***Review Article***

**Chemical Weed Management in Sesame:**

**A Review**

**ABSTRACT**

Sesame (*Sesamum indicum* L.) is a vital traditional oilseed crop in India, ranking next to groundnut, rapeseed, and mustard. Grown mainly in tropical and subtropical regions, it is highly valued for its oil-rich seeds. In 2023–24, India cultivated sesame over 15.31 lakh hectares, producing 8.47 lakh tonnes with an average productivity of 553 kg ha⁻¹ (India stat, 2023–24). However, sesame yield is significantly reduced by weed infestation, particularly during early growth stages due to the crop’s slow initial development and poor competitive ability. Yield losses from weeds have been reported as high as 64% to 95.9% (Bhavani *et al*., 2023; Aadi *et al*., 2024). Effective weed control, especially during the critical period of 15–30 days after sowing (DAS), is essential for maximizing productivity. Chemical weed control has gained importance for its efficiency and scalability. Pre-emergence herbicides like alachlor, pendimethalin, and pyroxasulfone effectively suppress early weed emergence, while post-emergence herbicides such as quizalofop-p-ethyl, clethodim, and propaquizafop control later-emerging grassy weeds. However, selective post-emergence options for broad leaf weeds remain limited due to phytotoxicity risks. This review highlights recent research on herbicide efficacy and crop safety, emphasizing integrated strategies for sustainable sesame weed management and improved yield outcomes.

*Keywords: Sesame, Pre-emergence herbicides, Post emergence herbicides, Crop toxicity*

**1. INTRODUCTION**

Sesame (*Sesamum indicum* L.), a tropical annual herb of the family Pedaliaceae, is commonly known as til or gingelly. Sesame (*Sesamum indicum* L.) holds significant importance as an edible oilseed crop next to groundnut, rapeseed and mustard in India. Sesame is the oldest oil seed crop known to human being and used by man since the ancient past. Sesame is one of the most significant traditional oilseed crops grown in tropical, subtropical, Asian and African nations. India is the world’s largest producer, with 15.31 lakh ha area, 8.47 lakh tonnes production and 553 kg ha⁻¹ productivity in 2023-24 (India stat, 2023-24). Among various biotic stresses, weed infestation is the most serious constraint in sesame production. During the initial stages, sesame seedlings are very small, tender and have very slow growth. Slow growth of sesame and simultaneous emergence and vigorous growth of weeds makes crop poor competitor with weeds for light, moisture, space, nutrients and shows negative impact on sesame yield (Bhadauria *et al*., 2012). According to Aadi *et al.* (2024) yield losses resulting from weed competition all over the growing season in sesame ranged from 66.4 to 95.9% during summer. Bhavani *et al*. (2023) reported that the seed yield of sesame due to uncontrolled weeds was reduced by 64-70%. According to Bhaumik *et al*. (2023) 41.6 kg ha-1 of N, 6.6 kg ha-1 of P and 33.3 kg ha-1 of K were removed by weeds in sesame field. The heavy weed infestation in unweeded check plots resulted in increased weed nutrient uptake upto 44.6, 5.6 and 34.0 kg of N, P and K ha-1, respectively in experimental field of sesame (Babu and Subramanyam 2018). The critical period of crop-weed competition during which weed management is very important to increase the yield of sesame is 15-30 DAS (Bhavani *et al.,* 2023; Verma *et al.,* 2023; Das *et al.,* 2022; Venu *et al.,* 2022; and Chauhan *et al.,* 2019). Hence, weed control at critical stages is essential to reduce yield losses caused by weeds. Weed control makes moisture and nutrient available to the crop and results in higher yield.

**2. WEED FLORA**

Hota *et al*. (2024) observed that *Digitaria sanguinalis*, *Echinochloa colona, Poa annua* and *Dactyloctenium aegyptium* among the grasses, *Melochia corchorifolia, Cleome viscosa* and *Cassia tora* among the broadleaved weeds and *Cyperus iria* among sedges were predominantly found in the sesame field in clayey soils of Odisha during summer. The weed flora of the sesame 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* in sandy loam soils of Visva-Bharati, West Bengal during summer (Debnath *et al*., 2022). Kamani *et al.* (2022) reported that the sesame field was infested with *Echinochloa crusgalli*, *Digitaria sanguinalis*, *Sorghum halepense*, *Cynodon dactylon*, *Bracharia* spp. among grassy weeds, *Amaranthus viridis, Alternanthera sessillis*, *Digera arvensis*, *Convolvulus arvensis*, *Eclipta alba*, *Vernonia cinerea*, *Euphorbia hirta*, *Euphorbia maderaspatensis*, *Cassia tora*, *Physalis minima*, *Trianthema portulacastrum* among broad leaf weeds and *Cyperus rotundus* among sedges during summer in clayey soils of Navsari, Gujarat. 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 broadleaved weeds- *Chenopodium album*, *Cleosia argentea*, *Amaranthus viridis, Portulaca oleracea*, *Cardiospermum halicacabum* in sandy clay loam soils of Odisha (Patnaik *et al.,* 2021).

**3. WEED MANAGEMENT**

Weed management in sesame (Sesamum indicum L.) is a critical component of crop production, as the crop is highly sensitive to weed competition, particularly during its early growth stages. Weeds compete aggressively with sesame for essential resources such as light, nutrients, water, and space, leading to significant reductions in growth, yield attributes, and overall productivity. Effective weed control is therefore essential for achieving optimum yields. A variety of weed management strategies have been explored, including physical, mechanical, and chemical methods. Among these, manual weeding, particularly two hand weedings at 20 and 40 days after sowing (DAS), has consistently shown to improve plant growth, enhance yield attributes, and ultimately boost seed yield in sesame (Hota *et al*., 2024; Saha *et al*., 2022 and Aktar *et al*., 2021). Despite its effectiveness, manual weeding is inherently labor-intensive, time-consuming, physically demanding, and costly, making it increasingly less feasible, especially in regions where agricultural labor is scarce or expensive. Mechanical weeding, although an alternative, is often not suitable in sesame cultivation due to the prevalent practice of broadcast sowing, which does not allow for easy maneuvering of weeding implements without causing crop damage. In contrast, chemical weed management offers a more efficient and practical approach. The application of herbicides provides rapid and selective weed control, is less labor-dependent and can be cost-effective over larger areas. As highlighted by Omezzine *et al.* (2011), chemical methods are advantageous due to their quick action, ability to target specific weed groups, and effectiveness from the very early stages of crop establishment, helping reduce initial crop-weed competition. Chemical weed control in sesame typically involves the application of pre-emergence and post-emergence herbicides, each serving a distinct role. Pre-emergence herbicides, applied shortly after sowing but before weed emergence, target early-germinating weed species and create a weed-free environment during the critical crop establishment phase. Post-emergence herbicides are used later in the season to control subsequent flushes of weeds, that escape early control measures.

Given the increasing importance and adoption of chemical weed control in sesame, there is a growing need to synthesize existing research on the efficacy, spectrum, and crop safety of various herbicides. Therefore, this review aims to consolidate and critically examine the studies conducted on different pre- and post-emergence herbicides evaluated for their effectiveness in weed management in sesame, with a focus on their impact on weed suppression, crop growth, and yield performance. The insights from this review will help guide herbicide selection, application strategies, and integrated weed management programs tailored to sesame production systems.

**4. CHEMICAL WEED MANAGEMENT**

**4.1 Pre-Emergence Herbicides**

**4.1.1 Alachlor**

Pre-emergence application of alachlor 50 EC @ 0.75 kg ha-1 produced the higher dry matter production (26.8 g plant-1), no. of capsules per plant (29), no. of seeds per capsule (34.3) and seed yield (480 kg ha-1) of sesame and reduced weed dry weight (Mruthul *et al*., 2023). Application of alachlor @ 1.5 kg ha-1 as pre-emergence *fb* quizalofop ethyl @ 50 g ha-1 on 25 DAS as early post emergence recorded significantly lesser weed density, dry weight, weed index (4.1%) and higher weed control efficiency (96.2%), seed yield (550 kg ha-1) and stalk yield (2432 kg ha-1) (Sujithra *et al*., 2019). Among chemical weed management practices, alachlor @ 0.375 kg ha-1 registered the maximum number of capsules per plant (38), seed per capsule (50.7) and test weight (3.46) of sesame according to Chauhan *et al.,* (2019).

**4.1.2 Butachlor**

Pre-emergence application of butachlor @ 1.0 kg ha-1 could be used as alternative to hoe weeding for effective weed control in sesame with higher seed yield but higher dose of butachlor @ 1.5 kg ha-1 resulted in suppressed crop growth of sesame (Audu *et al*., 2021). According to Chaudhari and Ghosh (2020) sole application of butachlor @ 1.0 kg ha-1 at 3 DAS may be considered as promising cost-effective herbicides for improvement of seed yield. The experimental results of Jadhav (2015) showed among herbicidal treatments lower weed count and dry weight of weeds and higher weed control efficiency, seed yield (0.48 t ha-1), stalk yield (1.40 t ha-1) and monetary returns were recorded with pre-emergence application of butachlor at 1.5 kg ha-1.

**4.1.3 Diuron**

The highest grain yield (669.9 kg ha-1) followed by weed free (837.5 kg ha-1) was obtained from the application of diuron @ 650 g ha-1 + hand weeding but the highest crop injury (10%) at 10 days after treatment was observed from the application of diuron @ 650 g ha-1sprayed two times (Baraki *et al*., 2023). Imoloame and Abubakar (2023) reported that tank mixture of pendimethalin + diuron @ 0.5 + 0.5 kg ha-1 resulted in greater yield components and increased sesame yield by 58.1% over weedy check.

**4.1.4 Fluchloralin**

Higher seed yield (760 kg ha-1) was recorded with pre-emergence application of fluchloralin @ 0.75 kg ha-1 + hand weeding which was 29.6% over weedy check (Ghatak *et al*., 2006). Svathi *et al*. (2005) results revealed that fluchloralin @ 1.0 kg ha-1 + hand weeding at 30 DAS gave higher sesame seed yield.

**4.1.5 Imazethapyr**

Pre-emergence application of imazethapyr @ 0.015 kg ha-1 + one HW at 30 DAS gave the greatest weed suppression and also produced the maximum seed yield (855 kg ha-1) (Dadarwal and Yadav 2025). Manoj *et al*. (2017) reported that application of imazethapyr @ 0.03 kg ha-1 as pre-emergence plus hand weeding in custard-sesame based agri-horticulture system recorded higher sesame seed yield (292 kg ha-1) and stalk yield (825 kg ha-1).

**4.1.6 Metribuzin**

Elakkiyapriya *et al.* (2022) reported that the least weed density and weed dry matter production were recorded in pre-emergence application of metribuzin @ 100 g ha-1 + early post emergence application of imazethapyr @ 30 g ha-1 at 10 DAS + hand weeding on 20 DAS in sesame. Metribuzin @ 300 g ha-1 produced the best reduction of total weeds without any significantly different in hand hoeing twice, but sesame seed yield was reduced due to phytotoxic effect of herbicide on the sesame crop (Elnenny *et al*., 2022).

**4.1.7 Metolachlor**

Application of metolachlor @ 1 kg ha-1 has scored lower weed density (<35 weeds m-2), lower fresh weed biomass and higher sesame seed yield 613.3 kg ha-1 (Zenawi *et al*., 2020). Imoloame *et al.* (2011) concluded that metolachlor at 1.5 kg ha-1 produced significantly higher seed yield (529.7 kg ha-1) and significantly low weed cover score and weed dry matter in sesame. Ndarubu *et al*. (2003) observed higher sesame yield with application of herbicide mixture of metolachlor + metobromuron at 1.0 + 1.0 kg ha-1.

**4.1.8 Oxyfluorfen**

Pre-emergence application of oxyfluorfen @ 0.15 kg ha-1 reduced weed density and dry weight of weeds with higher weed control efficiency and gave higher seed yield of sesame (Patnaik *et al.,* 2020). Singh *et al*. (2018) reported that higher stunting was observed with oxyfluorfen 0.l5 kg ha-1 in sesame on clay loam soils. The lowest density and dry weight of weeds with higher weed control efficiency (59.97 %), higher stature of yield components and seed yield (784 kg ha-1) of broadcasted sesame were registered with pre-emergence application of oxyfluorfen 75 g ha-1 + quizalofop 50 g ha-1 applied at 20 DAS (Babu *et al.,* 2016).

**4.1.9 Oxadiargyl**

Pre-emergence application of oxadiargyl @ 75 g ha-1 significantly reduced the total weed density and dry matter, but crop yield was reduced due to phytotoxic effect on sesame plants (Yadav, 2024). Oxadiargyl 80 WP @ 40 g ha-1 as PE *fb* quizalofop-p- ethyl 40 g ha-1 at 20 DAS resulted in comparable yield attributes and seed yield (377 kg ha-1) of sesame as that of hand weeding at 20 and 40 DAS (Rajpurohit *et al*., 2017).

**4.1.10 Pendimethalin**

Dhanush and Geetha (2024) reported that pre-emergence application of pendimethalin @ 0.75 kg ha-1 at 3 DAS recorded lesser total weed density (76 m-2), total weed dry matter (74.45 g m-2), weed index (24.00) and higher weed control efficiency (58.48%) at harvest without any phytotoxic effect on sesame The results of Kabirou *et al*. (2023) revealed that the pre-emergence application of pendimethalin followed by a hoe weeding at 6 weeks after seeding recorded higher sesamum seed yield (1160 kg ha-1). Venu *et al*. (2022) observed pre-emergence application of pendimethalin 30 % EC @ 0.75 kg ha-1 *fb* mechanical weeding at 30 DAS resulted in higher sesame seed yield (921 kg ha-1).

**4.1.11 Pyroxasulfone**

Experimental results of Giridhar (2024), showed that the lower density and dry weight of weeds in sesame was recorded with pre-emergence application of pyroxasulfone @ 100 g ha-1 at 20 DAS*.* Grichar *et al*. (2021) reported that pyroxasulfone @ 0.09 kg ha-1 produced yields that were over 260% greater than the untreated check.

**4.1.12 Trifluralin**

Amini *et al*. (2022) observed that application of trifluralin @ 2 l ha-1 as pre-emergence in integration with hand weeding in sesame had the higher weed control efficacy, higher reduction in weed biomass (79.33%) and recorded higher grain yield (164 g m-2) in Iran. The higher biological seed yield (1878.2 kg ha-1) was observed with pre-emergence application of trifluralin @ 1200 ml ha-1 (Akbia *et al*., 2020).

**4.2 Post Emergence Herbicides**

**4.2.1 Clethodim**

Ramesh *et al*. (2025) reported that among the different post-emergence herbicide treatments, clethodim 25 % EC @ 120 g ha-1 recorded weed control efficiency of 71% with higher sesame yield and demonstrated its potential to use for weed management in sesame. Higher seed yield (724.8 kg) and stalk yield (2640 kg) were observed with post emergence application of clethodim 7.5% + haloxyfop-methyl 15% @ 450 g ha-1 (Ismail *et al*., 2024).

**4.2.2 Fenoxaprop-ethyl**

Pramanik *et al*., 2025 observed that seed yield (1275 kg ha-1) and stalk yield (1275 kg ha-1) were the highest with post emergence application of fenoxaprop-ethyl 60 g ha-1. Sahu *et al*. (2019) reported that among the sequential application of herbicides, pre-emergence application of pendimethalin at 750 g ha-1 *fb* fenoxaprop at 100 g ha-1 gave higher weed control efficiency (76.6 %) and seed yield (468 kg ha-1).

**4.2.3 Haloxyfop-methyl**

Ismail *et al*., 2024 reported that post emergence application of clethodim 7.5% + haloxyfop-methyl 15% @ 450 g ha-1 recorded higher plant height (143.8), number of branches plant-1 (6.3), no. of capsules plant-1 (48.6) and no. of grains capsules-1 (56.8). According to Vafaei *et al*. (2013), higher dry matter accumulation (6578.1 kg ha-1) and grain yield (1117.7 kg ha-1) were recorded with application of haloxyfop + trifluralin @ 250+720 g ha-1.

**4.2.4 Imazethapyr**

Post-emergence application of imazethapyr @ 0.015 g ha-1 supplemented with hand weeding at 30 DAS recorded significantly higher plant height, dry matter production with higher number of capsules plant-1, which was on par with the hand weeding twice (Dhaka *et al*., 2013). The findings of Geethanjali *et al.* (2022) indicated that imazethapyr @ 75 g ha-1 applied as a post-emergence herbicide at seedling stage was toxic to sesame and caused adverse effects on sesame growth and yield.

**4.2.5 Imazamox**

Vinay *et al*. (2023) reported that post emergence application of imazethapyr 10% SL + imazamox 10% SC @ 35 +35 g ha-1 recorded the lowest weed density (10.6), dry weight (6.4), weed index (5.8) and the highest weed control efficiency (82 %), grain yield (810 kg ha-1) and stalk yield (2111 kg ha-1). EPoE imazethapyr 35 + imazamox 35% @ 30 g ha-1 *fb* hand weeding at 40 DAS recorded higher net return and benefit cost ratio from 743 kg ha-1 of seed yield (Sangeetha *et al.,* 2019).

**4.2.6 Propanil**

Propanil was applied post emergence @ 0.72, 1.44 and 2.16 kg ha-1. At lower dose (0.72 kg ha-1) higher grain yield of 858 kg ha-1 was recorded without toxicity to sesame crop. But, higher doses (1.44 and 2.16 kg ha-1) controlled the weeds effectively but caused significant injuries to sesame crop and crop recovered after one month of post emergence application of propanil. (Magani *et al.,* 2012).

**4.2.7 Propaquizafop**

According to Verma *et al*. (2023), post emergence application of propaquizafop 10 EC @ 50 g ha-1 at 20 DAS recorded lower density of total weeds and the highest seed yield (710 kg ha-1) and stover yield (1082 kg ha-1). Among herbicidal weed control treatments, the higher sesame seed yield (517 kg ha-1) and stalk yield (2691 kg ha-1) were recorded with propaquizafop application @ 50 g ha-1 but propaquizafop @ 125 g ha-1 and 100 g ha-1 had phytotoxic effects on growth of sesame (Gupta *et al.* 2016).

**4.2.8 Quizalofop-p-ethyl**

The sequential application of pendimethalin 0.50 kg ha-1 as pre-emergence followed by quizalofop-p-ethyl 0.05 kg ha-1 as post-emergence at 30 DAS, recorded the highest dry matter accumulation (15.01 g plant-1) and growth of summer sesame (Ninama *et al*., 2025). Higher seed (1177 kg ha-1) and stalk (1610 kg ha-1) yield were obtained with the application of quizalofop ethyl @ 0.05 kg ha-1 on 25 DAS + one hand weeding at 42 DAS in sesame (Roy and Umesha, 2023). Ambika and Sundari (2019) observed that pre-emergence application of alachlor @ 1.5 kg ha-1 at 3 DAS followed by post-emergence application of quizalofop ethyl @ 0.05 kg ha-1 at 21 DAS in sesame resulted in significantly higher plant height, number of branches plant-1, number of capsules plant-1 and number of seeds capsule-1.

**5. CONCLUSION**

Effective weed management is crucial for maximizing sesame yield, particularly during early growth stages when weed competition is most detrimental. Weeds compete for vital resources and serve as alternate hosts for pests and diseases, causing significant yield losses. Chemical weed control using herbicides has emerged as an effective strategy for managing weeds and improving crop performance. Pre-emergence herbicides like alachlor, pendimethalin, and pyroxasulfone effectively control early-emerging grasses and some broad leaf weeds by preventing seed germination. Post-emergence herbicides such as quizalofop-p-ethyl, clethodim, fenoxaprop-ethyl, and propaquizafop are effective against grassy weeds that emerge later, improving yield and economic returns. However, a major limitation is the lack of effective and crop-safe post-emergence herbicides for broad leaf weed control. Broad-spectrum herbicides may cause phytotoxicity in sesame, reducing seed yield. As sesame is a broad leaf crop, developing selective herbicides remains a challenge. Consequently, manual or integrated weed management practices are often needed, which can be labor-intensive and costly. Future research should focus on identifying selective post-emergence herbicides for broad leaf weeds and promoting integrated weed management approaches. Combining chemical, mechanical, and cultural methods can ensure sustainable and efficient weed control, ultimately improving sesame productivity and sustainability.

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