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# Effect of Weed Management Practices on Growth, Yield Attributes and Yield of Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

The growth, yield attributes and yield of clusterbean were influenced by various weed management treatments. The objective of the current study was to evaluate the impact of different weed management practices on growth, yield attributes and overall yield. An agronomic investigation was conducted at the Agricultural Research Station, Mandor, affiliated with the Agriculture University, Jodhpur, Rajasthan, during the *Kharif* season of 2018. The experimental design utilized a randomized block design (RBD) with three replications. The experiment encompassed ten treatments: $W_1$ - weedy check, $W_2$ - weed-free, $W_3$ - pendimethalin at 750 g/ha (pre-emergence), $W_4$ - imazethapyr at 40 g/ha (early post-emergence), $W_5$ - pendimethalin + imazethapyr at 750 g/ha (pre-emergence), $W_6$ - imazethapyr + imazamox at 50 g/ha (early post-emergence), $W_7$ - pendimethalin at 750 g/ha (pre-emergence) + 1 hand weeding (25 days after sowing), $W_8$ - imazethapyr at 40 g/ha (early post-emergence) + 1 hand weeding (35 days after sowing), $W_9$ - pendimethalin + imazethapyr at 750 g/ha (pre-emergence) + 1 hand weeding (25 days after

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sowing), and $W_{10}$ - imazethapyr + imazamox at 50 g/ha (early post-emergence) + 1 hand weeding (35 days after sowing). The early post-emergence application of imazethapyr + imazamox at 50 g/ha along with one hand weeding at 35 days after sowing resulted in significantly enhanced growth, yield attributes and overall yield. This treatment exhibited higher values for parameters such as dry matter per plant (g), plant height (cm), number of branches per plant, number of pods per plant, number of seeds per pod, 1000-seed weight (g), yields of both seed and stover and harvest index. Additionally, this treatment was comparable in effectiveness to the application of imazethapyr at 40 g/ha (early post-emergence) + 1 hand weeding at 35 days after sowing and the weed-free condition. The application of imazethapyr + imazamox at 50 g/ha + 1 hand weeding at 35 days after sowing emerged as a promising strategy during the *Kharif* season for achieving the highest yield and net monetary returns in clusterbean cultivation.

*Keywords: Clusterbean; growth attributes; yield attributes and yield.*

## 1. INTRODUCTION

Clusterbean (*Cyamopsis tetragonoloba* (L.) Taub), commonly referred to as "Guar," is a significant crop native to India and belongs to the family Fabaceae, subfamily Papilionaceae. “It thrives in rainfed regions, particularly the semi-arid and arid zones of India. This crop is recognized for its flower and pod clusters, earning it the name "clusterbean." Its primary origin can be traced back to India” [1]. “In the State of Rajasthan, where conditions are well-suited, clusterbean cultivation is prominent, covering approximately 2.39 million hectares and yielding around 1.0 million tones, with a productivity of 419 kg/ha” [2]. “Clusterbean serves various purposes such as vegetable consumption, green fodder, green manure, and seed production. The seeds contain a significant gum content (28-33 percent), finding utility in various industries including textiles, paper, petroleum, pharmaceuticals, food processing, cosmetics, mining explosives, and oil drilling, thus contributing to foreign exchange earnings” [3]. “In the context of Indian farming, pulses play a crucial role, serving as the main crop, catch crop, cover crop, green manure, and intercrop. However, low yields are often attributed to factors such as poor cultivation practices, cultivation on marginal lands, insufficient fertilization, monsoon-dependence, and lack of suitable varieties. Among these challenges, weed infestation stands out as a significant hurdle in clusterbean cultivation. The crop faces intense competition from weeds due to its slow initial growth and the rapid growth of weeds in the rainy season. Extended weed presence beyond the critical crop-weed competition phase leads to substantial yield reductions, ranging from 40-45 percent” [4]. Studies have shown that “crop-weed competition contributed to a 53.7 percent reduction in seed yield” [5]. “While hand weeding remains a traditional and effective option for weed management, challenges such as labor availability and rising labor costs limit its economic feasibility” [6]. “A combination of chemical and cultural weed control methods can mitigate herbicide expenses while ensuring adequate aeration and moisture conservation for the crop” [7]. While pre-emergence application of pendimethalin is recommended, the study also explores post-emergence herbicide application for effective control of mixed weed flora. The investigation aims to identify an appropriate weed management practice to control weeds in clusterbean cultivation.

## 2. MATERIALS AND METHODS

### 2.1 Soil Characterization

The soil's key elements (N, P, K) were analyzed using the alkali potassium permanganate method [8], Olsen method [9], and flame photometer method [10] for nitrogen, phosphorus and potassium, respectively. pH was determined using the method outlined by Richards [11] and organic carbon was assessed following the method by Walkley and Black [12]. Homogeneous composite soil samples were collected for the respective analyses. The soil exhibited a loamy sand texture, a slightly alkaline pH (8.2), low organic carbon content (1.3 g/kg), medium available nitrogen (174.0 kg/ha), medium available phosphorus (22.0 kg/ha), high availability of potash (325.0 kg/ha) and an electrical conductivity of 0.12 ds/m.

### 2.2 Field Investigation

During the *Kharif* season of 2018, a field investigation was conducted at the Agricultural Research Station, Mandor (Agriculture University, Jodhpur), situated between $26^0$15’ N

to $26^0$45' north latitude and $73^0$00' E to $73^0$29 East longitude at an altitude of 231 m above mean sea level within the western dry region agro-climatic zone. The weather conditions during the crop season are illustrated in Fig. 1. The experiment employed a randomized block design (RBD) with three replications. It included ten treatments: $W_1$ - weedy check, $W_2$ - weed-free, $W_3$ - pendimethalin at 750 g/ha (pre-emergence), $W_4$ - imazethapyr at 40 g/ha (early post-emergence), $W_5$ - pendimethalin + imazethapyr at 750 g/ha (pre-emergence), $W_6$ - imazethapyr + imazamox at 50 g/ha (early post-emergence), $W_7$ - pendimethalin at 750 g/ha (pre-emergence) + 1 hand weeding (25 days after sowing), $W_8$ - imazethapyr at 40 g/ha (early post-emergence) + 1 hand weeding (35 days after sowing), $W_9$ - pendimethalin + imazethapyr at 750 g/ha (pre-emergence) + 1 hand weeding (25 days after sowing) and $W_{10}$ - imazethapyr + imazamox at 50 g/ha (early post-emergence) + 1 hand weeding (35 days after sowing). The test crop used was clusterbean variety RGC-1017, sown in rows spaced 30 cm apart at a seed rate of 15 kg/ha. The recommended nutrient dose included 10 kg N and 40 kg $P_2O_5$/ha applied using urea and DAP. Basal application covered the entire dose of nitrogen and phosphorus. While adhering to the recommended practices of the zone, the cultivation practices were followed, with the exception of weed management.

### 2.3 Plant Growth and Yield Analysis

Plant growth parameters such as dry matter per plant (g), plant height (cm), number of branches per plant, number of pods per plant, and number of seeds per pod were manually recorded by selecting five representative plants from each plot in each replication. Yield attributes and actual yields were also recorded, with seed and stover yields measured from the net plot area of each treatment. The collected data underwent comprehensive statistical analysis, including treatment means, standard error means, critical differences, and ranges of variation. The F-test for significance was also conducted for each parameter. The entire dataset was compiled and statistically analyzed using the established procedures for a randomized block design as suggested by Gomez and Gomez [13].

### 2.4 Application of Treatments

Pendimethalin and its combination with imazethapyr were applied as pre-emergence treatments within 2 DAS, while imazethapyr and its combination with imazamox were applied as early post-emergence treatments at 20 DAS. Herbicides were sprayed using a knapsack sprayer at a rate of 800 liters/ha. Hand weeding was conducted in designated plots at 25 and 35 DAS according to treatment specifications.

## 3. RESULTS AND DISCUSSION

The major weed flora founded throughout crop season revealed that weedy check plots were heavily invaded by broad leaved weeds chiefly *Digera arvensis, Tribulus terristris, Corchorus trilocularis, Phyllanthus niruri, Amaranthus viridis, Celosia argentea and Portulaca oleracea* and *Eragrostis minor, Cyperus rotundus, Cynodon dactylon and Dactyloctenium aegyptium*among narrow leaved weeds*. Digera arvensis* and *Tribulus terristris* were found to be the prominent broad leaved weeds.

### 3.1 Effect on Growth Attributes

In the present study, the impact of different weed management treatments on the growth attributes and yield of clusterbean was investigated. The findings revealed a significant enhancement in the growth parameters, such as dry matter per plant, plant height, and number of branches per plant, due to the application of weed management treatments during the crop season. Specifically, the dry matter per plant increased significantly with the application of the herbicide imazethapyr + imazamox at a rate of 50 g/ha. Interestingly, when this treatment was combined with one hand weeding at 35 days after sowing (DAS), the plant's dry matter further improved by 28.8%. Moreover, the plant height was significantly taller (65.1 cm) with the application of imazethapyr + imazamox at 50 g/ha along with one hand weeding at 35 DAS. This was on par with the combination of imazethapyr at 40 g/ha + one hand weeding at 35 DAS (63.6 cm) and weed-free conditions (65.8 cm). The treatment of imazethapyr + imazamox at 50 g/ha + one hand weeding at 35 DAS recorded a remarkable increase in plant height by 22.8% and 73.6% compared to the sole application of imazethapyr + imazamox at 50 g/ha and the weedy check, respectively. Further, treatments like imazethapyr + imazamox at 50 g/ha + one hand weeding at 35 DAS and imazethapyr at 40 g/ha (early post-emergence) + one hand weeding at 35 DAS exhibited promising results in enhancing the growth attributes of clusterbean, with 82.5% and 81.3% higher branches per plant at the harvest stage compared to weedy check plots. The

presence of less crop-weed competition, as evidenced by the lowest population of narrow and broad leaf weed species, along with lower weed dry weight, led to improved growth attributes. This allowed the crop to efficiently utilize nutrients, moisture, light, and space, contributing to better growth and development. Previous studies by Yadav et al., [14] and Sharma and Singh [15] also supported the idea that "effective weed management practices can significantly increase plant height and the number of branches per plant. Furthermore, weed control was linked to improved moisture, nutrient availability, and solar radiation for the crops. This resulted in higher chlorophyll content, photosynthetic rates, and nitrate reductase activity, ultimately promoting greater carbohydrate production and growth". Similar improvements in growth characteristics due to imazethapyr + imazamox at 40 g/ha were noted by Singh et al., [16] and Sharma et al., [17] in clusterbean.

### 3.2 Effect on Yield Attributes and Yield

Moving on to yield attributes, the treatment involving early post-emergence application of imazethapyr + imazamox at 50 g/ha along with one hand weeding at 35 DAS recorded the highest number of pods per plant (45.3). This was significantly superior to other treatments except for imazethapyr at 40 g/ha + one hand weeding at 35 DAS. The same treatment also led to the highest number of seeds per pod (7.5), showing a 44.2% increase over the control. Additionally, this treatment resulted in the highest 1000-seed weight (33.5 g), which was on par with imazethapyr at 40 g/ha + one hand weeding at 35 DAS. The yield was significantly improved with various weed management treatments compared to the control, with the highest seed yield (1180 kg/ha) achieved by the imazethapyr + imazamox at 50 g/ha + one hand weeding at 35 DAS treatment. Alone application of imazethapyr + imazamox at 50 g/ha recorded stover yield of 2670 kg/ha which was significantly higher over weedy season long plots by 316.5 per cent. When this treatment was super imposed with one hand weeding at 35 DAS, the stover yield was significantly further improved by 25.1 percent over application of imazethapyr + imazamox at 50 g/ha. These results highlight that effective weed management strategies can substantially impact the growth attributes and yield of clusterbean. The improvement in the yield components of the clusterbean could be attributed to increase in the growth characters of the crop.The combination of herbicidal treatments with one hand weeding at the appropriate stage appears to be a promising approach in enhancing both growth and yield. The findings align with previous research by Dungarwal et al., [18], Sharma and Singh et al., [15], Kumar et al., [19], Singh et al., [20], Singh et al., [21], Sharma et al., [17] and Yadav and Mundra [22] in the context of clusterbean cultivation.

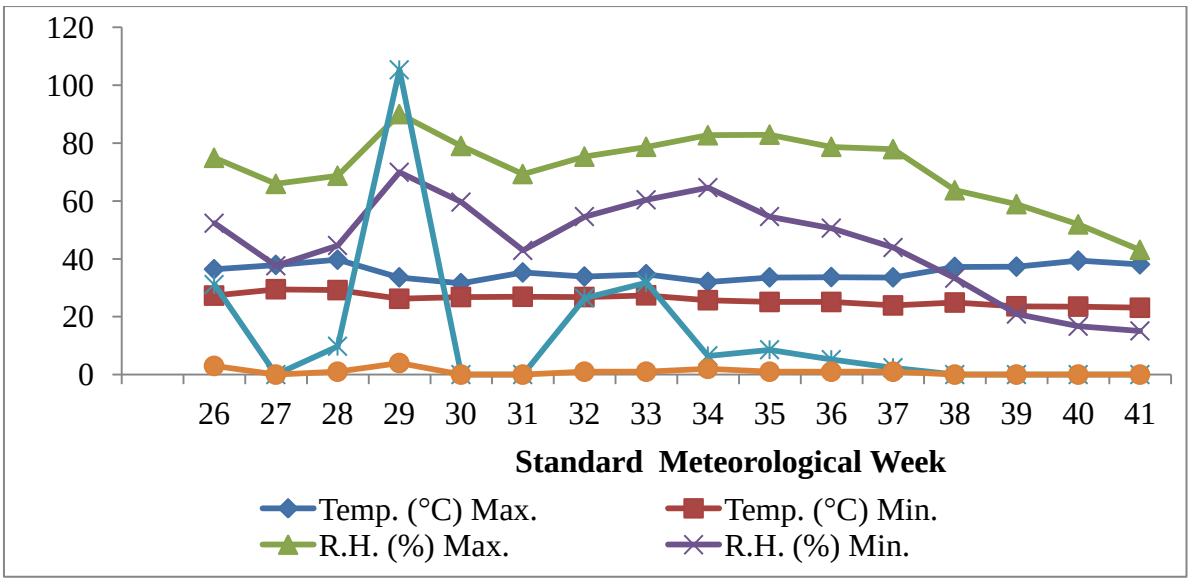


**Fig. 1. Meteorological data recorded at ARS, Mandor-Jodhpur during crop season**

**Table 1. Effect of different weed management treatments on growth attributes of clusterbean**

| Treatments | Plant population (Lakh/ha | | Dry matter/ plant (g) | Plant height (cm) | Number of branches/plant |
|---|---|---|---|---|---|
| | Initial | Final | | | |
| Weedy check | 3.12 | 1.91 | 12.2 | 37.5 | 3.60 |
| Weed free | 3.20 | 3.18 | 35.2 | 65.8 | 7.67 |
| Pendimethalin at 750 g/ha (pre-em.) | 3.18 | 2.25 | 23.3 | 44.3 | 4.47 |
| Imazethapyr at 40 g/ha(early post-em.) | 3.11 | 2.27 | 23.6 | 45.6 | 4.53 |
| Pendimethalin + imazethapyr at 750 g/ha (pre-em.) | 3.17 | 2.31 | 24.7 | 46.0 | 5.33 |
| Imazethapyr + imazamox at 50 g/ha (early post-em.) | 3.15 | 2.69 | 27.0 | 53.0 | 5.40 |
| Pendimethalin at 750 g/ha (Pre-em.) + 1 HW at 25 DAS | 3.19 | 2.77 | 27.4 | 53.4 | 5.47 |
| Imazethapyr at 40 g/ha (early post-em.) + 1 HW at 35 DAS | 3.16 | 3.07 | 32.5 | 63.6 | 6.53 |
| Pendimethalin + imazethapyr at 750 g/ha (pre-em.) + 1 HW at 25 DAS | 3.19 | 2.78 | 28.7 | 55.5 | 6.47 |
| Imazethapyr + imazamox at 50 g/ha (early post-em.) + 1 HW at 35 DAS | 3.19 | 3.11 | 34.8 | 65.1 | 6.57 |
| S Em ± | 0.12 | 0.11 | 0.78 | 2.07 | 0.28 |
| CD (P=0.05) | NS | 0.34 | 2.33 | 6.16 | 0.86 |

**Table 2. Effect of different weed management treatments on yield attributes, yield and harvest index of clusterbean**

| Treatments | Pods/plant (No.) | Seeds/pod (No.) | 1000-seed weight (g) | Seed yield (kg/ha) | Stover yield (kg/ha) | Harvest Index (%) |
|---|---|---|---|---|---|---|
| Weedy check | 22.0 | 5.2 | 26.4 | 210.0 | 641.0 | 24.67 |
| Weed free | 48.2 | 7.7 | 34.0 | 1237.0 | 3503.0 | 26.09 |
| Pendimethalin at 750 g/ha (pre-em.) | 29.4 | 5.8 | 29.5 | 694.0 | 2097.0 | 24.86 |
| Imazethapyr at 40 g/ha (early post-em.) | 31.0 | 5.8 | 29.7 | 713.0 | 2140.0 | 24.99 |
| Pendimethalin + imazethapyr at 750 g/ha (pre-em.) | 31.5 | 5.9 | 29.8 | 752.0 | 2257.0 | 24.99 |
| Imazethapyr + imazamox at 50 g/ha (early post-em.) | 35.9 | 6.7 | 30.6 | 893.0 | 2670.0 | 25.06 |
| Pendimethalin at 750 g/ha (pre-em.) + 1 HW at 25 DAS | 38.6 | 6.7 | 30.8 | 903.0 | 2711.0 | 25.01 |
| Imazethapyr at 40 g/ha (early post-em.) + 1 HW at 35 DAS | 43.4 | 7.4 | 33.2 | 1120.0 | 3240.0 | 25.68 |
| Pendimethalin + imazethapyr at 750 g/ha (pre-em.) + 1 HW at 25 DAS | 38.6 | 6.8 | 31.0 | 975.0 | 2923.0 | 25.01 |
| Imazethapyr + imazamox at 50 g/ha (early post-em.) + 1 HW at 35 DAS | 45.3 | 7.5 | 33.5 | 1180.0 | 3340.0 | 26.10 |
| S Em ± | 1.39 | 0.19 | 0.96 | 44.23 | 106.02 | 0.96 |
| CD (P=0.05) | 4.16 | 0.59 | 2.88 | 131.44 | 315.03 | NS |

## 4. CONCLUSION

Based on one year experiment, it may concluded that early post-emergence application of imazethapyr + imazamox at 50 g/ha + 1 HW at 35 DAS recorded higher growth, yield attributes and seed yield of clusterbean but equally effective with imazethapyr at 40 g/ha + 1 HW at 35 DAS. Keeping all views in mind, imazethapyr + imazamox at 50 g/ha + 1 HW at 35 DAS may be viable and taken for further research.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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