



# International Journal of Research in Agronomy

E-ISSN: 2618-0618  
P-ISSN: 2618-060X  
© Agronomy  
NAAS Rating (2026): 5.20  
[www.agronomyjournals.com](http://www.agronomyjournals.com)  
2026; 9(3): 339-342  
Received: 12-01-2026  
Accepted: 15-02-2026

**Khomeshwar**  
Khomeshwar, PG Scholar, D.K.S.  
College of Agriculture & Research  
Station, Bhatapara, Chhattisgarh,  
India

**Panch Ram Mirjha**  
Dr. Panch Ram Mirjha, Assistant  
Professor (Agronomy), D.K.S.  
College of Agriculture & Research  
Station, Bhatapara, Chhattisgarh,  
India

**Swati Thakur**  
Swati Thakur, Subject Matter  
Specialist (Agronomy), Krishi  
Vigyan Kendra Bhatapara,  
Bhatapara, Chhattisgarh, India

**Corresponding Author:**  
**Panch Ram Mirjha**  
Dr. Panch Ram Mirjha, Assistant  
Professor (Agronomy), D.K.S.  
College of Agriculture & Research  
Station, Bhatapara, Chhattisgarh,  
India

## Evaluation of herbicide efficacy through weed indices in transplanted finger millet (*Eleusine coracana* L.)

**Khomeshwar, Panch Ram Mirjha and Swati Thakur**

**DOI:** <https://www.doi.org/10.33545/2618060X.2026.v9.i3e.5149>

### Abstract

A field experiment was conducted during the *kharif* season of 2023 at the Instructional Farm, D.K.S. College of Agriculture and Research Station, Bhatapara, Chhattisgarh. The experiment was laid out in a randomized block design with eight treatments and three replications. The experimental field was infested with a diverse weed flora comprising grasses, sedges and broad-leaved weeds. Weed control efficiency (WCE) and weed index (WI) were significantly influenced by different weed management practices. Among the treatments, sequential application of Pyrazosulfuron ethyl 15 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam methyl 20 g ha<sup>-1</sup> at 25 DAT recorded the highest WCE (62.6, 61.2 and 79.9% at 30, 60 and 90 DAT, respectively) and the lowest weed index (4.1%), which was at par with the weed-free treatment. Other sequential herbicide applications, viz., Pretilachlor 500 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam Methyl 20 g ha<sup>-1</sup> at 25 DAT and Bensulfuron ethyl + Pretilachlor (pre-mix) 60 + 600 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam methyl 20 g ha<sup>-1</sup> at 25 DAT, also recorded higher WCE and lower weed index compared to sole herbicide applications. The weedy check recorded the highest weed index (45.1%), indicating substantial yield loss due to severe crop-weed competition.

**Keywords:** Finger millet (*Eleusine coracana*), transplanted, weed control efficiency, weed index

### Introduction

Finger millet (*Eleusine coracana* L.), commonly known as ragi, is an important climate-resilient small millet widely cultivated in semi-arid and rainfed regions of Asia and Africa. It plays a vital role in ensuring food and nutritional security, particularly among resource-poor communities, owing to its rich nutritional composition, including calcium, iron, dietary fiber, and essential amino acids (Devi *et al.*, 2014) [3]. In India, it ranks third among millets after sorghum and pearl millet, with an average productivity of about 1524 kg ha<sup>-1</sup> (Anonymous, 2025) [2].

In Chhattisgarh, millets are cultivated over about 1.41 lakh hectares, accounting for nearly 6% of the total cultivated area of the state. The major millets grown include sorghum, pearl millet, finger millet and foxtail millet. Among these, finger millet occupies an area of 43,640 ha with a production of 39,407 tonnes and an average productivity of 903 kg ha<sup>-1</sup> (Anonymous, 2023) [1]. However, finger millet occupies a relatively small share of the cultivated area in the state compared to major millet-growing regions of India. Its productivity is also lower than the national average, primarily due to cultivation under rainfed conditions, marginal soils and sub-optimal crop management practices. Nevertheless, finger millet holds significant potential for area expansion and productivity enhancement under suitable agro-climatic conditions, particularly with the adoption of improved production technologies and ongoing government initiatives promoting millet cultivation.

Despite its adaptability, the productivity of finger millet remains low, primarily due to severe weed infestation. Weeds compete aggressively with finger millet for nutrients, moisture, light, and space, particularly during the early growth stages when the crop is a poor competitor. The critical period of crop-weed competition (25-40 days after sowing or transplanting) is crucial, and uncontrolled weed growth during this stage can cause yield losses of up to 61%, depending on crop cultivar, weed intensity, duration of infestation, and management practices (Mishra *et al.*, 2018; Dubey and Mishra, 2023) [9, 4]. Additionally, weeds increase the cost of cultivation, reduce produce quality, and serve as hosts for various pests and pathogens. Although manual

weeding is effective, it is labour-intensive and often impractical during the *kharif* season. Therefore, herbicide-based weed management has emerged as an efficient and economical alternative for controlling diverse weed flora. However, information on the comparative efficacy and sequential application of herbicides in transplanted finger millet under *Vertisol* conditions of Chhattisgarh remains limited.

## Materials and Methods

A field experiment was conducted during the *kharif* season of 2023 at the Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Bhatapara, Chhattisgarh, India (21.72° N latitude and 81.98° E longitude) at an altitude of 293.82 m above mean sea level. The experimental soil was clayey (*Vertisols*) with neutral reaction (pH 7.6), low in available nitrogen (117.6 kg ha<sup>-1</sup>), medium in available phosphorus (20.5 kg ha<sup>-1</sup>), and high in available potassium (382.0 kg ha<sup>-1</sup>). The experiment was laid out in a randomized block design with eight treatments and three replications. The treatments comprised Weedy check (T<sub>1</sub>), Pretilachlor 500 g ha<sup>-1</sup> 3 DAT (T<sub>2</sub>), Bensulfuron methyl + Pretilachlor (pre mix) 60+600 g ha<sup>-1</sup> 3 DAT (T<sub>3</sub>), Pyrazosulfuron ethyl 15 g ha<sup>-1</sup> 3 DAT (T<sub>4</sub>), Pretilachlor 500 g ha<sup>-1</sup> 3DAT *fb* Penoxsulam methyl 20g ha<sup>-1</sup> 25 DAT (T<sub>5</sub>), Bensulfuron ethyl + Pretilachlor (pre mix) 60+ 600 g ha<sup>-1</sup> 3DAT *fb* Penoxsulam methyl 20 g ha<sup>-1</sup> 25 DAT (T<sub>6</sub>), Pyrazosulfuron ethyl 15 g ha<sup>-1</sup> 3DAT (PE) *fb* Penoxsulam methyl 20 g ha<sup>-1</sup> 25 DAT (T<sub>7</sub>) and Weed free (T<sub>8</sub>).

Finger millet variety 'Indira Ragi 1' was transplanted using 25-day-old seedlings at a spacing of 30 cm × 10 cm, maintaining 2-3 seedlings per hill. The crop was fertilized with the recommended dose of 60 kg N, 40 kg P<sub>2</sub>O<sub>5</sub> and 40 kg K<sub>2</sub>O ha<sup>-1</sup>. The full doses of phosphorus and potassium along with half of nitrogen were applied as basal, while the remaining nitrogen was top-dressed in two equal splits at appropriate growth stages. Pre-emergence herbicides were applied at 3 days after transplanting (DAT), while Penoxsulam methyl was applied as post-emergence at 25 DAT using a knapsack sprayer fitted with a flat-fan nozzle. Standard agronomic practices were followed throughout the crop growth period. Weed-free plots were maintained by hand weeding, while irrigation was provided at critical stages as needed. Weed observations were recorded at 30, 60 and 90 DAT using a 1 m<sup>2</sup> quadrat placed randomly in each plot. Weed density and dry weight were recorded separately for grasses, sedges and broad-leaved weeds. Weed control efficiency (WCE) was computed to assess the effectiveness of treatments in reducing weed biomass relative to the untreated (weedy) control, following the method suggested by Mani *et al.* (1973) [8]:

$$WCE(\%) = \frac{DWC - DWT}{DWC} \times 100$$

where, DWC is the dry weight of weeds in the control plot and DWT is the dry weight of weeds in the treated plot.

Weed index (WI) was calculated to determine the reduction in crop yield due to weed competition in comparison with the weed-free treatment, as suggested by Gill and Kumar (1969) [5]:

$$WI(\%) = \frac{x - y}{x} \times 100$$

where, x represents the yield from the weed-free plot and y represents the yield from the treated plot.

The data were subjected to statistical analysis using analysis of

variance (ANOVA) for a randomized block design, and treatment means were compared at the 5% level of significance following the procedure described by Panse and Sukhatme (1967) [10].

## Results and Discussion

### Weed flora

The experimental field was infested with a diverse spectrum of weed flora comprising grasses, sedges and broad-leaved weeds (Table 1). Among the narrow-leaved weeds, *Dactyloctenium aegyptium*, *Chloris barbata*, *Cynodon dactylon*, *Digitaria sanguinalis* and *Echinochloa colona* were the predominant species, all belonging to the family Poaceae. Sedges were represented by *Cyperus iria* and *Cyperus rotundus*, indicating their adaptability under moist soil conditions. The broad-leaved weeds observed in the experimental field included *Ammannia baccifera*, *Eclipta alba*, *Ipomoea pestigridis*, *Phyllanthus niruri*, *Rhynchosia minima*, *Trianthema portulacastrum* and *Tridax procumbens*, belonging to diverse families such as Lythraceae, Compositae, Convolvulaceae, Euphorbiaceae, Fabaceae and Aizoaceae.

The predominance of grassy weeds during the early stages of crop growth might be attributed to their rapid germination, vigorous growth and efficient utilization of available resources, enabling them to outcompete the crop during the initial growth period. In contrast, sedges and broad-leaved weeds appeared more prominently at later stages, thereby extending the period of crop-weed competition. The presence of such heterogeneous weed flora under *Vertisol* conditions highlights the complexity of weed management in transplanted finger millet and emphasizes the need for broad-spectrum and sequential herbicide application for effective control.

These findings are in close conformity with earlier reports of mixed weed flora dominated by grasses, sedges and broad-leaved weeds in finger millet, as reported by Kumara *et al.* (2007) [7], Pradhan and Singh (2009) [12] and Pradhan *et al.* (2010) [11], thereby reinforcing the necessity of effective weed management approaches in such cropping systems.

### Weed control efficiency

Weed control efficiency was significantly influenced by different weed management practices at all stages of crop growth (30, 60 and 90 DAT) (Table 2). At 30 DAT, the sequential application of Pyrazosulfuron ethyl @ 15 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam methyl @ 20 g ha<sup>-1</sup> at 25 DAT (T<sub>7</sub>) recorded significantly higher WCE (62.6%) over all other treatments. The next best treatments were Pretilachlor @ 500 g ha<sup>-1</sup> at 3 DAT *fb* Penoxsulam methyl (T<sub>5</sub>) (43.6%) and Bensulfuron methyl + Pretilachlor (pre-mix) *fb* Penoxsulam methyl (T<sub>6</sub>) (40.6%).

At 60 DAT, application of Pyrazosulfuron ethyl @ 15 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam methyl @ 20 g ha<sup>-1</sup> at 25 DAT (T<sub>7</sub>) again recorded significantly higher WCE (61.2%) compared to other treatments; however, it was found to be statistically at par with Pretilachlor *fb* Penoxsulam methyl (T<sub>5</sub>) 56.6%), Pyrazosulfuron ethyl 15 g ha<sup>-1</sup> 3 DAT (T<sub>4</sub>) (49.6) and Bensulfuron methyl + Pretilachlor *fb* Penoxsulam methyl (T<sub>6</sub>) (48.9%). Treatments pretilachlor @ 500 g ha<sup>-1</sup> at 3 DAT (T<sub>2</sub>) and Bensulfuron methyl + Pretilachlor (pre-mix) @ 60 + 600 g ha<sup>-1</sup> at 3 DAT (T<sub>3</sub>) recorded comparatively lower WCE and were at par with each other. At 90 DAT, significantly higher WCE (79.9%) was recorded under Pyrazosulfuron ethyl *fb* Penoxsulam methyl (T<sub>7</sub>), which was at par with Pretilachlor *fb* Penoxsulam methyl (T<sub>5</sub>) (74.7%) and Bensulfuron methyl +

Pretilachlor *fb* Penoxsulam methyl (T<sub>6</sub>) (70.0%), but significantly superior to other treatments.

The effective control of early-emerged weeds under sequential herbicide application may be attributed to the pre-emergence application of Pyrazosulfuron ethyl, which is absorbed through both foliage and roots and subsequently translocated to the meristematic regions. It inhibits the acetolactate synthase (ALS/AHAS) enzyme responsible for the biosynthesis of essential branched-chain amino acids (leucine, valine and isoleucine), thereby arresting cell division and suppressing weed growth, ultimately leading to weed mortality. Further, the post-emergence application of Penoxsulam methyl provided effective control of later-emerging weeds, resulting in a broad-spectrum weed suppression. Penoxsulam methyl is primarily absorbed through leaves and partly through roots, followed by translocation within the plant, exhibiting both knockdown and residual activity. It also inhibits ALS/AHAS enzyme activity, thereby disrupting amino acid synthesis and reducing weed dry matter accumulation.

The weedy check (T<sub>1</sub>) recorded zero weed control efficiency throughout the crop growth period due to the absence of weed management practices, resulting in unchecked weed growth and severe crop-weed competition. This led to higher weed biomass accumulation and depletion of essential resources such as nutrients, moisture, light and space, thereby adversely affecting crop performance. These results are in conformity with the findings of Kumar *et al.* (2023) <sup>[6]</sup>. Further, Sneha *et al.* (2023) <sup>[14]</sup> also reported higher weed control efficiency under sequential herbicide application involving Pyrazosulfuron-ethyl, whereas uncontrolled weed growth resulted in substantial yield reduction.

#### Weed index

Weed index varied significantly among different weed

management practices due to differences in their effectiveness in reducing crop yield loss caused by weeds (Table 2). The significantly lowest weed index was recorded under weed-free treatment (T<sub>8</sub>) (0.0%), which was found to be at par with Pyrazosulfuron ethyl *fb* Penoxsulam methyl (T<sub>7</sub>) (4.1%). Among the herbicidal treatments, T<sub>7</sub> recorded the lowest weed index, which was statistically at par with Bensulfuron ethyl + Pretilachlor *fb* Penoxsulam methyl (T<sub>6</sub>) (14.4%), indicating superior effectiveness in minimizing yield loss due to weeds.

Higher weed index values were recorded under sole herbicide applications, viz., Pyrazosulfuron ethyl (T<sub>4</sub>) (32.0%), Bensulfuron methyl + Pretilachlor (T<sub>3</sub>) (33.1%) and Pretilachlor (T<sub>2</sub>) (27.6%), indicating comparatively poor weed control due to limited residual activity and inability to suppress later-emerging weeds. The highest weed index (45.1%) was recorded under weedy check (T<sub>1</sub>) due to severe crop-weed competition throughout the crop growth period.

The lower weed index under sequential herbicide treatments may be attributed to effective and sustained weed suppression during the critical period of crop-weed competition, resulting in better utilization of nutrients, moisture, light and space by the crop, thereby enhancing yield. These findings are in close conformity with those of Kumar *et al.* (2023) <sup>[6]</sup> and Sneha *et al.* (2023) <sup>[14]</sup>, who also reported lower weed index and higher weed control efficiency under sequential herbicide application compared to single herbicide use. Similar results were also reported by Ramadevi *et al.* (2021) <sup>[13]</sup> and Pradhan and Singh (2009) <sup>[12]</sup>. The results clearly indicate that sequential herbicide application is more effective than sole herbicide use in managing diverse weed flora and minimizing yield losses in transplanted finger millet.

**Table 1:** Weed flora of the experimental field

| S. No.                         | Common Name      | Botanical Name                              | Family         |
|--------------------------------|------------------|---------------------------------------------|----------------|
| <b>I. Narrow leaved weeds</b>  |                  |                                             |                |
| 1.                             | Crow foot grass  | <i>Dactyloctenium aegyptium</i> (L.) Willd. | Poaceae        |
| 2.                             | Finger grass     | <i>Chloris barbata</i> Sw.                  | Poaceae        |
| 3.                             | Bermuda grass    | <i>Cynodon dactylon</i> (L.) Pers.          | Poaceae        |
| 4.                             | Large crab grass | <i>Digitaria sanguinalis</i>                | Poaceae        |
| 5.                             | Jungle grass     | <i>Echinochloa colonum</i> (L.) Link        | Poaceae        |
| <b>II. Sedges</b>              |                  |                                             |                |
| 6.                             | Flat sedge       | <i>Cyperus iria</i> L.                      | Cyperaceae     |
| 7.                             | Purple nut sedge | <i>Cyperus rotundus</i> L.                  | Cyperaceae     |
| <b>III. Broad leaved weeds</b> |                  |                                             |                |
| 8.                             | Red stem         | <i>Ammannia baccifera</i> L.                | Lythraceae     |
| 9.                             | False daisy      | <i>Eclipta alba</i> (L.) Hassk.             | Compositae     |
| 10.                            | Morning glory    | <i>Ipomoea pestigridis</i>                  | Convolvulaceae |
| 11.                            | Stone breaker    | <i>Phyllanthus niruri</i> L.                | Euphorbiaceae  |
| 12.                            | Least snout-bean | <i>Rhynchosia minima</i>                    | Fabaceae       |
| 13.                            | Horse purslane   | <i>Trianthema portulacastrum</i> L.         | Aizoaceae      |
| 14.                            | Tridax daisy     | <i>Tridax procumbens</i>                    | Compositae     |

**Table 2:** Effect of weed management practices on weed control efficiency (%) and weed index (%) of transplanted finger millet

| Treatment      |                                                                                                                                     | Weed control efficiency (%) |        |        | Weed index (%) |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------|--------|----------------|
|                |                                                                                                                                     | 30 DAT                      | 60 DAT | 90 DAT |                |
| T <sub>1</sub> | Weedy check                                                                                                                         | 0.0                         | 0.0    | 0.0    | 45.1           |
| T <sub>2</sub> | Pretilachlor 500 g ha <sup>-1</sup> 3 DAT                                                                                           | 39.1                        | 45.9   | 60.8   | 27.6           |
| T <sub>3</sub> | Bensulfuron methyl + Pretilachlor (pre-mix) 60+600g ha <sup>-1</sup> 3 DAT                                                          | 36.3                        | 42.4   | 58.9   | 33.1           |
| T <sub>4</sub> | Pyrazosulfuron ethyl 15 g ha <sup>-1</sup> 3 DAT                                                                                    | 39.0                        | 49.6   | 65.3   | 32.0           |
| T <sub>5</sub> | Pretilachlor 500 g ha <sup>-1</sup> 3 DAT <i>fb</i> Penoxsulam methyl 20 g ha <sup>-1</sup> 25 DAT                                  | 43.6                        | 56.6   | 74.7   | 20.7           |
| T <sub>6</sub> | Bensulfuron ethyl + Pretilachlor (pre-mix) 60+600 g ha <sup>-1</sup> 3 DAT <i>fb</i> Penoxsulam methyl 20 g ha <sup>-1</sup> 25 DAT | 40.6                        | 48.9   | 70.0   | 14.4           |
| T <sub>7</sub> | Pyrazosulfuron ethyl 15 g ha <sup>-1</sup> 3DAT (PE) <i>fb</i> Penoxsulam methyl 20 g ha <sup>-1</sup> 25 DAT                       | 62.6                        | 61.2   | 79.9   | 4.1            |
| T <sub>8</sub> | Weed free                                                                                                                           | 100.0                       | 100.0  | 100.0  | 0.0            |
| SEm ±          |                                                                                                                                     | 5.7                         | 4.3    | 3.6    | 4.1            |
| CD (P=0.05)    |                                                                                                                                     | 17.4                        | 13.0   | 10.8   | 12.4           |

## Conclusion

Sequential application of Pyrazosulfuron ethyl @ 15 g ha<sup>-1</sup> at 3 DAT followed by Penoxsulam methyl 20 g ha<sup>-1</sup> at 25 DAT proved most effective, recording the highest weed control efficiency and lowest weed index, comparable to the weed-free treatment. Sequential herbicide applications were superior to sole applications, while the weedy check resulted in severe crop-weed competition and maximum yield loss. Thus, sequential herbicide application is an efficient strategy for weed management in transplanted finger millet.

## References

1. Anonymous. Agricultural statistics at a glance. Government of India. 2023:57-59.
2. Anonymous. Agricultural statistics at a glance. Government of India. 2025:127.
3. Devi PB, Vijayabharathi R, Sathyabama S, Malleshi NG, Priyadarisini VB. Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. Journal of Food Science and Technology. 2014;51(6):1021-1040.
4. Dubey RP, Mishra JS. Weed management in millets. Technical Bulletin, ICAR-Directorate of Weed Research. 2023:44.
5. Gill GS, Kumar VK. Weed index - a new method of reporting weed control trials. Indian Journal of Agronomy. 1969;14:96-98.
6. Kumar H, Tiwari N, Savu RM, Langangmeilu G, Chandrakala. Effect of different herbicidal weed management on yield and economics of ragi. International Journal of Environment and Climate Change. 2023;13(9):3481-3485.
7. Kumara O, Basavaraj Naik T, Palaiah P. Effect of weed management practices and fertility levels on growth and yield parameters in finger millet. Karnataka Journal of Agricultural Sciences. 2007;20(2):230-233.
8. Mani VS, Mala ML, Gautam KC, Bhagavandas. Weed killing chemicals in potato cultivation. Indian Farming. 1973;23(1):17-18.
9. Mishra JS, Kumar R, Upadhyay PK, Hansraj H. Weed management in millets. Indian Farming. 2018;68(11):77-79.
10. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR; 1967.
11. Pradhan A, Rajput AS, Thakur A. Effect of weed management on growth and yield of finger millet. Indian Journal of Weed Science. 2010;42(1-2):53-56.
12. Pradhan A, Singh V. Integrated weed management in finger millet under rainfed region. Indian Journal of Weed Science. 2009;41(3-4):188-192.
13. Ramadevi S, Karuna Sagar G, Subramanyam D, Nirmal Kumar AR. Weed management in transplanted finger millet with pre- and post-emergence herbicides. Indian Journal of Weed Science. 2021;53(3):297-299.
14. Sneha SR, Raj SK, Jacob D, Pillai PS, Radhakrishnan NV. Weed management in finger millet (*Eleusine coracana* L.) intercropped in coconut garden. Indian Journal of Weed Science. 2023;55(3):349-354.