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# Herbicide weed management effect on growth attributing characters of *rabi* onion

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**Abstract**
A field experiment was carried out during the *rabi* seasons of 2022–23 and 2023–24 at the All India Coordinated Research Project on Weed Management, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The study aimed to assess the comparative effectiveness of different herbicides for weed control in *rabi* onion and to determine their influence on plant growth parameters. The experiment design followed was Randomized Block Design comprising eight treatments replicated thrice. The treatments includes oxyfluorfen at 100 g ha$^{-1}$ PE ($T_1$), oxyfluorfen at 100 g ha$^{-1}$ PE *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ (RM) PoE ($T_2$), oxyfluorfen at 100 g ha$^{-1}$ PE *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) PoE ($T_3$), pendimethalin at 677 g ha$^{-1}$ PE ($T_4$), pendimethalin at 677 g ha$^{-1}$ PE *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ (RM) PoE ($T_5$), pendimethalin at 677 g ha$^{-1}$ PE *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) PoE ($T_6$), hand weeding @ 20, 40 & 60 DAT ($T_7$) and weedy check ($T_8$). Among the chemical weed control treatments, application of oxyfluorfen at 100 g ha$^{-1}$ PE *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) PoE resulted in maximum plant growth parameters, demonstrating its superior efficacy in weed management and overall crop performance.

**Keywords:** Growth attributing characters, herbicide weed management, *rabi* onion

## Introduction

The *rabi* onion, known as 'unhali' onion, is planted around December or January and harvested between March-April. Onion is more prone to weed competition compared to other crops because of its inherent traits like slow initial growth, short stature, shallow roots and a tendency to produce non-branching shoots. Its narrow, upright leaves can not suppress weeds well. Also, its long growing season allows weeds to grow in several bursts. Manual weeding in onion is a common practice, but it is tedious, costly and time-consuming due to its close planting density and shallow roots. Additionally, the unavailability of timely labour during critical periods makes weeding difficult often resulting in significant yield losses (Dhananivetha *et al.*, 2017) [2].

Applying pre-emergence herbicides helps maintain the onion crop free from weeds during its early growth stages. At later stages, however, a second flush of weeds often appears, and their removal by manual or mechanical means can harm the developing bulbs (Dhananivetha *et al.*, 2017) [2]. Weed management in onion is therefore quite difficult, as close crop spacing restricts mechanical weeding, manual operations are costly, and the number of registered herbicides for this crop is limited. The choice of a herbicide must also depend on the expected weed species present in the field. The use of post-emergence herbicides can help reduce weed competition, minimize labor costs and prevent physical injury to bulbs. Effective weed control strategies should enhance both crop productivity and the efficiency of control practices. Hence, a detailed and coordinated research approach is necessary to achieve the dual goals of higher yield and efficient weed suppression by identifying suitable pre- and post-emergence herbicides, along with their ready-mix and sequential combinations, for broad and sustainable weed management.

The success of onion cultivation depends largely on timely and effective weed management. Although manual weeding provides good results, it is expensive and labor-demanding. Chemical control offers a viable substitute that is less costly but carries challenges such as the risk of herbicide resistance and environmental safety concerns. When manual operations become impractical due to soil constraints, high labor charges, or limited workforce availability, chemical weed control using pre- or post-emergence herbicides combined with cultural methods can provide effective management throughout the crop's growth cycle. Using mixtures of pre- and post-emergence herbicides represents a practical and reliable solution for timely weed suppression, as each chemical product has its own control spectrum (Kumar *et al*., 2019) [7]. Furthermore, the timing of herbicide application plays a decisive role in its overall effectiveness. Post-emergence sprays are advantageous because they can be selected after identifying the predominant weed flora and assessing infestation levels. The present study on weed management in onion explores new herbicide combinations and formulations to evaluate their effectiveness on weed suppression and their impact on onion growth parameters.

## Materials and Methods

The research work was carried out at All India Coordinated Research Project on Weed Management, Agronomy Department Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *rabi* season of 2022-23 and 2023-24. The experiment design followed was Randomized Block Design comprising eight treatments replicated thrice. Treatment details are given in Table1.

**Table 1:** Treatment details

| Symbol | Treatments |
|---|---|
| $T_1$ | Oxyfluorfen at 100 g ha$^{-1}$ PE |
| $T_2$ | Oxyfluorfen at 100 g ha$^{-1}$ PE *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ (RM) PoE |
| $T_3$ | Oxyfluorfen at 100 g ha$^{-1}$ PE *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) PoE |
| $T_4$ | Pendimethalin at 677 g ha$^{-1}$ PE |
| $T_5$ | Pendimethalin at 677 g ha$^{-1}$ PE *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ (RM) PoE |
| $T_6$ | Pendimethalin at 677 g ha$^{-1}$ PE fb propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) PoE |
| $T_7$ | Hand weeding @ 20, 40 & 60 DAT |
| $T_8$ | Weedy check |

Gross plot size taken was 9.0 m × 5.5 m, while the net plot size taken was 8.35 m × 5.1 m. Sowing was done on broad bed furrows with akola safed variety at spacing 10 × 10 cm$^2$ and 100:50:50:30 NPKS kg ha$^{-1}$ RDF. Seed rate was 10 kg ha$^{-1}$.

The texture of experimental plot soil was clayey. It was slightly alkaline in reaction. Soil analysis revealed organic carbon (0.46 g kg$^{-1}$), available nitrogen (182.0 kg ha$^{-1}$) and phosphorus (17.3 kg ha$^{-1}$) was found low and available potassium (264.0 kg ha$^{-1}$) was fairly rich. Pre-emergence herbicides oxyfluorfen 23.5% EC @ 100 g ha$^{-1}$ and pendimethalin 38.7% CS @ 677 g ha$^{-1}$ were applied a day after transplanting of seedlings in the moist soil. While post-emergence herbicides quizalofop-ethyl 4% + oxyfluorfen 6% EC @ 100 g ha$^{-1}$ (RM) and propaquizafop 5% + oxyfluorfen 12% EC @ 148 g ha$^{-1}$ (RM) were applied at 2-3 leaf stage of weed, which in general coincided with 25 DAS stage. Rain events across the growing period of onion (transplanting to harvest) amounted to 70.1 mm in 2023 and 30.4 mm in 2024. During growth period of crop maximum and minimum temperature deviation showed mostly below normal to near normal trend across the season, except few marginally above deviations.

## Results and Discussion

### Plant height

Plant height was influenced significantly by various weed management treatments at all growth stages except at 20 DAT where the treatment differences were statistically not significant. However, from 40 DAT up to harvest hand weeding @ 20, 40 & 60 DAT treatment attained significantly higher plant height as compared to other treatments and minimum plant height was observed in weedy check.

**Table 2:** Plant height (cm) and number of leaves per plant of onion as affected by various weed management treatments: pooled results for 2022–23 and 2023–24.

| Treatments | Plant height (cm) | | | | | Number of leaves plant per plant | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 20 DAT | 40 DAT | 60 DAT | 80 DAT | At harvest | 20 DAT | 40 DAT | 60 DAT | 80 DAT | At harvest |
| $T_1$ | 19.37 | 42.75 | 56.15 | 59.89 | 39.05 | 4.20 | 7.14 | 7.87 | 9.44 | 4.47 |
| $T_2$ | 19.82 | 46.35 | 57.61 | 64.24 | 41.20 | 4.33 | 7.30 | 8.23 | 9.74 | 5.00 |
| $T_3$ | 20.20 | 47.87 | 60.00 | 65.80 | 43.47 | 4.47 | 7.57 | 8.60 | 10.37 | 5.30 |
| $T_4$ | 18.92 | 39.62 | 55.58 | 59.04 | 38.23 | 4.00 | 6.74 | 7.77 | 9.40 | 4.43 |
| $T_5$ | 19.35 | 41.09 | 56.25 | 60.31 | 39.37 | 4.20 | 6.97 | 7.90 | 9.47 | 4.60 |
| $T_6$ | 19.66 | 41.12 | 56.43 | 61.46 | 39.97 | 4.27 | 7.00 | 7.94 | 9.57 | 4.73 |
| $T_7$ | 20.42 | 49.95 | 65.07 | 68.79 | 46.08 | 4.54 | 8.07 | 8.97 | 11.33 | 5.47 |
| $T_8$ | 17.94 | 34.50 | 45.96 | 53.60 | 34.75 | 3.90 | 6.00 | 6.97 | 7.80 | 3.77 |
| S.E (m)± | 0.53 | 0.92 | 1.64 | 2.16 | 1.56 | 0.12 | 0.27 | 0.26 | 0.23 | 0.15 |
| C.D. at 5% | NS | 2.77 | 4.94 | 6.53 | 4.71 | NS | 0.82 | 0.79 | 0.70 | 0.44 |
| G.M. | 19.46 | 42.90 | 56.63 | 61.64 | 40.26 | 4.24 | 7.10 | 8.03 | 9.64 | 4.72 |

At 40 days after transplanting (DAT), among herbicides treatments, treatment oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ performed better than the other herbicidal options. However, its effect was statistically comparable with the treatment oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$.

At 60 DAT treatment oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ recorded the tallest plants. This treatment was statistically at par with oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, oxyfluorfen at 100 g ha$^{-1}$ and pendimethalin at 677 g ha$^{-1}$.

At 80 DAT and at harvest, treatment oxyfluorfen at 0.100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ continued to record higher plant height values, which were statistically similar to oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ and oxyfluorfen at 100 g ha$^{-1}$.

The increase in plant height in treatment hand weeding @ 20, 40 & 60 DAT and oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ may be attributed to minimal crop–weed competition. In contrast, a significant reduction in plant height was observed in the weedy check due to strong competition between crop and weeds for soil moisture, nutrients, sunlight, and space during active growth. These findings align with those reported by Saraf (2007) [14] and Sahoo and Tripathy (2019) [13].

## Number of leaves per plant

Weed management practices significantly influenced the number of leaves per plant at all growth stages except at 20 DAT, where differences were non-significant. From 40 DAT until harvest, hand weeding @ 20, 40 & 60 DAT produced the maximum number of leaves per plant, while the lowest leaf count was recorded in the weedy check.

Among herbicidal treatments, at 40 and 60 DAT, oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ produced the highest number of leaves per plant. This treatment was statistically similar to oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ and oxyfluorfen at 100 g ha$^{-1}$.

At 80 DAT and at harvest treatment oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ maintained the highest number of leaves per plant, which was statistically at par with oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$.

The lowest number of leaves plant per plant was recorded in weedy check. This might be attributed to more competition for resources in the weedy check. This reduction could be due to severe competition for light, moisture, nutrients, and space. Conversely, reduced weed competition in hand-weeded and sequential herbicide treatments likely resulted in efficient and broad-spectrum weed control, ensuring better plant growth in terms of leaf production. Similar results were also reported by Kalhapure and Shete (2013) [5].

## Neck thickness of bulb

The mean neck thickness of onion bulbs was significantly influenced by various weed management treatments at all the growth stages of observations except 20 DAT.

At 40 DAT, hand weeding @ 20, 40 & 60 DAT treatment recorded maximum neck thickness. Among herbicides treatments, oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ produced the highest neck thickness, which was statistically comparable with oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$, pendimethalin at 677 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$, oxyfluorfen at 100 g ha$^{-1}$ and pendimethalin at 677 g ha$^{-1}$.

**Table 3:** Neck thickness of bulb and dry matter accumulation per plant of onion as affected by various weed management treatments: pooled results for 2022–23 and 2023–24

| Treatments | Neck thickness of bulb (in mm) | | | | Dry matter accumulation plant per plant (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 20 DAT | 40 DAT | 60 DAT | 80 DAT | 20 DAT | 40 DAT | 60 DAT | 80 DAT | At harvest |
| $T_1$ | 4.91 | 8.37 | 12.48 | 13.89 | 0.73 | 2.00 | 5.85 | 9.52 | 12.57 |
| $T_2$ | 5.11 | 8.64 | 13.08 | 15.43 | 0.76 | 2.52 | 6.52 | 10.07 | 13.94 |
| $T_3$ | 5.15 | 9.20 | 13.36 | 15.94 | 0.77 | 2.55 | 6.69 | 10.66 | 14.81 |
| $T_4$ | 4.75 | 8.30 | 11.46 | 12.43 | 0.71 | 1.54 | 5.74 | 9.29 | 12.40 |
| $T_5$ | 4.81 | 8.40 | 12.13 | 14.18 | 0.73 | 2.19 | 5.95 | 9.61 | 12.68 |
| $T_6$ | 4.88 | 8.54 | 12.55 | 14.53 | 0.74 | 2.40 | 6.33 | 9.90 | 13.18 |
| $T_7$ | 5.41 | 9.97 | 14.23 | 17.13 | 0.79 | 2.95 | 6.83 | 11.15 | 15.04 |
| $T_8$ | 4.70 | 7.10 | 10.56 | 11.31 | 0.69 | 1.37 | 5.10 | 7.86 | 11.12 |
| S.E (m)± | 0.17 | 0.36 | 0.29 | 0.52 | 0.06 | 0.11 | 0.16 | 0.30 | 0.46 |
| C.D. at 5% | NS | 1.10 | 0.87 | 1.56 | NS | 0.34 | 0.50 | 0.92 | 1.40 |
| G.M. | 4.96 | 8.56 | 12.48 | 14.35 | 0.74 | 2.19 | 6.12 | 9.76 | 13.22 |

At 60 and 80 days after transplanting (DAT), hand weeding @ 20, 40 & 60 DAT treatment recorded significantly highest neck thickness of bulb. Among various herbicidal treatments oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ resulted in maximum neck thickness of bulb which was at par with oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ and pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$.

The minimum neck thickness was recorded in weedy check which may be attributed to intense crop–weed competition for essential growth resources such as nutrients, moisture, and light. This competition likely restricted bulb nourishment and development. Similar findings were also reported by Yumnam *et al*. (2009) [21].

## Dry matter accumulation per plant

All weed management practices significantly affected dry matter accumulation plant per plant at every growth stage, except at 20 DAT. From 40 DAT onwards up to harvest, the treatment with hand weeding @ 20, 40, and 60 DAT resulted in the highest dry matter accumulation.

Among herbicidal treatments, oxyfluorfen at 100 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ greater dry matter accumulation plant per plant, closely followed by oxyfluorfen at 100 g ha$^{-1}$ *fb* quizalofop-ethyl + oxyfluorfen at 100 g ha$^{-1}$ and pendimethalin at 677 g ha$^{-1}$ *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$. The enhanced dry matter accumulation in these treatments could be due to favorable crop growth conditions resulting from efficient weed suppression, which minimized competition and improved the availability of sunlight, nutrients, and soil moisture. These observations are consistent with the results reported by Vishnu *et al*. (2015) [19].

## Conclusion
After the study it can be concluded that in *rabi* onion pre-emergence application of oxyfluorfen at 100 g ha$^{-1}$ pre emergence *fb* propaquizafop + oxyfluorfen at 148 g ha$^{-1}$ (RM) as post-emergence @ 2-3 leaf stage of weed gives higher values for growth parameters such as plant height, number of leaves per plant, neck thickness of bulb and dry matter accumulation per plant.

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