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Research Communication

Effect of integrated use of competitive cultivars, herbicide and mulch on weed dynamics, weed-control efficiency, weed index and yield of summer sesame (*Sesamum indicum*)

AYESHA FATIMA[1], B. DUARY[2], V.K. SINGH[3] AND BASANT KUMAR[4]

Palli Siksha Bhavana, Sriniketan, Birbhum, West Bengal 731 236

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ABSTRACT

A field experiment was conducted during the summer (pre-*kharif*) season of 2016 at Sriniketan, Birbhum, West Bengal, to study the effect of sesame cultivar (*Sesamum indicum* L.) on weed management by straw mulching along with or without pre-emergence herbicide. The experiment was laid out in a randomized block design with factorial concept, replicated thrice. The integrated use of cultivar Rama with pendimethalin at 1.0 litre/ha + straw mulching @ 3.5 t/ha resulted in significantly lower weed density and weed dry weight 45 days after sowing (DAS). The same combination recorded higher seed yield (1,496 kg/ha) and stick yield (3,404 kg/ha) which was significantly at par with the combination of cultivar Rama with weed-free check. The application of pendimethalin at 1.0 litre/ha + straw mulching @ 3.5 t/ha resulted in higher weed-control efficiency (98.36%) and lower weed index (7.89%). The loss of seed yield of sesame due to weed infestation was to the tune of 70% and it was comparatively less in 'Rama' cultivar (66.7%) than 'Tilottoma' (74.6%) and 'Savitri' cultivar (67.8%). The cultivar Rama with pendimethalin at 1.0 litre/ha + straw mulching @ 3.5 t/ha was found to be effective in controlling composite weed flora. Thus, this treatment can be the best weed control option for obtaining higher productivity of summer sesame in lateritic belt of West Bengal.

Key words: Pendimethalin, Straw mulching, Sesame, Weed-control efficiency, Weed index, Yield loss

Sesame is one of the important oilseed crops in West Bengal, mainly grown on marginal lands with minimum care. It is cultivated in summer (pre-*Kharif*), rainy season (*Kharif*) and post-*Kharif* season. Weed competition is considered to be one of the most important factors responsible for low productivity of sesame. High temperature coupled with high relative humidity and frequent rainfall during the crop season and slow early growth of the crop favour luxuriant weed growth since seedling emergence, resulting in about 50–75% reduction in seed yield (Bhadauria *et al*., 2012). Continuous use of the same herbicides year after year in the same crop in the same field may lead to shifting of weed flora and development of herbicides resistance in weed (Duary and Yaduraju, 1999; Duary and Hazra, 2008; Duary *et al.* 2011). Much work has not been done in this field to devise any method of weed management that would be of low-cost as well as feasible to be used by the local farmers and that would not have any harmful effect on the environment. No single method of weed management can reach the desired level of efficiency under all situations. Integrated method of weed management may prove beneficial in the long run to keep the weed population below threshold level. There are many pre-emergence herbicides successfully used in sesame such as alachlor, metolachlor, fluchloralin and pendimethalin. There is also scope of integrating herbicides with cultural practices to improve the sustainable use of herbicides. Therefore, a field study was conducted to evaluate the combine effects of competitive cultivar, herbicide and mulch on weed growth and sesame yield in lateritic belt of West Bengal.

The field experiment was conducted during the summer season of 2016 in the Agricultural Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, Birbhum, West Bengal. The soil of the experimental field was sandy loam (Ultisol) in texture, medium in phosphorus and low in nitrogen and potash, with *p*H 6.2 and organic carbon content 0.46%. Two factors were tested in this experiment. Factor cultivars having three levels ('Tilottoma', 'Rama', 'Savitri'), whereas factor weed man-

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[1]Corresponding author's Email: ayesharahman2507@gmail.com
[1]Ph.D. Scholar; [3]Head, Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110 012; [2]Associate Professor; [4]Ph.D. Scholar, Palli Siksha Bhavana, Sriniketan, Birbhum, West Bengal 731 236

agement having 5 levels (pendimethalin at 1.0 litre/ha, straw mulching @ 3.5 t/ha, pendimethalin at 1.0 litre/ha + straw mulching @ 3.5 t/ha, weedy check, weed-free check). These treatments were arranged in a factorial randomized block design and replicated thrice. Pendimethalin @ 1.0 litre/ha was sprayed a day after sowing (DAS) with a knapsack sprayer. Straw mulch @ 3.5 t/ha was applied 15 DAS between the crop rows. Sesame was sown manually on 4 March 2016 in line, with a row spacing of 30 cm and a seed rate of 4.5 kg/ha. The recommended dose of 80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha urea, single superphosphate and muriate of potash were applied for sustaining the normal growth of sesame. Half of the nitrogen and full dose of P_2O_5 and K_2O were applied as basal at the time of sowing of sesame. Remaining nitrogen was applied 18 DAS as top-dressing. Weed density and biomass were recorded 45 DAS by placing two 1 m × 1 m quadrats in each plot. The biomass was determined after drying the samples in an oven at 70°C for 72 hours until constant weights were obtained. Weed data (i.e. density and dry weight) was transformed through square root $\sqrt{(X+0.5)}$ and the original data have been given in parentheses in each table along with the transformed value. At crop maturity, the number of capsules was counted from 4 randomly selected 1 meter rows. The plot size was 12 m^2 and the crop was harvested from a 4 m^2 area on 18, 24 and 29 May, 2016 for 'Savitri', 'Tilottoma' and 'Rama' respectively. Weed-control efficiency was calculated in relation to total weed dry weight as per Mani *et al*. (1981) and expressed in per cent. Weed index was determined by using the formula given by Gill and Vijayakumar (1969).

The data were analysed statistically by Analysis of variance using MSTAT statistical package in the computer and significance was tested by variance ratio, i.e. value at 5% level of significance as described by Gomez and Gomez (2010). Standard error of mean (SEm±) and critical difference (CD) were worked out for each character to evaluate the difference between treatment means.

The major weeds present in the experimental field were Bermuda grass [*Cynodon dactylon* (L.) Pers.], water grass [*Echinochloa colona* (L.) Link.], crab grass [*Digitaria sanguinalis* (L.) Scop.] among grasses; nutsedge (*Cyperus rotundus* L.) among sedges; three lobe false mallow [*Malvastrum coromandalianum* (L.) Garcke] and paracress [Acmella oleracea (L.) Jansen; syn. *Spilanthes acmella* L.] among broad-leaf weeds. Only total weed density and weed biomass data are presented in this article.

The data on total weed density at 45 DAS showed that the cultivar 'Rama' registered significantly lower density of total weeds than the other cultivars. However, the weed management treatment–the integrated use of pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha–recorded the

Table 1. Interaction effect of cultivars and weed management on weed density, dry-matter, seed yield, straw yield, weed-control efficiency (WCE) and weed index (WI) of summer sesame

Treatment	Density of weeds (No./m^2) at 45 DAS			Dry weight of weeds (g/m^2) at 45 DAS			Seed yield (kg/ha)			Stick yield (kg/ha)			WCE (%)	WI (%)
	'Rama'	'Tilottoma'	'Savitri'	'Rama'	'Tilottoma'	'Savitri'	'Rama'	'Tilottoma'	'Savitri'	'Rama'	'Tilottoma'	'Savitri'		
Pendimethalin @ 1.0 litre/ha	3.02 (8.62)	2.67 (6.64)	3.28 (10.26)	1.57 (1.97)	2.23 (4.47)	3.43 (11.27)	996	1,090	462	2,200	2,460	1,005	92.99	30.37
Straw mulching @ 3.5 t/ha	4.27 (17.72)	3.67 (12.99)	4.14 (16.64)	5.12 (25.71)	4.08 (16.12)	6.25 (38.59)	1,054	1,188	490	2,324	2,575	1,085	80.45	25.31
Pendimethalin @ 1.0 litre/ha + straw mulching @ 3.5 t/ha	2.11 (3.96)	2.03 (3.62)	1.68 (2.31)	1.16 (0.84)	1.28 (1.15)	2.06 (3.75)	1,313	1,496	561	2,890	3,404	1,225	98.36	7.89
Weedy check	6.64 (43.64)	6.84 (46.29)	6.49 (41.60)	6.34 (39.75)	4.62 (28.88)	7.08 (49.65)	345	531	224	999	1,079	490	0	69.93
Weed-free check	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	1,363	1,598	697	2,994	3,490	1,395	100	0
	V	W	V×W	V	W	V×W	V	W	V×W	V	W	V×W		
SEm±	0.07	0.09	0.16	0.06	0.07	0.13	17.49	22.58	39.11	43.17	55.73	96.53	–	–
CD (P=0.05)	NS	0.26	0.45	0.17	0.21	0.37	50.67	65.42	113.31	125.05	161.44	279.63	–	–

V, Cultivar; W, Weed-management

Data presented are $\sqrt{(x+0.5)}$ transformed values; Figures in parentheses are original values; DAS, Days after sowing; WCE, Weed control efficiency; WI, Weed Index.

lowest weed density, followed by pendimethalin at 1.0 litre/ha. The interaction effect of cultivar and weed management on density of total weeds at 45 DAS was significant. All the cultivars recorded significantly lower density of total weeds with integrated use of pendimethalin at 1.0 l/ha + straw mulching at 3.5 t/ha and were at par with each other (Table 1). However, integrated use of pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha was most effective in reducing total weed density in cultivar 'Savitri', registering significantly the lowest density as compared to the other 2 cultivars, whereas cultivar 'Rama' recorded significantly lower weed density with all the weed-management treatments 45 DAS. Thus, we can say that cultivar 'Rama' is more competitive than the other cultivars and integration of cultivar 'Rama' with pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha can significantly reduce weed population in summer sesame. The data on total weed dry weight at 45 DAS showed that, cultivar 'Rama' significantly resulted in lower weed dry weight than the other cultivars, while the treatment pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha significantly recorded lower total weed dry weight than the other treatments, followed by the treatment pendimethalin at 1.0 litre/ha. This treatment was effective in reducing complex weed flora. The interaction effect of cultivar and weed management on dry weight of total weeds at 45 DAS expressed that cultivar 'Rama' showed the lowest dry weight with all the weed-management treatments. It was also observed that combination of cultivar 'Tilottoma' with pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha resulted in lower dry weight than the other combinations. But it was statistically at par with the combination of cultivar 'Rama' with pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha (Table 1). Again the cultivar Rama registered significantly lower dry weight of total weeds at 45 DAS compared with other cultivars in weedy check which signifies that it is more competitive than the cultivar Tilottoma. This may be due to the fact that cultivar Rama had dense foliage and recorded significantly higher leaf-area index (LAI) and dry-matter accumulation and also higher crop-growth rate (CGR) as compared to the other cultivars which would have provided smothering effect on weed growth. Also, the combination of herbicide and mulch would have provided broad-spectrum weed control. The results are in conformity with the findings of Duary *et al.* (2014).

The cultivar 'Rama' in combination with treatment pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha resulted in higher seed yield and was at par with the combination of cultivar 'Rama' with weed-free check, followed by combination of cultivar 'Tilottoma' with the treatment pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha (Table 1). The per cent reduction in seed yield of sesame in weedy check was 74.6, 67.8 and 66.7% as compared to the weed-free in the cultivars 'Tilottoma', 'Savitri' and 'Rama' respectively. Thus, the yield reduction due to weed competition was less in cultivar 'Rama' which once again proved that the cultivar 'Rama' has better weed-suppressing ability than the others tested in the present experiment. The data on stick yield as influenced by interaction of cultivars and weed management showed that 'Rama' in combination with treatment pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha gave higher stick yield than the other treatments followed by combination of cultivar 'Tilottoma' with the treatment pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha. The competition between sesame and weed for nutrient, water, light and space was less under the above treatment, which facilitate more utilization of sun light, higher synthesis of carbohydrate and better partitioning of photosynthates towards seed development and ultimately leading to higher seed yield of sesame. Besides these, straw mulching was supposed to supply additional macro- and micro-nutrients, growth-promoting substances at later stages of crop growth and thus better soil environment including conserved moisture etc. (Teame *et al.,* 2017). It was interesting to note that straw mulching produced at par yield with that of herbicide pendimethalin at 1.0 litre/ha, indicating eco-friendly weed management reducing the herbicide load in the environment. These results support previous suggestions that integrating herbicide use with other weed-management strategies could result in a greater yield advantage over the use of herbicide alone (Chauhan and Abugho, 2013) and the use of rice straw as mulch can suppress seedling emergence and weed growth (Chauhan and Mahajan, 2012).

The weed-control efficiency (WCE) of different weed-management treatments revealed that, the integrated use of pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha exhibited the highest WCE, followed by pendimethalin at 1.0 l/ha. Weed index (WI) was calculated on the basis of yield of sesame and it was observed that the lowest weed index was registered in the treatment pendimethalin at 1.0 l/ha + straw mulching at 3.5 t/ha, followed by straw mulching at 3.5 t/ha and sole application of pendimethalin at 1.0 l/ha. The highest value of weed index was recorded in weedy check due to presence of weeds throughout the growing period.

Thus, integrated use of cultivar 'Rama' with pendimethalin at 1.0 litre/ha + straw mulching at 3.5 t/ha was found to be the most effective in managing broad-spectrum weeds in sesame registering lower weed density, dry weight, weed index and higher weed-control efficiency and increased values of seed and stick yield. In lateritic belt of West Bengal weeds are the major constraints in sesame resulting in yield losses. The results of our study showed

that integrated use of weed competitive cultivar 'Rama' along with pre-emergence application of pendimethalin at 1.0 l/ha + straw mulching at 3.5 t/ha at 15 DAS appeared to be the most promising approach for effective weed management and obtaining higher productivity and profitability of summer sesame.

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