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Influence of Integrated Weed Management Practices on Weed Dynamics, Growth and Yield of Indian mustard (*Brassica juncea* L.)

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ABSTRACT

A field experiment was conducted during the winter season of 2023-24 at Crop research centre, ITM University, Gwalior, to work out the Influence of Integrated Weed management practices on weed dynamics, growth and yield of Indian Mustard (*Brassica juncea* L.). A field was allocated thrice replicated with ten treatment as per randomized block design. It was concluded that application of pre emergence Pendimethaline 30% EC @ 1.0 kg ai.ha^{-1} fb application of post emergence Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} fb @ 5 tonnes of straw mulch / ha was recorded lower weed count species (no./m^{-2}), biomass (gm^{-2}), lower in weed index and higher in weed control efficiency which was statistically at par with application of pre-emergence Pendimethaline 30% EC @ 1.0 kg ai.ha^{-1} fb application of post emergence Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1}. And also, maximum growth attributed such as plant height, number of branches, dry matter accumulation of Crop and leaf area index. The maximum yield attributed such as Length of siliquae (cm), siliquae plant^{-1}, seed sliquae^{-1} and test weight. The maximum yield such as Grain yield (kg ha^{-1}), Stover yield (kg ha^{-1}), Biological yield (kg ha^{-1}) and harvest index was recorded in application of pre emergence Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} fb application of post emergence Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} fb @ 5 tonnes of straw mulch / ha which was at par with application of pre emergence Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} fb application of post emergence Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1}

Key words*: Pre-emergence, Post emergence, Mulching, Mustard, yield.*

Introduction

Mustard (*Brassica juncea* L.) is third most significant oilseed crop farmed worldwide, after soybean (Glycine max) and palm (*Elaeis guineensis* L.). The mustard and rapeseed belonging to family of cruciferous (Brassicacae). The mustard seeds oil content varies from 37-49 %. Most crops grown in temperate climates are mustard and rapeseed. Additionally, it is grown in tropical and subtropical regions with chilly climates. India, Canada, China, Pakistan, Australia and European are the mustard growing Countries in the world. The estimation rapeseed and mustard occupying 35.59 million hectares with Production 72.35 million tonnes and productivity 1980 kg/ha respectively. In India rapeseed-mustard (*Brassica juncea* (L.) occupying 7.32 million hectares with production 7.26 million tonnes and productivity 985 kg

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/ha respectively. The productivity is lower in compare to developed countries mainly due to in adequate supply of fertilizers and growing crop on marginal lands under rainfed condition. As this crop is grown in poor soils with poor management practices, weed infestation is one of the major causes of low productivity (Singh, 1992). Yield losses due to crop weed competition in rapeseed and mustard have been estimated to the tune of 10-58% (Gill *et al.* 1989).

In Madhya Pradesh the area under rapeseed and mustard is 0.75 mha with annual production 0.98 million tonnes and average productivity of 1.30 t/ha (anonymous 2018). Bhind, Morena, Shivpuri, Gwalior, Neemuch and Mandla are important mustard growing district in Madhya Pradesh is. In Bhind district the mustard crop covers of area 180.54 thousand hectare area and 175.5 thousand tones production and it share 24 percent area and 27 percent production of mustard in Madhya Pradesh (Kumar *et al*., 2020).

The major factor to achieved the best yield of mustard and rapeseed are without any weed competition. In Indian mustard weeds are recognized as detrimental factors responsible for lower yield. The lower yield of mustard is due to competition of weeds for nutrients, moisture, light and space was reported high (Buttar and Aulakh, 2003). Certain cultural methods, such mulching and hoeing, help control some of the principal weeds in mustard by blocking sunlight, lowering soil temperature, and acting as a physical barrier to inhibit weed emergence. Maximum seed yield (2540 kg/ha) (Degra *et al*. 2011) were obtained in the treatments where plots were kept weed-free followed by the treatment where mulching was done after hoeing.

Materials and Methods

A field investigation was conducted during winter season 2023-24 at Crop research centre, School of Agriculture, ITM University, Gwalior (longitude 79° 54′ E, latitude 23° 10′ N, 412 meters above mean sea level), Madhya Pradesh, the average annual rainfall in the area is 750 mm. During the field investigation the minimum and maximum temperature ranged between 2°C to 32°C, respectively. The field experiment was allocated in uniform topography with well- drain soil characterized with low fertility and alkaline condition. The soil of field experiment sites was sandy loam in texture with pH 8.28, electrical conductivity 0.41S/m, organic carbon 0.33, Nitrogen (175 kg/ha), Phosphorus (25kg/ha) and Potassium (312 kg/ha) respectively. The field investigation was conducted randomized block design (RBD) with three replication and ten treatment viz., Weed Free, Weedy check, Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1}(PE), Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE), Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + hand weed 45 DAS, Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE), Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + @ 5 tonnes of straw mulch., Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch, Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch / ha and Straw mulch @ 10 ton/ha. The gross plot size of experiment was 16.2m^{-2}. Seed of mustard variety 'laxmi sona' were sown at a rate 5 kg/ha in rows space 45 cm apart with plant to plant distance to maintain plant population after thinning. Seed was sown on October 26th 2023. Before sowing, the mustard seed were treated with Trichoderma viride 3g/kg of seed, lasted for 30 minute which was aim to control soil borne diseases.

The recommended dose of fertilizer with 100 kg of nitrogen, 40 kg of phosphorus and 40 kg of potassium per hectare. The nutrients nitrogen, phosphorus, and potassium were supplied via urea, single super phosphate, and muriate potash, in that order. The full dosage of phosphate and potash were applied during seeding, while half of the nitrogen dose was applied during top dressing following the initial irrigationHerbicide was sprayed according to the treatment with the aid of a backpack sprayer and flat-fan nozzles with a 500 litre water/ha spray volume. A 1.0 m^{-2} quadrate that was positioned in three random locations at 30, 60, 90, and harvest time was used to detect weed. The type of weed found within the quadrated was recorded, dried in the sun for two days, and then dried for 48 hours at 72 °C in a hot air oven. The dried material was weighed and expressed asg/m^{-2}. The efficacy of weed management was determined at 60 DAS of weed biomass, and the weed index, expressed as a percentage, was determined using grain yield. The data was statistically analysed using appropriate randomised block design ANOVA procedures.

Results and Discussion

Effect on Weeds

The majority of the experimental field was infested with *Cyperus rotandus* (7.26%) as sedges, *Chenopodium album* (11.69%), *Anagallis arvensis* (14.11%), *Fumeria parviflora* (12%) as broad leaves and *Phalaris minor* (14.25%) and *Cynodon dactylon* (6.05%) as grasses and Others weed (34.01%). The similar type of weed flora in mustard was reported by bhawawana *et al.* (2017) and Bissen and singh (2028). T9-Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% + Imazethapyr 15% EC @ 175 ml ai.ha^{-1} + @ 5 tonnes of straw mulch / ha showed lower weed species count (no./m^{-1}), weed dry weight (g/m^{-2}), higher weed control efficiency (%), and lower weed index (%) at 30, 60, and 90 DAS. These results were statistically comparable to T6-Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} fb application of post-emergence herbicide Quizalofop ethyl 7.5% fb Imazethapyr 15% EC @ 175 ml ai.ha^{-1}. This is reason the application of pre-emergence herbicide are more effective than application of post emergence herbicide which results reveals that lower weed species count and weed dry matter accumulation. Jandir *et al.* (2017) and Upasani *et al.* (2017).

Effect on crop

At 30, 60 and 90 DAS the plant height, number of branches, crop dry weight and leaf area index influenced by weed management practices are presented in Table 2. The taller plant height (cm), maximum number of branches, crop dry matter accumulation (g/plant) and leaf area index (%) was superior in weed free. Among the herbicide treatment the taller plant height, maximum number of branches, crop dry matter accumulation and leaf area index was observed in T9- Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} + @ 5 tonnes of straw mulch/ha which was at par with T6-Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1}. Lower plant height, number of branched, crop dry matter accumulation and leaf area index was recorded in weedy check. However, all the treatment were superior to weedy check. Singh *et al.* (2000) had also obtained more plant height, number of branched, crop dry matter accumulation and leaf area index superior to weedy check. Similar result of growth attributes was conformity with Singh *et al.* (2017) and Pandey *et al.* (2019).

The yield attribute and yield impacted by weed management treatment presented in Table 3. Weed free was recorded as maximum yield attribute and yield due to under free competition environment with effective management of weed. Among the herbicide treatment the maximum yield attributed character viz. Length of siliquae (cm), siliquae plant-1, seed sliquae-1 was observed in T9-Pendimethaline 30% EC @ 1.0 Kg ai./ha + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} fb @ 5 tonnes of straw mulch / ha which was statistically at par with T6- Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai./ha and test weight was not affected by weed control treatment as directly related to genetic character. Similar yield attributes reported by Kumar *et al.* (2012) and Yadav *et al.* (2017).

Yield such as Grain yield (kg ha^{-1}), Stover yield (kg ha^{-1}) and Biological yield (kg ha^{-1}) was significantly influenced by weed management practices. The highest yield was observed in T9-Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} fb @ 5 tonnes of straw mulch / ha which was statistically at par with T6-Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} + Quizalofop ethyl 7.5% fb Imazethapyr 15 % EC @ 175 ml ai./ha. Similar results reported by Raj *et al.* (2020) and Kumar and Kaur (2015).

Conclusion

It can be conclude that significantly lower weed species count, weed dry weight, weed index and higher weed control efficiency and also higher growth attributed, yield attributed and yield was observed in application of pre-emergence herbicide Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} fb application of post-emergence herbicide Quizalofop ethyl 7.5% fb Imazethapyr 15% EC @ 175 ml ai.ha^{-1} fb @ 5 tonnes of straw mulch /ha was statistically at par with application of pre-emergence herbicide Pendimethaline 30% EC @ 1.0 Kg ai.ha^{-1} fb application of post-emergence herbicide Quizalofop ethyl 7.5% fb Imazethapyr 15% EC @ 175 ml ai./ha.

Table 1. Effect of weed management practices on weed species count (no./m^{-2}), weed dry weight, weed control efficiency and weed index.

Treatment	Total weed species count (no./m^{-2})			Total weed dry weight (g/m^{-2})			Weed control efficiency (%)			Weed Index (%)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
T1- Weed Free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	100.00	100.00	100.00	0.00
T2- Weedy check	14.03 (196.34)	15.76 (247.99)	17.45 (304.00)	10.52 (110.10)	13.12 (171.63)	14.59 (212.50)	0.00 43.27	0.00	0.00	
T3- Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE)	8.24 (67.34)	11.48 (131.32)	13.15 (172.34)	6.06 (36.19)	9.54 (90.47)	10.58 (111.53)	67.13	47.29	47.52	31.41
T4- Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	13.97 (194.68)	9.35 (87.00)	11.90 (141.00)	10.47 (109.14)	7.55 (56.46)	9.65 (92.60)	0.87	67.10	56.42	17.43
T5- Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1} (PE) + hand weed 45 DAS	8.01 (63.67)	9.65 (92.67)	12.13 (146.65)	5.93 (34.64)	7.97 (63.00)	9.84 (96.31)	68.54	63.29	54.68	18.34
T6-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1} (PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	7.43 (54.66)	5.96 (35.00)	10.40 (107.66)	5.47 (29.47)	4.69 (21.50)	7.97 (63.10)	73.23	87.47	70.31	5.30
T7-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1} (PE) + @ 5 tonnes of straw mulch	7.25 (52.01)	11.22 (125.33)	12.30 (150.68)	5.36 (28.20)	8.84 (77.60)	9.97 (98.83)	74.39	54.79	53.49	19.55
T8- Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch	10.73 (114.67)	8.86 (78.00)	11.63 (134.66)	8.08 (64.73)	6.73 (44.79)	9.43 (88.44)	41.21	73.90	58.38	16.20
T9-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1} (PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch / ha	6.92 (47.33)	5.31 (27.66)	9.21 (84.33)	5.09 (25.44)	4.20 (17.14)	7.37 (53.87)	76.89	90.01	74.65	2.19
T10-Straw mulch @ 10 ton/ha.	7.67 (58.34)	12.21 (148.67)	12.67 (160.00)	5.74 (32.42)	9.40 (87.79)	10.22 (103.96)	70.55	48.85	51.08	24.61
Sem±	1.11	1.35	1.44	0.89	1.05	1.18	-	-	-	-
CD (P=0.05)	3.38	3.89	4.28	2.67	3.18	3.53	-	-	-	-

*original figure value are shown in parenthesis, PE stand for Pre-emergence, POE stand for post emergence, DAS stand for DAS

Table 2. Effect of integrated weed management practices on Plant height, number of branched, dry matter accumulation and leaf area index

Treatment	Plant height (cm)			Number of branches/plant			Dry matter accumulation (g/plant)			Leaf area index		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T1- Weed Free	83.50	154.44	177.86	2.28	16.60	27.67	1.38	13.51	42.56	2.18	8.00	6.40
T2-Weedy check	61.50	98.98	122.29	2.03	8.21	13.68	1.35	7.51	26.13	1.74	4.31	3.45
T3-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE)	62.75	106.90	132.97	2.12	10.06	16.77	1.46	8.37	28.52	1.91	4.52	3.62
T4- Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	68.86	122.32	145.68	2.00	11.95	19.92	1.37	10.41	33.32	2.06	5.38	4.30
T5-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + hand weed 45 DAS	67.64	120.94	145.16	2.15	11.61	19.35	1.55	10.12	32.71	2.12	5.19	4.15
T6- Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	73.42	132.11	160.60	2.36	13.07	22.98	1.46	11.69	36.16	2.01	6.18	4.94
T7-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + @ 5 tonnes of straw mulch	66.56	116.93	148.25	2.10	11.18	18.63	1.56	9.61	31.77	2.12	4.91	3.93
T8-Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch	69.66	124.39	150.25	2.20	12.47	20.78	1.54	11.04	34.46	2.05	5.38	4.30
T9-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch / ha	76.38	137.90	164.46	2.37	14.37	24.29	1.42	12.41	38.41	2.02	7.08	5.66
T10- Straw mulch @ 10 ton/ha.	64.31	113.77	134.33	2.07	10.75	17.92	1.51	9.01	30.59	2.06	4.73	3.79
Sem±	2.16	6.26	7.82	0.13	0.57	0.94	0.07	1.07	1.55	0.09	0.31	0.25
CD (P=0.05)	6.5	19.39	23.25	NS	1.68	2.80	Ns	3.18	4.62	NS	0.94	0.75

*original figure value are shown in parenthesis , PE stand for Pre-emergence, POE stand for post emergence, DAS stand for DAS

Table 3. Effect of integrated weed management practices on yield attributed and yield of mustard

Treatment	Length of siliquae (cm)	Siliquae plant^{-1}	Seed siliquae^{-1}	1000-seed weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
T1- Weed Free	7.38	324.32	16.03	3.68	2325.34	5968.80	8294.15	28.07
T2-Weedy check	4.61	215.86	12.53	2.81	1319.23	3700.35	5019.58	26.76
T3-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE)	4.84	229.81	13.01	2.79	1461.53	4084.58	5546.11	26.41
T4- Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	5.46	245.42	14.07	2.91	1920.05	5088.28	7008.32	27.44
T5-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + hand weed 45 DAS	5.45	245.36	14.44	2.93	1898.96	5010.58	6909.55	27.45
T6- Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE).	6.19	264.82	15.03	3.20	2202.21	5666.50	7868.70	27.98
T7-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + @ 5 tonnes of straw mulch	5.29	243.65	13.60	2.91	1870.72	4965.70	6836.42	27.56
T8-Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch	5.58	245.79	14.61	3.09	1948.73	5133.45	7082.18	27.59
T9-Pendimethalin 30% EC @ 1.0 Kg ai.ha^{-1}(PE) + Quizalofop ethyl 7.5% + Imazethapyr 15 % EC @ 175 ml ai.ha^{-1} (POE) + @ 5 tonnes of straw mulch / ha	6.40	283.12	15.49	3.23	2274.50	5710.12	7984.62	28.61
T10- Straw mulch @ 10 ton/ha.	4.88	234.06	13.43	2.83	1753.11	4638.20	6391.31	27.59
Sem±	0.27	12.72	0.34	0.17	92.80	317.48	318.42	1.79
CD (P=0.05)	0.79	36.59	1.02	NS	275.72	943.30	946.08	NS

*Original figure value are shown in parenthesis , PE stand for Pre-emergence, POE stand for post emergence, DAS stand for DAS.

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