**Impact of Pre and Post-Emergence Herbicides on Growth and Yield Performance of Urdbean (*Vigna mungo* L.)**

**Abstract:** The experiment was conducted at the Agronomy Research Farm of N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the Kharif season of 2015-16, to evaluate the effects of pre-emergence and post-emergence herbicides on the growth and yield of Urdbean (*Vigna mungo* L.). Twelve weed management treatments were tested, including: Imazethapyr 70 g ha⁻¹ PRE, Imazethapyr 80 g ha⁻¹ PRE, Imazethapyr 70 g ha⁻¹ POE (3-4 leaf stage of weeds), Imazethapyr 80 g ha⁻¹ POE (3-4 leaf stage of weeds), Imazethapyr + imazamox (RM) 70 g ha⁻¹ PRE, Imazethapyr + imazamox (RM) 80 g ha⁻¹ PRE, Imazethapyr + imazamox (RM) 70 g ha⁻¹ POE (3-4 leaf stage of weeds), Imazethapyr + imazamox (RM) 80 g ha⁻¹ POE (3-4 leaf stage of weeds), Pendimethalin 1000 g ha⁻¹ PRE, Imazethapyr + Pendimethalin (RM) 1000 g ha⁻¹ PRE, Hoeing (20 & 40 DAS) and a Weedy check. The results showed that the pre-emergence application of imazethapyr + pendimethalin at 1000 g ha⁻¹ was the most effective treatment, improving the growth parameters and grain yield of urdbean. This was followed by imazethapyr + imazamox (RM) at 80 g ha⁻¹, imazethapyr + imazamox (RM) at 70 g ha⁻¹, and pendimethalin at 1000 g ha⁻¹. The post-emergence application of imazethapyr + imazamox (RM) at 80 g ha⁻¹ produced significantly higher grain yield compared to the other treatments.

**Keywords RM: PRE** – Pre- emergence, **POE –** Post emergence, **DAHA** - Day after herbicide applied, Herbicide treatments

**Introduction**

Pulses are a vital group of leguminous crops grown for their nutritious seeds, which are high in protein, carbohydrates, fiber, and other essential nutrients. These include crops like lentils, chickpeas, beans, peas, and urdbean. Pulses are crucial for global food security, especially in developing nations, as they provide an affordable source of plant-based protein. They also contribute to soil health by fixing nitrogen, improving fertility, and supporting sustainable farming practices. “Urdbean, also known as Blackgram (*Vigna mungo* L.), is a crucial short-duration pulse crop widely cultivated in various regions of the country. It is grown in different cropping systems, including as a mixed crop, catch crop, sequential crop, or as a sole crop under residual moisture conditions following rice harvest. It is also grown before or after other summer crops in semi-irrigated and dryland areas. The seeds of urdbean are highly nutritious, containing protein (25-26%), carbohydrates, minerals, and vitamins”. “Its short duration and photosensitivity and thermosensitivity insensitivity make it an excellent crop for intensification and diversification. The development of short-duration, photo and thermo-insensitive, and disease-resistant varieties has facilitated its cultivation as a sole or intercrop during the spring season in North India, as well as a sole relay crop during the rabi season in the rice fallows of the coastal peninsula. Blackgram cultivation is mainly confined to wet tropical regions due to the favorable warm temperatures and adequate rainfall that support its growth and development. These conditions ensure good germination, vegetative growth, and overall crop productivity. It is grown in India, Pakistan, Sri Lanka, and some countries in Southeast Asia, Africa, and America. India produced 17.21 million tonnes of pulses from an area of 24.78 million hectares **(Anonymous, 2012)** with Madhya Pradesh (4.16 million tonnes), Uttar Pradesh (2.43 million tonnes), and Rajasthan (2.36 million tonnes) being the major contributors. However, India imports about 2-3 million tonnes of pulses annually to meet domestic consumption needs” **(Chaturvedi *et al.,* 2010**). “In India, urdbean are cultivated across approximately 3.1 million hectares, yielding a total of 1.4 million tonnes, with an average productivity of 452 kg per hectare” **(Anonymous, 2014-15).** “The crop is grown in various states, including Maharashtra, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, and West Bengal. Among these, Maharashtra stands out as the leading state in terms of area (575,000 hectares), production (327,000 tonnes), and productivity (569 kg per hectare). In Uttar Pradesh, pulses are grown on 391,000 hectares, with a production of 172,000 tonnes and a productivity of 440 kg per hectare **(Anonymous, 2014-15)”.**

“ *Vigna mungo* (L.) Hepper (formerly *Phaseolus mungo*), commonly known as black gram or urdbean, is an annual pulse crop native to Central Asia. It is widely used as a staple crop in Central and Southeast Asia and has also been introduced in regions like the Southern United States, the West Indies, Japan, and other tropical and subtropical countries. Urdbean is classified into two main varieties based on seed color and other characteristics: var. mungo, which has large black seeds and matures early, and var. viridis, which has smaller greenish seeds and matures later. The green-seeded types, locally known as katikahia urd, are typically grown as mixed crops alongside sorghum, pigeonpea, and cotton. Urdbean is cultivated in three main seasons: kharif, rabi, and summer. While it is grown in all these seasons, the largest area is devoted to the kharif season, primarily as an intercrop with sorghum, pearl millet, maize, cotton, castor, and pigeonpea. This pulse crop is short-duration (85-90 days) and highly nutritious, valued for its digestibility and minimal flatulence effect **(El Karamany, 2006).** Black gram is used in a variety of ways, including for human food (in vegetable diets), as green manure, a cover crop, forage, silage, hay, and even as chicken pasture. *Vigna mungo,* commonly known as urd bean, black gram, black lentil, or white lentil, is a legume grown primarily in southern Asia. It was once classified alongside mung beans in the Phaseolus genus but has since been reassigned to the Vigna genus. Initially, black gram was considered a variety of mung bean. Originating in India, where it has been cultivated since ancient times, black gram is one of the country's most highly valued pulses. It has also been introduced to other tropical regions, mainly through Indian migration. The productivity of urdbean in India, particularly in Uttar Pradesh, remains relatively low, which can be attributed to a range of biotic and abiotic factors. One significant issue is the invasion of weeds, which pose a major challenge in black gram fields. Weeds, especially grassy types, cause the most harm, followed by sedges and broadleaf weeds (BLWS). In addition to directly competing for resources with the crop, these weeds can also harbor pests and pathogens that affect black gram. Urdbean is less competitive against many weeds during its early growth stages, with the most critical period of crop-weed competition occurring between 15 and 45 days after sowing. When urdbean is intercropped with taller cereals or pigeonpea, it helps suppress weed growth by 20-45%, reducing the need for costly weed control measures. Various methods, including cultural, mechanical, biological, and chemical techniques, are employed to manage weeds **(Fand *et al.,* 2013).** Weed damage can reach up to 50-60% in severe cases. The critical period for summer black gram is typically 10-40 days after sowing **(Kumar and Tewari, 2004)**, although it can range from 25-35 days in some situations (Randhawa et al., 2002). Timely weed removal using appropriate methods is essential for maximizing black gram yields. While hand weeding **(Chand *et al.,* 2004)** is effective, it is labor-intensive, time-consuming, expensive, and often difficult to carry out during the critical period of weed competition. As a result, chemical herbicides have been tested as alternatives for weed control in urdbean fields. Several herbicides, including fluchloralin and pendimethalin, are widely used for pre-emergence weed control. However, weeds that emerge later in the growing season can still pose a problem. New-generation herbicides like imazamox and imazethapyr, either alone or in ready-mixed combinations, have shown promising results in various pulse crops”.

**Materials and Methods**

The experiment was conducted at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.), India, during the Kharif season of 2015-16, to evaluate the effects of pre and post-emergence herbicides on the growth and yield of Urdbean (*Vigna mungo* L.). Twelve different weed management treatments were tested, including various concentrations of Imazethapyr, Imazethapyr + Imazamox, and Pendimethalin, applied either pre-emergence (0-2 DAS) or post-emergence (25 DAS, at the 3-4 leaf stage of weeds), along with hoeing and a weedy check. Twelve different weed management treatments were evaluated, which included Imazethapyr at 70 g ha-1 (PRE), Imazethapyr at 80 g ha-1 (PRE), Imazethapyr at 70 g ha-1 (POE, at the 3-4 leaf stage of weeds), Imazethapyr at 80 g ha-1 (POE, at the 3-4 leaf stage of weeds), Imazethapyr + Imazamox (RM) at 70 g ha-1 (PRE), Imazethapyr + Imazamox (RM) at 80 g ha-1 (PRE), Imazethapyr + Imazamox (RM) at 70 g ha-1 (POE, at the 3-4 leaf stage of weeds), Imazethapyr + Imazamox (RM) at 80 g ha-1 (POE, at the 3-4 leaf stage of weeds), Pendimethalin at 1000 g ha-1 (PRE), Imazethapyr + Pendimethalin (RM) at 1000 g ha-1 (PRE), Hoeing at 20 and 40 DAS, and a Weedy check. These treatments were tested under a randomized complete block design with three replications. The herbicides were applied using a manually operated knapsack sprayer with 500 liters of water per hectare. The field was sown on 7th July 2015, with rows spaced 45 cm apart, at a depth of 5-7 cm, and a basal fertilizer dose of 20 kg N, 60 kg P2O5, and 40 kg K2O per hectare was applied at sowing. The experiment followed a randomized complete block design with three replications. Data were collected on various growth parameters, such as initial plant population, plant height, number of leaves per plant, dry matter accumulation, yield-contributing factors, seed yield, biological yield, and harvest index, at different stages of crop development. Samples from each plot were randomly selected, with a few plants tagged for further study.

**RESULTS AND DISCUSSION**

**Growth attributes**

The data on the initial plant population per square meter, plant height in cm, number of leaves per plant and dry matter accumulation gm per square at harvest stage of blackgram, influenced by various weed control treatments, are presented in Table 1. The application of different pre-emergence and post-emergence herbicides did not result in a significant change in the blackgram plant population. The data clearly indicate that different weed control treatments significantly affected the number of leaves per plant at harvest stage of blackgram growth at harvest stage, the number of leaves per plant was affected significantly due to different weed control treatments. Regarding the different treatments, application of imazethapyr + pendimethalin (RM) 1000 g ha-1 significantly increased number of leaves per plant as compared to other treatment combinations, however, it was at par with T5, T6 and T9. Application of imazethapyr + imazamox (RM) 80 g ha-1 produced significantly more number of leaves per plant than rest of the treatments but it was at par with T5, T2 and T1. Number of leaves per plant was not influenced significantly with the application of imazethapyr 80 g ha-1 PRE and imazethapyr 70 g ha-1. As far as post-emergence herbicides was concerned, application of imazethapyr + imazamox (RM) 80 g ha-1 POE (3-4 leaf weeds stage) did not influence the number of leaves per plant than T7, T4 and T3. Application of imazethapyr 80 g ha-1 POE (3-4 leaf weeds stage) did not increased significantly the number of leaves per plant than imazethapyr 70 g ha-1 POE (3-4 leaf weeds stage). Significantly highest number of leaves per plant was recorded with hoeing (20 and 40 DAS) than the other weed control treatments, however, it was at par with T10,T9, and T5. Weedy check plots recorded minimum number of leaves per plant. Similar results have also been reported by **(Singh *et al.,* 2004 and Sharma 2009).**

It is evident from the data that the different weed control treatments significantly influenced the plant height of blackgram at harvest stage of crop growth. Pre-emergence application of herbicides produced taller plant as compared to post-emergence herbicides. Significantly higher plant height of blackgram was obtained with the application of imazethapyr + pendimethalin (RM) 1000 g ha-1 PRE at harvest stage of crop growth as compared to rest of the weed control treatments, however, it was at par with T9, T6, T5. Application of imazethapyr + imazamox (RM) 80 g ha-1 PRE also recorded more plant height at all the harvest stages of crop growth than weedy check and was at par with imazethapyr + imazamox (RM) 70 g ha-1 PRE. Application imazethapyr 80 g ha-1 PRE recorded taller plants but did not reach to the level of significance. As far as post-emergence at harvest stages, application of imazethapyr + imazamox (RM) 80 g ha-1 POE did not influence plant height significantly of blackgram with different post-emergence herbicide treatments. Application of imazethapyr 80 g ha-1 POE (3-4 leaf weeds stages) did not influence significantly on plant height with imazethapyr 70 g ha-1 POE. Significantly tallest plants of blackgram at harvest of crop growth was obtained with hoeing done at 20 and 40 days after sowing than the other weed control treatments, however, it was non-significant than T10 and T9 treatments. Weedy check plot recorded minimum plant height of blackgram at harvest stage of crop growth. These results are in close conformity with the findings of **(Singh *et al.* 2011, Nandan *et al.,* 2011).**

At harvest stage, application of different herbicides significantly influenced the dry matter accumulation (g m-2) of blackgram. Significantly higher dry matter accumulation of blackgram was obtained with imazethapyr + pendimethalin (RM) 1000 g ha-1 as compared to rest of the weeds control treatments, except T6 and T5. Application of pendimethalin 1000 g ha-1 PRE recorded significantly more dry matter accumulation of blackgram as compared to T2 and T1. Non-significant difference on dry matter accumulation of blackgram was recorded with imazethapyr + imazamox (RM) 80 g ha-1 and imazethapyr + imazamox (RM) 70 g ha-1. As far as post-emergence herbicides was concerned, application of imazethapyr + imazamox (RM) 80 g ha-1 POE (3-4 leaf weeds stage) recorded more dry matter accumulation but did not reach to the level of significance with imazethapyr + imazamox (RM) 70 g ha-1 POE (3-4 leaf weeds stage). Non-significant difference on dry matter accumulation was obtain with the application of imazethapyr 80 g ha-1 POE (3-4 leaf weeds stage) and imazethapyr 70 g ha-1 POE (3-4 leaf weeds stage). Hoeing done at 20 and 40 days after sowing recorded maximum level of dry matter accumulation while minimum was recorded in weedy check. Crop dry matter is a net result of photosynthesis which remains in balanced after respiration process. At the same time, growth attributes *e.g.* plant height, number branches and plant population have the direct bearing in contributing the dry matter accumulation, while density and the dry weight of the weeds have a strongly negative correlation. This is very true here also that the treatments, reduced the density and dry weight of the weeds more effectively, provided a more favorable micro-environment to enhance the crop growth and ultimately having more crop dry weight in the respective treatments. Similar results have also been reported by **(Vaishya *et al.,* 2003).**

**Yield attributes and Yield:**

The data on the number of pods per plant, grain per pod and 1000 seed weight in blackgram, as affected by various weed control treatments, are presented in Table 2.The results clearly show that the different weed control treatments had a significant impact on the number of pods per plant. The combination of imazethapyr + pendimethalin (RM) at 1000 g ha-1 led to the highest number of pods per plant (32.27), which was significantly greater than all other treatments, except T6, T5, and T9. The treatment with imazethapyr + imazamox at 80 g ha-1 produced 31.95 pods per plant, significantly more than treatments T2 and T1, though not significantly different from T5 and T9.There were no significant differences in the number of pods per plant (28.59) between imazethapyr at 80 g ha-1 and imazethapyr at 70 g ha-1. Among the post-emergence herbicide treatments, imazethapyr + imazamox (RM) at 80 g ha-1, applied at the 3-4 leaf weed stage, resulted in a significantly higher number of pods per plant than treatments T4 and T3, but was comparable to T7. On the other hand, imazethapyr at 80 g ha-1 applied at the 3-4 leaf weed stage did not significantly affect the number of pods per plant compared to imazethapyr at 70 g ha-1 applied at the same stage.The highest number of pods per plant (33.21) was recorded with hoeing at 20 and 40 days after sowing, while the lowest number of pods was observed in the weedy check (25.07). **(Butter *et al.*, 2008)** also reported the similar type of response of weed control treatments. The application of imazethapyr + pendimethalin (RM) at 1000 g ha-1 resulted in the highest number of grains per pod (7.82) compared to the other treatments. However, no significant differences were observed in the number of grains per pod with treatments T6, T5, and T9. The combination of imazethapyr + imazamox (RM) at 80 g ha-1 led to 7.65 grains per pod, though it did not show a significant difference compared to imazethapyr + imazamox (RM) at 70 g ha-1, which produced 7.56 grains per pod. Imazethapyr at 80 g ha-1 (6.53 grains per pod) and imazethapyr at 70 g ha-1 (6.49 grains per pod) showed non-significant differences in the number of grains per pod. Regarding post-emergence herbicide treatments, imazethapyr + imazamox (RM) at 80 g ha-1 applied at the 3-4 leaf stage of weeds (POE) resulted in significantly more grains per pod (6.75) compared to treatments T4 and T3, but not T7. No significant differences were found between T3 and T4. Hoeing at 20 and 40 days after sowing yielded the highest number of grains per pod (8.30), while the weedy check produced the lowest (5.12). **(Singh *et al.,* 2003, Vaishya *et al.,* 2005 and Butter *et al.*, 2008)** also reported the similar type of responses of weed control treatments.The different weed control treatments did not have a significant effect on test weight. However, the highest test weight was observed with hoeing (37.72 g), followed by imazethapyr + pendimethalin (RM) at 1000 g ha⁻¹ (37.30 g), imazethapyr + imazamox (RM) at 80 g ha⁻¹ (37.28 g), and imazethapyr + imazamox (RM) at 70 g ha⁻¹ (37.22 g). The lowest test weight (36.43 g) was recorded in the weedy check.

The grain yield and straw yield of blackgram, influenced by various weed control treatments, is presented in Table 3. The data clearly indicate that different weed control treatments significantly impacted the grain yield. Among all treatments, the combination of imazethapyr + pendimethalin (RM) at 1000 g ha⁻¹ resulted in the highest grain yield (12.36 q ha⁻¹), significantly outperforming most other herbicide treatments, except for T5 and T6. The combination of imazethapyr + imazamox (RM) at 80 g ha⁻¹ had a similar effect on grain yield (12.06 q ha⁻¹), which was slightly higher than imazethapyr + imazamox (RM) at 70 g ha⁻¹ (11.66 q ha⁻¹). No significant difference was observed between imazethapyr at 80 g ha⁻¹ (9.09 q ha⁻¹) and imazethapyr at 70 g ha⁻¹ (8.99 q ha⁻¹) in terms of grain yield. Among post-emergence herbicides, imazethapyr + imazamox (RM) at 80 g ha⁻¹ POE produced a significantly higher grain yield (9.56 q ha⁻¹) compared to treatments T3 and T4, though it was on par with T7. The use of imazethapyr at 80 g ha⁻¹ POE at the 3-4 leaf weed stage resulted in a grain yield of 7.95 q ha⁻¹, which was comparable to imazethapyr at 70 g ha⁻¹ POE at the same stage. The highest grain yield (12.93 q ha⁻¹) was recorded with hoeing at 20 and 40 DAS, while the lowest yield (5.67 q ha⁻¹) was observed in the weedy check. Similar results are in close conformity with the finding of **(Shruthi *et al.,* 2015)**. Among the various weed control treatments, the application of imazethapyr + pendimethalin (RM) at 1000 g ha⁻¹ PRE resulted in the highest straw yield (28.35 q ha⁻¹), significantly outperforming most other herbicide treatments, except for T5, T6, and T10. The combination of imazethapyr + imazamox (RM) at 80 g ha⁻¹ did not significantly affect the straw yield (28.31 q ha⁻¹), which was slightly higher than imazethapyr + imazamox (RM) at 70 g ha⁻¹ (27.72 q ha⁻¹). There were no significant differences in straw yield between imazethapyr at 80 g ha⁻¹ (24.58 q ha⁻¹) and imazethapyr at 70 g ha⁻¹ (24.29 q ha⁻¹). Among post-emergence herbicides, the application of imazethapyr + imazamox (RM) at 80 g ha⁻¹ POE resulted in significantly higher straw yield (26.25 q ha⁻¹) compared to T3 and T4, though it was on par with T7. The use of imazethapyr at 80 g ha⁻¹ POE at the 3-4 leaf weed stage produced a straw yield of 23.51 q ha⁻¹, which was similar to imazethapyr at 70 g ha⁻¹ POE at the same stage. The highest straw yield (29.98 q ha⁻¹) was recorded with hoeing at 20 and 40 DAS, while the lowest straw yield (22.43 q ha⁻¹) was observed in the weedy check.Overall, pre-emergence herbicides were more effective in enhancing the grain yield and straw yield of blackgram compared to post-emergence treatments. These results are in the conformity with the work of **(Singh *et al.*, 2011 and Ratnam *et al.*, 2011).**The different weed control treatments did not significantly affect the harvest index of the blackgram crop. However, the highest harvest index (30.36%) was observed with imazethapyr + pendimethalin (RM) at 1000 g ha⁻¹ PRE, followed by imazethapyr + imazamox (RM) at 80 g ha⁻¹ (29.87%), imazethapyr + imazamox (RM) at 70 g ha⁻¹ (29.61%), pendimethalin at 1000 g ha⁻¹ (27.03%), and imazethapyr at 70 g ha⁻¹ (27.01%). The lowest harvest index (19.92%) was recorded in the weedy check.

**Table-1 Effect of weed control treatments on Initial plant population (No.m-1), Plant height (cm), Number of leaves per plant and Dry matter accumulation (g m-2) at harvest growth stages in Urdbean.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Initial plant population (No.m-1)** | **Plant height (cm) At harvest stage** | **Number of leaves per plant** | **Dry matter accumulation At harvest stage (g m-2)** |
| T1: Imazethapyr 70 g ha-1 PRE | 14.60 | 36.15 | 27.08 | 240.06 |
| T2: Imazethapyr 80 g ha-1 PRE | 14.70 | 36.75 | 27.37 | 242.72 |
| T3: Imazethapyr 70 g ha-1 POE (3-4 leaf weeds stage) | 14.20 | 35.33 | 26.41 | 226.88 |
| T4: Imazethapyr 80 g ha-1 POE (3-4 leaf weeds stage) | 14.40 | 35.84 | 26.83 | 234.58 |
| T5: Imazethapyr + imazamox (RM) 70 g ha-1 PRE | 15.20 | 39.04 | 29.07 | 313.17 |
| T6: Imazethapyr + imazamox (RM) 80 g ha-1 PRE | 15.40 | 39.36 | 29.31 | 317.46 |
| T7: Imazethapyr + imazamox (RM) 70 g ha-1 POE (3-4 leaf weeds stage) | 15.00 | 38.14 | 27.94 | 298.22 |
| T8: Imazethapyr + imazamox (RM) 80 g ha-1 POE(3-4 leaf weeds stage) | 15.00 | 38.66 | 28.23 | 300.59 |
| T9: Pendimethalin 1000 g ha-1 PRE | 15.70 | 40.10 | 28.91 | 290.80 |
| T10: Imazethapyr + pendimethalin (RM) 1000 g ha-1 PRE | 15.80 | 40.88 | 29.64 | 330.48 |
| T11: Hoeing (20&40 DAS) | 16.48 | 42.62 | 30.09 | 337.74 |
| T12: Weedy check | 14.00 | 30.70 | 23.11 | 171.12 |
| SEm± | 0.69 | 1.69 | 1.21 | 11.24 |
| CD at 5% | **NS** | **4.97** | **3.54** | **32.97** |

**Table 2 Effect of weed control treatments on yield contributing characters of Urdbean**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **No. of pods** | **Grain per pod** | **1000 seed weight (g)** |
| T1: Imazethapyr 70 g ha-1 PRE | 28.48 | 6.49 | 37.00 |
| T2: Imazethapyr 80 g ha-1 PRE | 28.59 | 6.53 | 36.89 |
| T3: Imazethapyr 70 g ha-1 POE (3-4 leaf weeds stage) | 25.58 | 5.31 | 36.63 |
| T4: Imazethapyr 80 g ha-1 POE (3-4 leaf weeds stage) | 25.68 | 5.79 | 36.81 |
| T5: Imazethapyr + imazamox (RM) 70 g ha-1 PRE | 31.24 | 7.56 | 37.22 |
| T6: Imazethapyr + imazamox (RM) 80 g ha-1 PRE | 31.95 | 7.65 | 37.28 |
| T7: Imazethapyr + imazamox (RM) 70 g ha-1 POE (3-4 leaf weeds stage) | 29.01 | 6.65 | 37.10 |
| T8: Imazethapyr + imazamox (RM) 80 g ha-1 POE(3-4 leaf weeds stage) | 29.22 | 6.75 | 37.15 |
| T9: Pendimethalin 1000 g ha-1 PRE | 30.59 | 7.22 | 37.18 |
| T10: Imazethapyr + pendimethalin (RM) 1000 g ha-1 PRE | 32.27 | 7.82 | 37.30 |
| T11: Hoeing (20&40 DAS) | 33.21 | 8.30 | 37.72 |
| T12: Weedy check | 25.07 | 5.12 | 36.43 |
| SEm± | 1.27 | 0.27 | 1.60 |
| CD at 5% | **2.71** | **0.81** | **NS** |

**Table 3 Effect of weed control treatments on Grain yield, Straw yield and Harvest index of Urdbean**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Grain yield (q ha-1)** | **Straw yield (q ha-1)** | **Harvest index (%)** |
| T1: Imazethapyr 70 g ha-1 PRE | 8.99 | 24.29 | 27.01 |
| T2: Imazethapyr 80 g ha-1 PRE | 9.09 | 24.58 | 27.00 |
| T3: Imazethapyr 70 g ha-1 POE (3-4 leaf weeds stage) | 7.72 | 23.16 | 25.00 |
| T4: Imazethapyr 80 g ha-1 POE (3-4 leaf weeds stage) | 7.95 | 23.51 | 25.27 |
| T5: Imazethapyr + imazamox (RM) 70 g ha-1 PRE | 11.66 | 27.72 | 29.61 |
| T6: Imazethapyr + imazamox (RM) 80 g ha-1 PRE | 12.06 | 28.31 | 29.87 |
| T7: Imazethapyr + imazamox (RM) 70 g ha-1 POE (3-4 leaf weeds stage) | 9.22 | 25.96 | 26.21 |
| T8: Imazethapyr + imazamox (RM) 80 g ha-1 POE(3-4 leaf weeds stage) | 9.56 | 26.25 | 26.70 |
| T9: Pendimethalin 1000 g ha-1 PRE | 10.16 | 27.43 | 27.03 |
| T10: Imazethapyr + pendimethalin (RM) 1000 g ha-1 PRE | 12.36 | 28.35 | 30.36 |
| T11: Hoeing (20&40 DAS) | 11.9 | 28.9 | 29.09 |
| T12: Weedy check | 5.67 | 22.43 | 19.92 |
| SEm± | 0.37 | 1.25 | **-** |
| CD at 5% | **1.09** | **3.67** | **-** |

**Conclusion**

Based on the experiment conducted during the kharif season of 2015, it can be concluded that the pre-emergence application of imazethapyr + pendimethalin at 1000 g ha⁻¹ was the most effective treatment for improving the growth parameters and grain yield of Urdbean, followed by imazethapyr + imazamox (RM) at 80 g ha⁻¹, imazethapyr + imazamox (RM) at 70 g ha⁻¹, and pendimethalin at 1000 g ha⁻¹. In contrast, post-emergence herbicide treatments showed less effectiveness.

**Recommendation**   
Based on the findings of the 2015 kharif season experiment, farmers are advised to adopt the pre-emergence application of imazethapyr + pendimethalin at 1000 g ha⁻¹ for effective weed control and improved growth and yield of Urdbean. If unavailable, imazethapyr + imazamox (RM) at 80 g ha⁻¹ can be considered as the next best alternative. Post-emergence herbicide treatments are less effective and therefore not recommended as the primary weed management strategy for Urdbean.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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