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Evaluate the effect of weed management practices on growth and yield of sesame (*Sesamum indicum* L.)

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Abstract
At the Dry Land Horticulture Research-cum-Instructional Farm, Pt. SKS College of Agriculture and Research Station, Rajnandgoan (C.G.), a field experiment was carried out during the 2023 *kharif* season. Eight treatments and three replications were used in the Randomized Block Design experiment. At 20 and 40 DAS (T_2), two hand weedings produced noticeably more sesame seeds. 750 g a.i. ha^{-1} of 50% EC metolachlor as PE *fb* Propaquizafop 10% EC @ 100 g a.i. ha^{-1} at 20 DAS as PoE (T_8) to other herbicides, the latter proved most successful in suppressing various narrow-leaved and broad-leaved weeds, leading to increased growth, yield characteristics and yield of sesame (568.64) and B:C.

Keywords: Economics, yield, propaquizafop, metolachlor, quizalofop ethyl and sesame

Introduction
Sesame (*Sesamum indicum* L.) is an ancient oilseed crop known by various names such as gingely, til, simsim, gergelim and biniseed. Often referred to as the "Queen of Oilseeds," its seeds are celebrated for their high-quality polyunsaturated stable fatty acids, which help prevent rancidity. As noted by Dawale *et al.* (2009) [4], sesame seeds are a rich source of protein (20-28%) and edible oil (48-55%), containing vitamins like niacin, minerals such as calcium and phosphorus, and amino acids methionine and tryptophan. Research indicates that sesamol possesses antioxidant properties and can induce apoptosis and growth arrest in cancer cells (Magani *et al.*, 2012) [6]. Due to its excellent quality, sesame oil is often termed the "poor man's substitute for ghee." In India, sesame ranks among the most important oilseed crops, alongside mustard, rapeseed, and groundnuts. It is cultivated on 17.22 lakh hectares, producing 8.17 lakh tonnes annually with a productivity of 502 kg ha^{-1} (Anonymous, 2023) [2]. In the Chhattisgarh region, production and productivity figures were 25.16 million hectares, 12.7 million tonnes and 505 kg ha^{-1}, respectively (Anonymous 2021-22) [1].

Weed invasion in sesame fields poses a significant challenge to productivity, as these undesirable plants vie with the crop for essential resources like light, nutrients, and water. Additionally, they can serve as hosts for pests and diseases, further burdening the sesame plants. The crop season's high temperatures, elevated humidity, frequent rainfall, and poor plant growth, especially in the initial stages, promote robust weed growth. When weeds emerge simultaneously with seedlings, seed yield can be drastically reduced by 50-75% (Magani *et al.*, 2012) [6]. The critical period for crop-weed competition in sesame occurs between 15 and 30 days after sowing (DAS) (Imoloame *et al.*, 2010) [5]. Utilizing herbicides for chemical weed control is one of the most effective and commonly used strategies for managing weeds in sesame (Narkhede *et al.*, 2000) [8]. Pre-emergence herbicides, applied right after sowing, target the early waves of weeds, while post-emergence herbicides address those that appear later. A range of herbicides with different modes of action is available for use in sesame (Chauhan and Gurjar, 1998) [3]. However, herbicide recommendations should be tailored to specific locations, taking into account the prevalent weed species and soil-climatic conditions.

Materials and methods
The research took place at the Dry Land Horticulture Research-cum-Instructional Farm, Pt. Shiv Kumar Shastri College of Agriculture and Research Station, Surgi, Rajnandgoan (C.G.)

during the 2023 kharif season. The experiment was organized in a Randomized Block Design with three replications. Eight chemical weed control strategies were tested, including: T_1:Weedy check, T_2: two manual weeding at 20 and 40 DAS, T_3: pendimethalin 30% EC @ 750 g a.i. ha^{-1} PE, T_4: metolachlor 50% EC @ 750 g a.i. ha^{-1} as PE, T_5: Pendimethalin 30% EC @ 750 g a.i. ha^{-1} as PE followed by quizalofop ethyl 10% EC @ 50 g a.i. ha^{-1} at 20 DAS as PoE, T^6: pendimethalin 30% EC @ 750 g a.i. ha^{-1} as PE followed by propaquizafop 10% EC @ 100 g a.i. ha-1 at 20 DAS as PoE, T_7: metolachlor 50% EC @ 750 g a.i. ha^{-1} as PE followed by quizalofop ethyl 10% EC @ 50 g a.i. ha^{-1} at 20 DAS as PoE and T_8: metolachlor 50% EC @ 750 g a.i. ha^{-1} as PE followed by propaquizafop 10% EC @ 100 g a.i. ha^{-1} at 20 DAS as PoE. The sesame variety Madhuri was planted on August 8, 2023 and harvested on October 28, 2023. Observations were made on plant population, height, number of branches, seed yield, stalk yield and harvest index, all of which were statistically analyzed. Weed density and dry matter production were also measured and statistically evaluated. Additionally, the economic aspects of sesame cultivation, such as net return, gross return, and benefit-cost ratio, were calculated.

Results and Discussion

Effect on growth and yield

At harvest, the treatment with two hand weedings at 20 and 40 DAS resulted in a much higher plant population. The treatment that produced the highest plant height and number of branches per plant at harvest was T_2, which involved two manual weedings at 20 and 40 DAS. This was followed by the treatment T_8 which was at par with T_6. Plant height, number of branches and plant population were all lowest in the T_1 condition. Various chemical weed control methods had a major impact on test weight, number of capsules $plant^{-1}$ and number of seeds $capsule^{-1}$. The maximum number of capsules $plant^{-1}$ (31.56), number of seeds $capsule^{-1}$ (39.04) and test weight (2.39) was reported under T_2. The treatment T_8 came next and it was comparable to T_6. T_1 had the lowest number of capsules $plant^{-1}$ (19.27), number of seeds $capsule^{-1}$ (23.92) and test weight (2.07). Significantly the highest seed yield and stick yield was recorded T_2. The following successful treatment was T_8. These treatments were statistically comparable to T_6.

Effect on weeds

The experimental field revealed the presence of several weed species, including *Cynodon dactylon* L., *Dactyloctenium aegyptium* L., *Digitaria sanguinalis* L., *Bulbostylis capillaris* L., *Mollugo pentaphylla* L., *Cleome viscosa* L., *Alternanthera sessilis* L. and *Phyllanthus nirruri* L., which were observed across different treatments at all stages. Among the chemical weed control methods, the approach involving two manual weedings at 20 and 40 DAS (T_2) resulted in the fewest weeds, proving to be significantly more effective than other herbicide treatments. This method was comparable to the T_8, which was similar to T_6. The highest weed population was recorded in the T_1. Weed control efficiency at 30, 60 DAS and harvest was influenced by different sesame weed management strategies, with herbicides being the most effective in reducing weed growth. All treated plots showed higher weed control efficiency compared to the untreated control. Treatment T_2 achieved the highest weed control efficiency at 30, 60 DAS and harvest. The next most effective treatment was T_8, followed by T_6, T_7, T_5, T_4 and T_3, respectively. This effectiveness can be attributed to improved weed control under the various treatments, which likely provided the crop with a less stressful environment. The weed index was significantly affected by the weed control methods. Treatment T_2 resulted in the lowest weed index, followed by T_8 (13.66%), T_6 (14.85%), T_7 (17.03%), T_5 (17.46%), T_4 (29.90%) and T_3 (33.10%). The highest weed index was observed in the untreated control (43.69%). The weed index reflects the yield loss due to weed competition compared to the maximum seed yield.

Table 1: Effect of pre and post-emergence herbicide on plant growth of sesame

Notation	Plant population (No. m^{-2})	Plant height (cm)	Number of branches $plant^{-1}$
T_1	17.61	91.80	1.58
T_2	20.66	126.69	3.05
T_3	18.19	106.28	2.04
T_4	18.31	107.46	2.08
T_5	19.04	115.63	2.56
T_6	19.75	118.35	2.62
T_7	19.22	116.94	2.59
T_8	19.91	119.79	2.65
SEm ±	0.15	2.40	0.12
CD(P= 0.05)	0.45	7.31	0.35

Table 2: Effect of pre and post-emergence herbicides on yield attributes of sesame

Notation	Number of capsule $plant^{-1}$	Number of seeds $capsule^{-1}$	Test weight (g)
T_1	19.27	23.92	2.07
T_2	31.56	39.04	2.39
T_3	22.98	28.95	2.16
T_4	23.12	29.67	2.19
T_5	26.47	33.87	2.25
T_6	27.96	35.01	2.31
T_7	27.35	34.45	2.28
T_8	28.27	35.76	2.33
SEm ±	1.02	1.07	0.33
CD(P= 0.05)	3.04	3.19	0.42

Table 3: Effect of pre and post-emergence herbicides on yield of sesame

Notation	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	HI (%)
T_1	320.11	1561.21	17.02
T_2	568.51	2408.88	19.09
T_3	380.29	1853.19	17.03
T_4	384.46	1869.51	17.06
T_5	469.25	2170.50	17.78
T_6	484.10	2227.70	17.85
T_7	471.65	2181.51	17.78
T_8	491.01	2257.18	17.87
SEm ±	18.09	45.77	0.63
CD(P= 0.05)	54.88	138.8	NS

Table 4: Effect of pre and post-emergence herbicides on weed density

Notation	Weed density (no.m^{-2})		
	30 DAS	60 DAS	At harvest
T_1	228.41	331.99	422.09
T_2	25.08	35.18	43.03
T_3	148.96	108.60	81.40
T_4	147.85	106.44	80.05
T_5	126.71	81.97	56.05
T_6	118.52	78.48	53.65
T_7	123.91	80.89	55.10
T_8	116.42	76.88	52.51
SEm ±	0.51	1.12	1.9
CD(P= 0.05)	1.54	3.39	3.61

Table 5: Effect of pre and post-emergence herbicides on weed control efficiency

Notation	Weed control efficiency (%)		
	30 DAS	60 DAS	At harvest
T_1	0.00	0.00	0.00
T_2	91.06	90.16	89.92
T_3	28.51	64.90	79.76
T_4	28.90	65.55	80.07
T_5	41.93	73.35	86.30
T_6	45.69	74.63	86.97
T_7	43.23	73.77	86.65
T_8	46.60	75.16	87.21
SEm ±	1.36	0.73	0.44
CD(P= 0.05)	4.11	2.21	1.34

Conclusion

In comparison with other chemical weed management methods, T_2 produced the highest growth characters, such as plant population, plant height, number of branches, seed yield, stalk yield and harvest index. These were followed by T_8. The maximum seed output was recorded in T_2. The next most successful treatment was T_8.

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