

Management of *Orobanche* in mustard crop

through glyphosate application

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Parasitization of Orobanche in broad-leaved crops, especially those belonging to brassicaceae and solanaceae family, is a serious problem globally. Orobanche, a non-chlorophyllous root parasitic weed, causes serious damage to specific host crops in the Mediterranean region, Europe, Africa, Australia and Americas. Despite continuous and extensive efforts by the breeders and crop protection scientists, no effective solutions are available for its management, the only possible approach being avoiding growing of host crops and replacing with suitable trap crops which are not parasitized by this troublesome weed. However, this is not always possible due to economic and other operational considerations.

Key words: Glyphosate application, Management, Mustard, *Orobanche*

IN India, *Orobanche* is a serious weed for mustard, tomato, brinjal, tobacco, potato and other commercial crops in some regions throughout the country. This weed is location-specific and also its infestation is highly unpredictable. It causes near complete failure in some crops/regions, depending on the severity of infestation, soil fertility, moisture availability, environmental factors and crop competitiveness. Some farmers have abandoned cultivation of *Orobanche* host crops due to want to effective measures for its management. In the semi-arid tracts of north-western India including Haryana, northern Rajasthan, northern-eastern Madhya Pradesh, western Uttar Pradesh and also in some areas of Punjab, mustard is a very important cash crop because of its suitability in light-textured soils, less moisture and nutritional requirement, effective management of pests and diseases, better climate and market availability. No other crop including chickpea, lentil, barley, wheat etc. match the performance of mustard during winter. However, the increasing infestations of *Orobanche* over the years have seriously



Fig. 1. Parasitic association of *Orobanche* with mustard roots

impacted mustard cultivation and threatened the livelihood security of the farmers of the region.

INNOVATION

Intensive research was undertaken under the All India Coordinated Research Project on Weed Management at different centers for more than a decade using farmer participatory approaches. Herbicide screenings trials were undertaken using chemicals at different rates, time and method of application. After some initial positive response on tolerance of mustard plants and significant reduction in *Orobanche* shoots with the application of glyphosate, research work was straightened to standardize the dose,

timing, and number of sprays, and also associated agronomic practices. It was realized that sequential application of glyphosate at low doses at specific time intervals provided excellent control of *Orobanche* leading to improvements in mustard seed production. A slight suppression in crop growth due to glyphosate application was only temporary, and the plants recovered after about a week following irrigation. The tolerance of mustard plants to glyphosate was attributed to its degradation to non-toxic metabolites. Absorption of glyphosate by the mustard foliage and its translocation to the roots inhibited synthesis of EPSP synthase, leading to production of aromatic

Table 1. Comparative performance of mustard under glyphosate application *vis-à-vis* farmers' practice for *Orobanche* management in large-scale multi-locational trials in Haryana

Years	No. of trials	Area covered (ha)	<i>Orobanche</i> control (%)	Seed yield (tonne/ha)		Increase in yield (%)
				Treated*	Farmer's practice*	
2010-11	12	5	82 (70-95)	1.72 (1.40-2.10)	1.4915.4 (1.20-1.95)	
2011-12	24	20	79 (65-90)	1.59 (1.20-2.20)	1.37 (0.90-1.80)	16.1
2012-13	86	156	72 (55-90)	1.75 (1.25-2.25)	1.54 (1.00-1.95)	13.6
2013-14	35	82	63 (40-90)	1.65 (1.25-2.40)	1.44 (1.10-2.10)	14.6
2014-15	119	436	83 (62-95)	1.82 (1.16-2.24)	1.56 (0.98-2.10)	16.7
2015-16	185	597	81 (70-98)	1.75 (1.45-2.40)	1.26 (0.82-1.60)	38.9
2016-17	225	650	75 (65-80)	1.95 (1.65-2.40)	1.52 (0.72-1.46)	28.3
Total/mean	686	1,946	76.4	1.75	1.45	20.7

*Application of glyphosate 25 g/ha at 30 days after sowing (DAS) and 50 g/ha at 55-60 DAS (2 sprays)

**One hoeing at 25-30 DAS

Figures in parentheses indicate range of mustard seed yield in different trials.



Fig. 2. Spraying of 25 g/ha glyphosate at 30 Days after sowing



Fig. 3. Spraying of 50 g/ha glyphosate at 55 Days after sowing

amino-acids and non-parasitization of the host plant with *Orobanche*.

Technology

The technology developed at the AICRP-Weed Management centre at CCS Haryana Agricultural University, Hisar involved application of glyphosate @ 25 g/ha at 30 days of sowing, followed by its second application @ 50 g/ha between 50 and 55 days of sowing when the mustard plants are in the active growing stage and do not experience any stress due to deficit soil moisture. This provides 70 to 80% reduction in *Orobanche* shoots emerging from the soil, and 20 to 25% increase in seed yield of mustard. The technology was validated through a large number of multi-locational trials in different districts of Hisar, Bhiwani and Mahendergarh between 2010 and

2017. Results of over 686 demonstrations covering 1,946 ha of land revealed 40-98% reduction (mean of 76%) in *Orobanche* infestation and 20.7% improvement in seed yield of mustard over the conventional farmers practice of one-hand weeding at 25 to 30 days of growth. A similar response was obtained on the farmers' fields in the Gwalior district of Madhya Pradesh. This technology has now spread to the most *Orobanche*-infested mustard-growing areas of Haryana and the farmers are fully convinced of the benefits of this low-cost technology.

Continuous demonstration and adoption of this technology over the last 5-6 years in some farmers' fields has led to progressive decrease in *Orobanche* infestation and thus the weed seed bank, resulting in virtual complete eradication of this weed in



Fig. 4. Examining *Orobanche* infestation.

some locations. During the visit to several villages including Chikan was (Hisar), and Ganghala, Bidhwan and Gignau (Bhiwani), the farmers opined that mustard crop saved through this technology, which otherwise was on the verge of collapse about a decade back in the severely *Orobanche*-infested areas.

Precautions

Glyphosate is a non-selective herbicide and kills all the green vegetation over which it is applied. Its application is, therefore, recommended in non-crop lands and also in the cropped fields before sowing of the crop as in zero-tillage conditions. The dose, timing and number of sprays of glyphosate optimized for mustard for *Orobanche* control are very specific, and therefore must be precisely followed with utmost care. It is essential to follow this technology under some expert guidance initially for 1-2 years, and develop confidence as any wrong measure, such as higher dose or repetitive application can cause adverse irreparable damage to the crop plants as well.

SUMMARY

To avoid any possible toxic or suppressive effect of glyphosate even at the recommended low dose on mustard plants, it is advisable to ensure that the crop does not suffer from moisture stress at the herbicide spray. Therefore, irrigation may be applied 2-3 days prior to or 1-2 days after the herbicide application.

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