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## Chemical management of *Orobanche* in Toria (*Brassica campestris* L. var. Toria)

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### Abstract

*Orobanche*, a parasitic weed, poses a major threat to Toria (*Brassica rapa*), a vital cash crop for farmers in Assam, particularly in the Nagaon district. *Orobanche* infestation severely affects crop yield, often leading to crop failure. This study, conducted over three winter seasons (2020–2022) on farmers' fields in Nagaon, aimed to evaluate glyphosate's effectiveness in controlling *Orobanche* and enhancing Toria yield. A treatment protocol was developed based on previous successful applications in mustard, with glyphosate applied at 25 g/ha at 30 days after sowing (DAS) and 50 g/ha between 50–55 DAS. Results demonstrated a significant reduction in *Orobanche* shoots (up to 90%) and an increase in Toria yield by 50-60%. Prior studies (Punia *et al.*, 2018) supported these findings, indicating that sequential, low-dose applications effectively reduce *Orobanche* by targeting the EPSP synthase pathway in the parasite. This selective inhibition allows mustard plants to degrade glyphosate into non-toxic metabolites, minimizing crop impact. This research provides a promising, field-tested approach to managing *Orobanche* in Toria, helping farmers enhance crop productivity and protect against this challenging weed.

**Keywords:** *Orobanche*, glyphosate, toria, weed management

### Introduction

*Orobanche* is a serious weed affecting various crops across the country, particularly rapeseed, mustard, tomato, brinjal, and other solanaceous crops. Its impact on yield can be devastating, often leading to near-complete crop failure in some areas. This depends on factors such as infestation severity, soil fertility, moisture availability, environmental conditions, and the competitiveness of the crop. Toria (a type of mustard) is an important cash crop in Assam due to its adaptability to the local soils, compatibility with rice-based cropping systems, and minimal moisture and nutrient requirements. It is also relatively low-maintenance in terms of pest and disease management. In Nagaon district, Toria performs exceptionally well during the winter season, making it a preferred crop for farmers. However, *Orobanche* infestations have been increasing over the years, significantly affecting crop yields as reported by many farmers.

*Orobanche* is an annual, highly branched, achlorophyllous, and harmful root parasite that relies entirely on host plants for survival, reproducing solely through seeds (Punia *et al.*, 2012) [2]. Upon germination, its seed-dependent on host plant signals-develops a germ tube or radicle, which elongates chemotropically to form a haustorium. This haustorium attaches firmly to the host plant's vascular system, turning the parasite into a powerful metabolic sink, often referred to as a "super-sink." This enables it to effectively compete with the host plant for water and essential nutrients, leading to moisture and nutrient starvation, plant stress, stunted growth, and a notable reduction in crop yield and quality in infested fields (Punia *et al.*, 2012) [2]. The level of damage from *Orobanche* varies based on infestation intensity, environmental factors, soil fertility, and the competitiveness of the host crop. In severe cases, it can lead to complete crop failure, forcing some farmers to abandon mustard cultivation entirely due to this parasitic weed. The study was conducted over three consecutive winter seasons (2020, 2021, and 2022) at various farmer-managed field locations in the Nagaon district of Assam. The primary objective was to evaluate the tolerance of mustard plants to *Orobanche* infestations and to assess the efficacy of glyphosate applications in reducing *Orobanche* shoots.

This research was motivated by previous positive findings indicating that glyphosate could reduce *Orobanche* infestations and improve mustard crop resilience. Based on those findings, a glyphosate dose for Toria (a type of mustard) was formulated from prior experiments on mustard crops.

### Experimental Design and Treatments

The experiment was designed as a field trial with glyphosate applications planned at specific stages of crop growth to maximize efficacy and minimize crop stress. The application of glyphosate was divided into two stages to ensure optimal control of *Orobanche* without harming the Toria plants.

#### 1. First Application of Glyphosate

- **Timing:** The first application of glyphosate was administered 30 days after sowing (DAS) of the Toria crop.
- **Dosage:** Glyphosate was applied at a rate of 25 g/ha.
- **Objective:** This initial application aimed to target early *Orobanche* growth, preventing it from establishing a significant presence in the crop. At 30 DAS, Toria plants are in the early vegetative stage, which is critical for preventing *Orobanche* attachment and minimizing parasitic competition for resources.

#### 2. Second Application of Glyphosate

- **Timing:** The second application was scheduled between 50 and 55 DAS, during the active growth stage of the Toria crop.
- **Dosage:** Glyphosate was applied at an increased rate of 50 g/ha.
- **Objective:** The purpose of the second application was to suppress any *Orobanche* shoots that may have survived or emerged after the first application. At this stage, Toria plants are actively growing and resilient, with sufficient soil moisture, which minimizes stress on the plants and supports herbicide efficacy.

### Results and Discussion

Based on the data presented in Table 1, glyphosate application was shown to reduce *Orobanche* infestation by up to 90%, while increasing Toria crop yield by 50-60%. These results align with findings by Punia *et al.* (2018) <sup>[1]</sup>, who reported that sequential, low-dose glyphosate applications at specific intervals provided effective *Orobanche* control and significantly enhanced mustard seed production.

Punia and colleagues attributed this tolerance in mustard plants to glyphosate's degradation into non-toxic metabolites. Glyphosate, when absorbed by mustard foliage, is translocated to the roots, where it inhibits EPSP synthase synthesis. This inhibition disrupts the production of aromatic amino acids, effectively preventing *Orobanche* parasitization of host plants. This mechanism allows glyphosate to target *Orobanche* without harming the mustard crop, demonstrating its potential as an effective treatment strategy.

### Conclusion

Based on the above trials conducted in farmer's field, it can be concluded that foliar application of glyphosate at 25 g/ha at 30 DAS followed by 50 g/ha at 55 DAS would be very helpful in reducing the *Orobanche* infestation by reducing the further increase in weed seed bank without any crop suppression and also residual effect on any succeeding crop. The results of our present study very convincingly show that glyphosate, if used as recommended, may prove to be very effective in significantly reducing parasitic weed *Orobanche* infestation, and increasing yield of toria grown in weed-infested fields. However, the dosage of glyphosate should be kept in concern as it is required in trace amounts.

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**Table 1:** Performance of Toria under glyphosate application vs farmers' practice for *Orobanche* management in farmer's field

| Year    | Trials conducted | <i>Orobanche</i> density control | Toria yield (t/ha) |       | Increase in yield (%) |
|---------|------------------|----------------------------------|--------------------|-------|-----------------------|
|         |                  |                                  | Demo               | Check |                       |
| 2020-21 | 9                | 83.50                            | 1.57               | 0.98  | 60.20                 |
| 2021-22 | 13               | 79.10                            | 1.33               | 0.79  | 68.35                 |
| 2022-23 | 12               | 92.33                            | 1.72               | 1.11  | 54.95                 |
| Mean    |                  | 84.98                            | 1.54               | 0.96  | 61.17                 |