



Research Article

MANAGEMENT OF PARASITIC WEED (*OROBANCHE*) IN MUSTARD (*Brassica juncea* L.) FOR WCE AND YIELD ENHANCEMENT

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Abstract-The present investigation was conducted at Gwalior during *rabi* 2011-12 entitled management of parasitic weed (*Orobancha*) in mustard (*Brassica juncea* L.) for weed control efficiency (WCE) and yield enhancement. The results showed that, application of Pendimethalin 1.0 kg/ha pre-emergence resulted in lowest weed density (81.3/m²), weed dry weight (13.6 g/m²) and highest weed control efficiency (86.98%). While highest *orobanche* control efficiency (37.22%) and lowest weed density (0.33/m²) was noted under the treatment trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation. As concern with yield and yield attributes, the treatment pendimethalin at the rate of 1.0 kg/ha pre-emergence recorded highest seeds/silique (15.16), test weight (4.76 g) and seed yield (22.22 q/ha) which was similar with the treatments trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation, application of neem cake at the rate of 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 days after sowing (DAS) and significantly superior over rest of the treatments under study. The treatment pendimethalin at the rate of 1.0 kg/ha pre-emergence was found to be cost effective with net returns of Rs. 51350 and B: C ratio 4.36 which was followed by the treatment trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation. Hence for effective control of *Orobancha* and other associated weeds, application of pendimethalin at the rate of 1.0 kg/ha pre-emergence can be the best option which was followed by trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation for higher WCE and yield in Indian mustard.

Keywords- Mustard, Weed management, *Orobancha*, Weed control efficiency, Yield.

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Introduction

Indian mustard (*Brassica juncea* L.) is the principal oilseed crop of Madhya Pradesh. It occupied an area of 5.92 million hectares and produced 6.78 million tonnes annually with the average productivity of 1145 kg/ha of country. In Madhya Pradesh rapeseed and mustard is grown in 0.79 million hectares area with annual production of 0.87 million tones and average productivity of 1108 kg/ha [1]. In India, mustard weeds are recognized as one of the major negative factors of crop production. Broomrape *Orobancha aegyptiacaps*. has been causing heavy losses to the mustard crop in light soils of Grid region. Weed infestation during early stages reflected the crop growth and reduction in yield up to 58 percent [4]. As *Orobancha* is reported to be the holo-parasitic weed, it is very tough to control by following physical and mechanical weed control methods. Hence, its control by chemical means will be the cost effective option for managing losses up to economical threshold levels. With this view the present experiment was carried out to find out cost effective herbicide for the control of *Orobancha* and associated weeds causing yield reduction in Mustard.

Materials and Methods

A field investigation was conducted at Research Farm of Agronomy, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during *rabi* 2011-12 to

test different weed control measures against weeds in mustard. The soil of the experimental site was sandy loam in texture having low available N (179 kg/ha), medium P (19 kg/ha) and high K (382 kg/ha). Twelve weed control treatments administered to mustard consisted of T₁ - pendimethalin at the rate of 1.0 kg/ha pre-emergence, T₂ - glyphosate at the rate of 50 g/ha alone after emergence of *orobanche*, T₃ - trifluralin at the rate of 1.5 kg/ha pre-plant incorporation, T₄ - glyphosate at the rate of 25 g/ha alone with 1% solution NH₄SO₄ at 40 DAS, T₅ - neem cake at the rate of 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS, T₆ - neem cake at the rate of 200 kg/ha in furrow followed by imazethapyr at the rate of 30g/ha at 20 DAS, T₇ - trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation, T₈ - soybean oil 2 drops / shoot after emergence of *orobanche*, T₉ - Application of 25% extra dose of phosphorus and phosphorus solubilizing bacteria, T₁₀ - *Trichoderma viride* at the rate of 2.5 kg/ha as basal application, T₁₁ - farmers practice 1 hoeing at 40 DAS and T₁₂ - weedy check. These treatments were replicated three times in randomised block design (RBD). Variety 'JM 3' was sown at row spacing of 30 cm. Fertilizers were applied as per the recommended dose i.e. 80kg N, 40 kg P₂O₅, 20 kg K₂O and 25 S kg/ha. Weed control efficiency (WCE) of each treatment was calculated using the formula:

$$\text{WCE (\%)} = \frac{\text{Weed dry weight in weedy check} - \text{Weed dry weight in treatment}}{\text{Weed dry weight in weedy check}} \times 100$$

Net income and Benefit: Cost ratio was calculated by using the formulae given below:

$$\text{Net income (Rs./ha)} = \text{Gross income (Rs./ha)} - \text{Cost of cultivation (Rs./ha)}$$

$$\text{Benefit : cost ratio} = \frac{\text{Gross income (Rs./ha)}}{\text{Total cost of cultivation (Rs./ha)}}$$

The data were statistically analysed through the procedure adopted for RBD[2]. The data pertaining to weeds were transformed to square root scale of $\sqrt{(X + 0.5)}$. Where ever significant difference existed, critical difference was constructed at five per cent level of probability.

Results and Discussion

Weed flora

The mustard crop was infested mainly by seven weed species during the course of investigation. Out of which *Chenopodium album*, *Chenopodium murale*, *Spergula arvensis* and *Anagallis arvensis* are among the broad leaf weeds, *Phalaris minor* and *Cyperus rotundus* are the narrow leaf weeds and *Orobancha aegyptica* was parasitic weed. However, few more weeds were also recorded as other weeds.

Weed growth

The weed density (no./m²), weed dry weight (g/m²), weed control efficiency (%) of total weeds and *orobanche* were significantly affected by weed management practices [Table-1]. The lowest total weed density (81.3/m²) was noted under the treatment pendimethalin at the rate of 1.0 kg/ha pre-emergence, which was similar with trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation and neem cake at 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by one hoeing at 40 DAS while significantly superior over rest of the treatments. The lowest *Orobancha* density (0.33/m²) was registered under the treatment trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation and similar with rest of treatments except soybean oil 2 drops / shoot after emergence of *orobanche*, application of 25% extra dose of phosphorus and phosphorus solubilizing bacteria and weedy check. Pendimethalin at the rate of 1.0 kg/ha resulted in significantly lowest weed dry weight (13.60 g/m²) which was similar with trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation, trifluralin at the rate of 1.5 kg/ha pre-plant incorporation and Neem cake at the rate of 200kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS and significantly superior over rest of the treatments. The highest weed control efficiency (86.98%) was observed under application of pendimethalin at the rate of 1.0 kg/ha pre-emergence followed by trifluralin at the rate of 1.5 kg/ha pre-plant incorporation and trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation. The highest *Orobancha* control efficiency (37.22%) was recorded under application of trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation followed by neem cake at the rate of 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS and trifluralin at the rate of 1.5 kg/ha pre-plant incorporation. Similar results were obtained by [3] in mustard.

Table-1 Weed density, weed dry weight, weed control efficiency of total weeds and *orobanche* as influence by various weed management treatments

Treatments	Total Weed density (No./m ²)	<i>Orobancha</i> density (No./m ²)	Weed dry weight (g/m ²)	Weed Control efficiency (%)	<i>Orobancha</i> Control efficiency (%)
T ₁ - Pendimethalin at the rate of 1.0 kg/ha pre-emergence	9.04(81.3)*	1.52(1.33)*	13.60	86.98	15.56
T ₂ - Glyphosate at the rate of 50 g/ha alone after emergence of <i>Orobancha</i>	22.29(496.3)	1.38(1.00)	79.66	33.34	23.33
T ₃ - Trifluralin at the rate of 1.5kg/ha pre-plant incorporation	9.84(96.3)	1.27(0.33)	15.30	82.97	29.44
T ₄ - Glyphosate at the rate of 25 g/ha alone with 1% solution NH ₄ SO ₄ at 40 DAS	17.62(310.0)	1.24(0.66)	55.60	44.96	31.11
T ₅ - Neem cake at the rate of 200 kg/ha in furrow and Pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS	9.63(92.3)	1.27(0.66)	15.30	79.93	29.44
T ₆ - Neem cake at the rate of 200 kg/ha in furrow followed by Imazethapyr at the rate of 30 g/ha at 20DAS	19.98(398.6)	1.52(1.33)	70.90	41.74	15.56
T ₇ - Trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation	9.19(84.0)	1.13(0.33)	13.80	82.47	37.22
T ₈ - Soybean oil 2 drops / shoot after emergence of <i>Orobancha</i>	27.46(753.6)	1.71(2.00)	93.30	13.87	5.00
T ₉ - Application of 25% extra dose of phosphorus and phosphorus solubilizing bacteria	25.84(667.0)	1.62(1.66)	88.76	22.14	10.00
T ₁₀ - <i>Trichoderma viride</i> at the rate of 2.5 kg/ha as basal application	24.17(583.6)	1.52(1.33)	83.43	30.92	15.56
T ₁₁ - Farmers practice 1 hoeing at 40DAS	22.15(490.3)	1.41(1.00)	79.60	31.57	21.67
T ₁₂ - Weedy check	29.00(840.6)	1.80(2.30)	99.53	0.00	0.00
S.E.m±	0.051	0.149	1.95	0.433	0.166
C.D. (P= 0.05)	0.150	0.439	5.72	1.272	0.488

*Values in parentheses are original. Data transformed to square root transformation

Yield Attributes and Yield

The yield attributes viz., number of siliquae per plant, length of siliqua, number of seeds per siliqua and seed weight were significantly affected by weed management practices [Table-2]. Highest yield attributes were recorded under pendimethalin at the rate of 1.0 kg/ha pre-emergence followed by trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation and neem cake at 200 kg/ha in furrow with pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS. This may be because of fact that due to less density of weeds under these treatments result in less competition between crops and weed plants for moisture, light, space and nutrients which provided congenial condition to the crop for proper development of its reproductive phase which resulted in the enhancement of all these yield contributing characters. These finding are closely conformity with the findings of [6, 7]. The seed yield per hectare mainly depends on performance of individual plant in term of seed yield. The number of siliquae, length of siliqua and number of seeds per siliqua determine the seed yield per plant. The perusal of data showed that, pendimethalin at the rate of 1.0 kg/ha pre-

emergence was similar with trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation and recorded significantly higher seed yield as compared to remaining weed control methods and weedy check. Neem cake at the rate of 200kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS, trifluralin at the rate of 1.5 kg/ha pre-plant incorporation and glyphosate at the rate of 25 g/ha alone with 1% solution NH₄SO₄ at 40 DAS were the next best treatments. This may also be because of less crop-weed competition at the early growth stages of crop under these treatments, which resulted in higher seed yield. Increase in seed yield of mustard with application of pendimethalin at the rate of 1.0 kg/ha pre-emergence was also reported by [3, 5,8].

Economics of treatments

Gross monetary return is directly related to the value of produce in the market. Among the different weed control treatments, the highest gross income was under pendimethalin at the rate of 1.0 kg/ha pre-emergence (Rs. 66660/ha) followed by

trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation (Rs. 64230/ha), neem cake at the rate of 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS (Rs. 63180/ha) and trifluralin at the rate of 1.5 kg/ha pre-plant incorporation (Rs. 60750/ha) due to maximum seed yield, whereas lowest gross monetary return was recorded under the treatment neem cake at the rate of 200 kg/ha in furrow followed by imazethapyr at the rate of 30 g/ha at 20DAS (Rs. 49050/ha). The lowest seed yield under neem cake at the rate of 200 kg/ha in furrow followed by imazethapyr at the rate of 30 g/ha at 20DAS was the reason for the lowest gross monetary returns. In respect of net income per hectare, pendimethalin at the rate of 1.0

kg/ha pre-emergence recorded highest net profit of Rs. 51355/ha followed by trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation, neem cake at the rate of 200 kg/ha in furrow and pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS and trifluralin at the rate of 1.5 kg/ha pre-plant incorporation of Rs. 48428, Rs. 46297 and Rs. 45248/ha, respectively. In case of B: C ratio, pendimethalin at the rate of 1.0 kg/ha pre-emergence and trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation recorded higher B: C ratio (Rs. 4.36 and 4.07, respectively) as compared to rest of the treatments [Table-3] [5, 7] has reported similar findings.

Table-2 Yield attributes and seed yield as influence by various weed management treatments

Treatments	No. of primary branches/plant	No. of secondary branches /plant	No. of Siliquae/plant	Length of siliqua (cm)	No. of Seeds/siliqua	Test weight (g)	Seed yield (q/ha)
T ₁ - Pendimethalin at the rate of 1.0kg/ha pre-emergence	5.34	8.73	277.53	3.95	15.16	4.760	22.22
T ₂ - Glyphosate at the rate of 50g/ha alone after emergence of <i>Orobanche</i>	4.70	7.86	217.23	3.68	12.93	4.180	18.52
T ₃ - Trifluralin at the rate of 1.5kg/ha pre-plant incorporation	5.24	8.36	240.50	3.84	13.83	4.486	20.25
T ₄ - Glyphosate at the rate of 25g/ha alone with 1% solution NH ₄ SO ₄ at 40 DAS	4.89	8.03	229.70	3.75	13.16	4.296	18.63
T ₅ - Neem cake at the rate of 200 kg/ha in furrow and Pendimethalin at the rate of 0.5kg/ha pre-emergence followed by 1 hoeing at 40 DAS	5.13	8.56	246.76	3.86	13.90	4.523	21.06
T ₆ - Neem cake at the rate of 200kg/ha in furrow followed by Imazethapyr at the rate of 30g/ha at 20DAS	3.46	6.51	180.66	2.99	10.73	3.910	16.36
T ₇ - Trifluralin at the rate of 1.5kg/ha +neem oil 1% pre-plant incorporation	5.33	8.66	252.86	3.87	14.70	4.600	21.41
T ₈ - Soybean oil 2 drops / shoot after emergence of <i>Orobanche</i>	4.56	6.86	195.73	3.58	12.76	4.016	17.48
T ₉ - Application of 25% extra dose of phosphorus and phosphorus solubilizing bacteria	4.63	6.86	190.86	3.56	12.73	3.956	17.13
T ₁₀ - <i>Trichoderma viride</i> at the rate of 2.5kg/ha as basal application	4.56	7.20	201.13	3.58	12.90	4.056	18.40
T ₁₁ - Farmers practice 1 hoeing at 40DAS	4.70	7.26	207.86	3.61	12.90	4.100	18.52
T ₁₂ - Weedy check	4.13	6.50	171.06	3.46	12.10	3.820	16.44
S.E.m±	0.148	0.276	2.249	0.057	0.56	0.068	0.45
C.D. (P= 0.05)	0.435	0.809	6.597	0.170	1.66	0.202	1.33

Table-3 Economics of treatments as influence by various weed management treatments

Treatments	Cost of cultivation (Rs./ha)	Treatment cost (Rs./ha)	Total cost of cultivation (Rs./ha)	Gross income (x10 ³ Rs./ha)	Net income (x10 ³ Rs./ha)	B:C ratio
T ₁ - Pendimethalin at the rate of 1.0 kg/ha pre-emergence	13940	1365	15305	66.66	51.36	4.36
T ₂ - Glyphosate at the rate of 50 g/ha alone after emergence of <i>Orobanche</i>	13940	34	13974	55.53	41.56	3.98
T ₃ - Trifluralin at the rate of 1.5 kg/ha pre-plant incorporation	13940	1562	15502	60.75	45.25	3.92
T ₄ - Glyphosate at the rate of 25 g/ha alone with 1% solution NH ₄ SO ₄ at 40 DAS	13940	317	14257	55.89	41.63	3.93
T ₅ - Neem cake at the rate of 200 kg/ha in furrow and Pendimethalin at the rate of 0.5 kg/ha pre-emergence followed by 1 hoeing at 40 DAS	13940	2943	16883	63.18	46.30	3.75
T ₆ - Neem cake at the rate of 200 kg/ha in furrow followed by Imazethapyr at the rate of 30g/ha at 20DAS	13940	2505	16445	49.05	32.61	2.99
T ₇ - Trifluralin at the rate of 1.5 kg/ha +neem oil 1% pre-plant incorporation	13940	1862	15802	64.23	48.42	4.07
T ₈ - Soybean oil 2 drops / shoot after emergence of <i>Orobanche</i>	13940	150	14090	52.41	38.32	3.72
T ₉ - Application of 25% extra dose of phosphorus and phosphorus solubilizing bacteria	13940	380	14320	51.36	37.04	3.59
T ₁₀ - <i>Trichoderma viride</i> at the rate of 2.5 kg/ha as basal application	13940	500	14440	55.20	40.76	3.83
T ₁₁ - Farmers practice 1 hoeing at 40DAS	13940	160	14100	55.53	41.43	3.94
T ₁₂ - Weedy check	13940	00	13940	49.29	35.35	3.54

Conclusion

From the above results it can be concluded that for effective control of *orobanche* and other associated weeds, application of pendimethalin at the rate of 1.0 kg/ha pre-emergence was the best cost effective option which was followed by trifluralin at the rate of 1.5 kg/ha + neem oil 1% pre-plant incorporation for higher weed control efficiency and yield enhancement in Indian mustard.

Conflict of Interest: None declared

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