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Efficacy of pre and post emergence herbicides on growth and yield dynamics of mustard (*Brassica juncea* L.)

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Abstract

A field experiment was conducted during rabi season of 2025-26 at the Agronomy Farm, College of Agriculture, Nagpur, Maharashtra, India, to evaluate the efficacy of pre and post-emergence herbicides on mustard yield and economic returns. The experiment was laid out in randomized block design with three replications and ten treatment. Result revealed that, Among all the treatments Pendimethalin 678 a.i. g ha⁻¹ fb quizalofop ethyl 50 g a.i ha⁻¹ at 15-20 DAS fb straw mulch (T₂) result in significantly higher seed yield ha⁻¹, straw yield ha⁻¹, gross monetary returns, net monetary returns and benefit-cost ratio followed by Farmers practice (Hoeing fb HW) (T₉).

Keywords: Mustard, weed control, herbicide, yield, economics, pendimethalin, quizalofop ethyl, oxyfluorfen, isoproturon, straw mulch

Introduction

Mustard (*Brassica juncea* L.) is an important oilseed crop cultivated in many parts of the world. It belongs to the family Brassicaceae and has a significant role in India's oilseed production. Indian mustard contributes considerably to meeting the edible oil requirements of the country. It is mainly cultivated as a rabi season crop and is valued for its high oil content. The crop can be grown under a wide range of agro-climatic conditions. For good growth and yield of mustard generally performs well under cool temperatures, adequate soil moisture during the growing period, and relatively dry weather at maturity and harvest. Although mustard is mainly adapted to temperate conditions, it is also successfully cultivated as a cool-season crop in several tropical and subtropical regions.

Indian mustard is used extensively as a spice to season cuisine in addition to being a significant source of oil. According to Thiyam *et al.*, (2016) [15], Indian mustard is an excellent source of phenolic antioxidants such as sinapic acid and sinapine and has nutritional content of 4.51 g of carbs, 1.41 g of sugar, 2.0 g of dietary fibre, 0.47 g of fat, and 2.56 g of protein per 100 g (3.5). Rapeseed is cultivated to produce biodiesel, vegetable oil for human use, and animal feed. In northern India, these crops are seeded in October and November because they need a chilly growth season and consistent, mild temperatures (Das *et al.*, 2019) [8].

India's rapeseed and mustard production stood at 126.06 lakh tonnes in 2024- 25 crop year (July-June) with an acreage of 86.29 lakh hectares and an average yield of 1,461 kg ha⁻¹ (Anonymous, 2025 a) [2]. Although rapeseed-mustard is cultivated in majority of states of the country, bulk of the production comes from Rajasthan (45.40 %), Madhya Pradesh (13.28%) Uttar Pradesh (14.24 %) Haryana (10.78%) and West Bengal (6.0 %) during 2023-24 (Anonymous, 2025 b) [3]. By 2030, the projected demand for oilseeds is estimated at 82–101 million tonnes, of which rapeseed–mustard is expected to contribute around 16.4–20.5 million tonnes, accounting for 20–25% of total production (Chauhan *et al.*, 2020) [7].

Weed infestation is one of the major factors responsible for reducing mustard productivity, and yield losses may range from 35 to 60 per cent or even higher, depending on the intensity of infestation, weed composition and the period for which weeds remain associated with the crop (Bharat *et al.*, 2015 & Kumar *et al.*, 2020) [5, 10].

Several weed species, including *Physalis minima* L., *Medicago sativa* L., *Sonchus arvensis* L. and *Cichorium intybus* L., have been reported to interfere with mustard growth and consequently reduce crop productivity (Suryavanshi *et al.*, 2018) [14]. Among the important weeds occurring in mustard, *Chenopodium album* L., *Asphodelus tenuifolius* Cav., *Melilotus indicus* (L.) All., *Coronopus didymus* (L.) Sm., *Spergula arvensis* L. and *Phalaris minor* Retz. are particularly troublesome and can cause considerable reductions in seed yield when their infestation is not effectively managed (Brar *et al.*, 2021) [6]. In Indian mustard, pre-emergence pendimethalin is widely used for early weed control, but its effectiveness generally declines after about 30 days after sowing (DAS). Manual weeding at 3-4 weeks after sowing is effective, but increasing labour costs and labour shortages make it less feasible. Post-emergence quizalofop-ethyl can provide additional control of grassy weeds, while straw mulch can suppress weed emergence and reduce weed competition. Therefore, the present study was conducted to evaluate pendimethalin, quizalofop-ethyl, straw mulch and manual weeding, along with their suitable combinations, for their effects on weed dynamics, crop growth and yield of Indian mustard.

Material and Methods

The experiment was conducted during rabi season of 2025-26 at the Agronomy Farm, College of Agriculture, Nagpur, Maharashtra, India. in randomized block design (RBD) with ten treatments and three replications. In the present investigation, the weed treatments consisted of different combinations of pre-emergence and post-emergence herbicides, with or without straw mulch. Pendimethalin (PE) 678 a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS (T₁), Pendimethalin (PE) 678 a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂), Oxyflurofen (PE) 200 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS (T₃), Oxyflurofen (PE) 200 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₄), Isoproturon (PE) 1000 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS (T₅), Isoproturon (PE) 1000 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₆), Quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS (T₇), Quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₈), Farmers practice (Hoeing fb HW) (T₉) and Weedy check (T₁₀) were compared to assess their effectiveness in managing weeds and improving crop performance. All other recommended agronomic practices for mustard were followed uniformly across the field with spacing of 45 cm × 5 cm on gross plot and net plot with size of 5.4 m × 4.5 m and 4.5 m × 3.9 m respectively. Observations on grain yield and straw yield were recorded from the net plot area and subsequently converted into yield ha⁻¹ using the appropriate hectare conversion factor. The recorded data were subjected to statistical analysis. Cost of cultivation was calculated and studies on economics were carried out with the help of current market price of mustard.

Results and Discussion Yield attributes

Seed yield (q ha⁻¹)

The data related to seed yield (Table 1) indicated that mustard seed yield significantly influenced by different weed control treatments applied. Among all the treatments, application of Pendimethalin (PE) 678 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂) recorded significantly higher seed yield (11.24 q ha⁻¹) followed by Farmers practice (Hoeing fb HW) which produced comparable seed yield (10.76 q ha⁻¹) and remained statistically at par with T₂. The lowest seed yield (4.71 q ha⁻¹) was recorded under weedy check (T₁₀), which might be due to severe weed infestation throughout the crop growth period.

The superiority to integrated weed control practices involving pre-emergence herbicides followed by post-emergence herbicides and mulching in improving seed yield has been reported by Bharat *et al.*, (2022), Saranya *et al.*, (2022) and Kumar *et al.*, (2026) [4, 11, 9].

Straw yield (q ha⁻¹)

The data presented in the table clearly indicate that different weed control strategies had a significant effect on the straw yield of mustard. Among all the treatments, application of Pendimethalin (PE) 678 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂) (18.98 q ha⁻¹) produced significantly higher straw yield of mustard as compared to rest of the treatments.

The lowest straw yield (7.87 q ha⁻¹) was observed in weedy check (T₁₀) and also all treatments were found significantly superior over weedy check (T₁₀) treatment. The increase in straw yield in weed control treatments over weedy check (T₁₀). Might be because of more dry matter accumulation plant⁻¹ of mustard with less dry matter accumulation in weeds among all the treatments, facilitating better growth and development of the crop for producing more seed and straw yields. Comparable findings have been documented by of Sharma *et al.*, (2021) [13], Ananthapadmanabhan *et al.*, (2022) [1] and Sharma *et al.*, (2024) [12].

Economics

In terms of economics, different weed control practices had a notable impact on both gross monetary return (GMR) and net monetary return (NMR). Application of Pendimethalin (PE) 678 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂) recorded the highest gross monetary return (GMR) of ₹71,576 ha⁻¹ and net monetary return (NMR) of ₹48,286 ha⁻¹ which was significantly superior to all other treatments. The second best treatments was Farmers practice (Hoeing fb HW) recorded a GMR of ₹68446 ha⁻¹ and NMR of ₹42111 ha⁻¹.

The highest benefit-cost (BC) ratio of 3.07 was achieved under the application of Pendimethalin (PE) 678 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂), followed by closely by T₉.

Table 1: Evaluating the efficacy of pre and post-emergence herbicides on yield and economics of mustard

Treatment	Yield		Economics		
	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	GMR (₹ ha ⁻¹)	NMR (₹ ha ⁻¹)	B:C ratio
T ₁ Pendimethalin (PE) 678 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS	9.86	15.73	62722	37697	2.51
T ₂ Pendimethalin (PE) 678 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS fb straw mulch	11.24	18.98	71576	48286	3.07
T ₃ Oxyflurofen (PE) 200 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS	8.69	14.43	55348	29973	2.18
T ₄ Oxyflurofen (PE) 200 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS fb straw mulch	9.54	15.31	60683	33998	2.27
T ₅ Isoproturon (PE) 1000 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS	7.92	12.90	50373	23785	1.89
T ₆ Isoproturon (PE) 1000 g a.i. ha ⁻¹ fb quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS fb straw mulch	8.32	13.62	52947	25049	1.90
T ₇ Quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS	7.16	11.98	45566	21661	1.91
T ₈ Quizalofop ethyl 50 g a.i. ha ⁻¹ at 15-20 DAS fb straw mulch	7.86	13.21	50044	24829	1.98
T ₉ Farmers practice (Hoeing fb HW)	10.76	17.64	68446	42111	2.60

T ₁₀	Weedy check	4.71	7.87	29993	9183	1.44
	SM (M) ±	0.21	0.34	1343	1343	-
	CD at 5%	0.63	1.02	3990	3990	-
	GM	8.61	14.17	54770	29657	-

Conclusion

On the basis of the field experimentation it is concluded that, application of Pendimethalin 678 g a.i. ha⁻¹ fb quizalofop ethyl 50 g a.i. ha⁻¹ at 15-20 DAS fb straw mulch (T₂) recorded significantly seed yield (q ha⁻¹), straw yield (q ha⁻¹), GMR, NMR and B:C ratio of mustard followed by Farmers practice (Hoeing fb HW) (T₉).

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