International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Selectivity and efficacy of Pulsar 40 (imazamox) applied at different doses in sorghum (*Sorghum bicolor* L.) under field conditions

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International Journal of Science and Research Archive, 2025, 17(03), 1266-1269

Publication history: Received 05 November 2025; revised on 18 December 2025; accepted on 20 December 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.17.3.3304

Abstract

Weed control is a critical factor for successful sorghum production, particularly during the early stages of crop development, when competition with weeds can significantly reduce growth and productivity. The present study aimed to evaluate the selectivity and biological efficacy of the herbicide Pulsar 40 (active ingredient: imazamox), applied at different doses, in sorghum (*Sorghum bicolor* L.), hybrid Sentinel IG. Field experiments were conducted during three consecutive growing seasons (2023–2025) under the agro-climatic conditions of South Central Bulgaria. Herbicide selectivity to the crop was assessed visually using the EWRS scale at 7, 14 and 21 days after treatment (DAT). Biological efficacy was evaluated against major annual and perennial weed species present in the experimental field. The results showed high selectivity of Pulsar 40 to sorghum at all tested doses, with only transient phytotoxic symptoms observed at the highest dose during 2023, which disappeared completely by 21 DAT. Herbicide efficacy varied among weed species and doses, with high control of annual broadleaf and grass weeds, while perennial species such as Sorghum halepense and Convolvulus arvensis were only partially controlled. The study confirms that Pulsar 40, when applied at recommended and moderately increased doses, provides effective weed control with good crop selectivity in sorghum.

Keywords: Sorghum; Imazamox; Pulsar 40; Herbicide selectivity; Weed control

1. Introduction

Sorghum (*Sorghum bicolor* L.) is one of the most drought-tolerant cereal crops and is increasingly important in sustainable agricultural systems, particularly in regions affected by climate variability and water scarcity [1,2]. Despite its adaptability, sorghum is highly sensitive to weed competition during the early stages of development, when slow initial growth allows weeds to dominate and utilize available resources more efficiently than the crop [3].

Chemical weed control remains a key component of sorghum production systems; however, the choice of herbicide must ensure a high degree of selectivity, as sorghum is known to be sensitive to several post-emergence active ingredients [4]. Imazamox is an acetolactate synthase (ALS)-inhibiting herbicide with broad-spectrum activity against annual broadleaf and grass weeds and is commonly used in imidazolinone-tolerant cropping systems [5,7].

Previous studies have demonstrated that herbicide efficacy and crop selectivity depend on application dose, environmental conditions and weed species composition [6,8]. In addition, perennial weeds often show reduced sensitivity to ALS inhibitors, requiring careful management strategies [9]. The objective of this study was to evaluate the selectivity and biological efficacy of Pulsar 40 (imazamox) applied at different doses in sorghum under field conditions over a three-year period.

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2. Materials and Methods

2.1. Experimental site and design

Field experiments were conducted during the growing seasons of 2023, 2024 and 2025 at the experimental field of the Agricultural University of Plovdiv, Bulgaria. The soil was classified as alluvial-meadow soil with moderate fertility. The experiment was arranged in a randomized block design with four replications.

2.2. Plant material and treatments

The imazamox-tolerant sorghum hybrid **Sentinel IG** was used in all experimental years. The herbicide Pulsar 40 (imazamox 40 g L^{-1}) was applied post-emergence at the 3–4 leaf stage of sorghum at the following doses:

- **A3** – 120 ml da^{-1} (recommended dose)
- **A4** – 240 ml da^{-1}
- **A5** – 480 ml da^{-1}

An untreated control (**A1**) was included for comparison.

2.3. Selectivity assessment

Crop selectivity was assessed visually at 7, 14 and 21 days after treatment (DAT) using the EWRS scale, where 1 indicates no visible injury and 9 indicates complete destruction of the crop.

2.4. Weed assessment and herbicide efficacy

Weed species composition and density were recorded prior to herbicide application. Biological efficacy of Pulsar 40 was assessed at 21 DAT using the EWRS efficacy scale and expressed as percentage control relative to the untreated control.

3. Results and Discussion

3.1. Selectivity of Pulsar 40 to sorghum

Across all three experimental years, Pulsar 40 exhibited high selectivity to sorghum (Tables 1–3). In 2023, slight and transient phytotoxic symptoms were observed at the highest dose (480 ml da^{-1}) at 7 DAT, expressed as mild chlorosis and growth retardation. These symptoms diminished by 14 DAT and were completely absent by 21 DAT. In 2024 and 2025, no visible phytotoxicity was observed at any dose.

Table 1 Selectivity of Pulsar 40 to sorghum (EWRS scale), 2023

Variant	7 DAT	14 DAT	21 DAT
A1 – Control	1	1	1
A3 – 120 ml da^{-1}	1	1	1
A4 – 240 ml da^{-1}	2	1	1
A5 – 480 ml da^{-1}	3	2	1

Table 2 Selectivity of Pulsar 40 to sorghum (EWRS scale), 2024

Variant	7 DAT	14 DAT	21 DAT
A1 – Control	1	1	1
A3 – 120 ml da^{-1}	1	1	1
A4 – 240 ml da^{-1}	1	1	1
A5 – 480 ml da^{-1}	1	1	1

Table 3 Selectivity of Pulsar 40 to sorghum (EWRS scale), 2025

Variant	7 DAT	14 DAT	21 DAT
A1 – Control	1	1	1
A3 – 120 ml da^{-1}	1	1	1
A4 – 240 ml da^{-1}	1	1	1
A5 – 480 ml da^{-1}	1	1	1

These results confirm that Pulsar 40 is highly selective to sorghum, even at increased doses, which is consistent with previous reports on ALS-tolerant crops [4,7]

3.2. Weed species composition and density

The experimental field was infested with a mixed weed flora dominated by annual broadleaf and grass species. Weed density varied between years due to climatic conditions, but annual species consistently prevailed.

Table 4 Weed species density before treatment, 2025 (plants m^{-2})

Species	Density
Amaranthus retroflexus	22
Chenopodium album	98
Portulaca oleracea	42
Setaria viridis	78
Sorghum halepense	6
Convolvulus arvensis	7

3.3. Biological efficacy of Pulsar 40

Pulsar 40 demonstrated high efficacy against most annual weed species, with control levels increasing with herbicide dose (Tables 5 and 6). Annual species such as *Amaranthus retroflexus* and *Setaria viridis* were effectively controlled, while *Chenopodium album* showed moderate, dose-dependent sensitivity. Perennial weeds (*Sorghum halepense* and *Convolvulus arvensis*) were only partially controlled, even at the highest dose, which aligns with literature data on ALS inhibitors [5,9].

Table 5 Biological efficacy of Pulsar 40, 2023 (% control, 21 DAT)

Dose	*A. retroflexus*	*C. album*	*P. oleracea*	*S. viridis*	*S. halepense*	*C. arvensis*
120 ml da^{-1}	90	65	40	80	15	70
240 ml da^{-1}	90	65	50	90	20	80
480 ml da^{-1}	90	75	50	90	30	85

Table 6 Biological efficacy of Pulsar 40, 2024–2025 (% control, 21 DAT)

Dose	*A. retroflexus*	*C. album*	*P. oleracea*	*S. viridis*	*S. halepense*	*C. arvensis*
120 ml da^{-1}	80	55	10–20	100	10	10
240 ml da^{-1}	85	65	15–30	100	20	15
480 ml da^{-1}	90	75	25–40	100	25	20

4. Conclusion

The three-year field study demonstrates that Pulsar 40 (imazamox) is a selective and effective post-emergence herbicide for sorghum. At recommended and moderately increased doses, it provides high control of major annual weed species with minimal and transient crop injury. Perennial weeds remain partially controlled, indicating the need for integrated weed management approaches. Overall, Pulsar 40 represents a reliable chemical tool for weed control in imazamox-tolerant sorghum production systems.

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