding at 15 and 30 DAS. Similar results were reported by Rajpurohit *et al*. (2017).

Effect on yield components

The maximum number of capsules per plant and seed weight was recorded with weed free check in contrast to weedy check which recorded the minimum values. The application of herbicides integrated with one hand weeding and two hand weeding recorded significantly higher no. of capsules per plant than sole application of the herbicides and hand weeding once, respectively. Pendimethalin *fb* one hand weeding recorded significantly higher number of seeds per capsule than butachlor *fb* one hand weeding and sole application of pendimethalin and butachlor. Rajpurohit *et al*. (2017) revealed similar results.

Effect on yield

The highest seed yield (1354.11 kg/ha) and stalk yield (2917.19) were recorded with weed free check (Table 2) whereas the lowest values were observed under weedy check (505.58 and 1359.2 kg/ha, respectively). Mane *et al.* 2018 also recorded similar results.

All the weed management treatments recorded significantly higher seed yield and stalk yield than weedy check. Application of pendimethalin and butachlor each followed by one HW at 30 DAS as well as two HW at 15 and 30 DAS recorded significantly higher seed yield than sole application of the herbicides and one hand weeding at 15 DAS. Hand weeding once recorded significantly lower seed stalk yield than hand weeding twice. Mondal *et al.* (2016) also reported similar findings.

Economics

The maximum return per rupee invested (2.81) was obtained in sole application of pendimethalin as pre-emergence (Table 2) closely followed by sole application of butachlor (2.59) and the values were significantly higher than their application *fb* HW (2.28, 2.18, respectively) and two hand weeding (1.79). Similar findings were obtained by Sangeetha *et al.* (2019). The minimum return per rupee was recorded with weed free check (1.37).

CONCLUSION

It may be concluded from the experiment that, for improving growth and productivity of summer sesame and to earn higher return per rupee invested, pre-emergence application of pendimethalin or butachlor is promising in red and laterite belt of West Bengal.

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