***Original Research Article***

**WEED DYNAMICS IN HYBRID MAIZE (*Zea mays* L.) AS INFLUENCED BY VARIOUS NON-CHEMICAL WEED MANAGEMENT STRATEGIES**

**ABSTRACT**

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| --- |
| A field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Chidambaram, Cuddalore district of Tamil Nadu during the *kharif* season (July to October) of 2023 to study the effect of different non-chemical weed management practices on weed dynamics in hybrid maize (*Zea mays* L.). The experiment was laid out in randomized block design (RBD) with eight non-chemical weed management treatments and the treatments were replicated thrice. The treatments comprised of T1 - Hand weeding twice on 20 and 40 DAS, T2 - Intercropping of cowpea in maize, T3 - Mulching with water hyacinth @ 6 t ha-1 *fb* hand weeding on 30 DAS, T4 - Mulching with sugarcane trash @ 6 t ha-1 *fb* hand weeding on 30 DAS, T5 - Foliar application of 10% sorghum water extract on 15 and 30 DAS, T6 - Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS, T7 - Mechanical weeding by long handled weeder on 20 and 40 DAS and T8 - Unweeded control. Among the different treatments tried out, hand weeding twice on 20 and 40 DAS (T1) significantly reduced the weed density and weed dry matter production, thereby minimizing the nutrient depletion by weeds. This treatment not only demonstrated superior weed control efficiency but also recorded the highest values for weed control index in hybrid maize. Although labour-intensive, hand weeding method of weed management remains an effective and viable option for sustainable maize production. |

***Keywords:*** *non-chemical, hybrid maize, weed control efficiency, sustainable maize production.*

**1. INTRODUCTION**

Maize (*Zea mays* L.) is one of the most important and versatile cereal crops having wider adaptability under varied agro-climatic conditions. Globally, Maize is known as the **“Queen of Cereals”** because of its high genetic production potential among cereals. Maize is cultivated throughout the year for various purposes including grain, fodder, green cobs, sweet corn, baby corn and popcorn in peri-urban areas. In addition to staple food for human beings and quality feed for animals, maize serves as a basic raw material as an ingredient in thousands of industrial products that include starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries, etc. Maize boasts a rich nutritional profile containing 7.6 % crude protein, 2.3 % crude fibre, 3.6 % crude fat, a substantial 63.8 % starch, 1.7 % total sugars and an impressive 3840 k cal kg-1 of gross energy (Srivastava & Singh, 2023). This makes it a powerful contender in addressing the food needs of both humans and animals.

However, achieving optimal maize productivity is hindered by several biotic and abiotic constraints, among which weed infestation poses a major challenge. Weeds are one of the primary yield-limiting factors in maize cultivation, competing aggressively with the crop for nutrients, moisture, sunlight,   
and space. As a wide spaced crop, maize is often subjected to heavy weed infestation, particularly   
during germination to 45 days after sowing (DAS) causes a maximum reduction in the yield of maize   
(Das *et al*., 2016). It is reported that the yield losses in hybrid maize due to weeds in the absence of weed management practices ranged from 44.1 to 49.1 % (Jat *et al*., 2018).

Conventional weed management relies heavily on chemical herbicides, which, although effective, pose serious concerns on the environment. Indiscriminate use of herbicides could create many environmental and health related problems globally, in addition to resistance development in weeds (Jabran *et al*., 2015). Environmental pollution, development of herbicidal resistance, shift in weed flora and residual toxicity in soil and water are some of the serious threats of excessive use of synthetic herbicides. Non-chemical weed management is a sustainable approach in managing weeds, leveraging on cultural, mechanical and biological methods to suppress weed growth effectively. Given the increasing global emphasis on sustainable agriculture and reduced chemical dependency, evaluating the effectiveness of non-chemical weed management on weed dynamics in hybrid maize becomes imperative.

**2. MATERIALS AND METHODS**

**2.1 Experimental details**

The field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar during the *kharif* season (July to October), 2023. The soil of the experimental field was clay loam in texture with a pH of 7.64. The soil was low in   
available nitrogen, medium in available phosphorus and high in available potassium. The hybrid maize   
NK - S6668 was chosen for the study. The seeds were sown by hand dibbling at the rate of 20 kg ha-1 with the specified spacing of 60 cm × 25 cm. The recommended fertilizer schedule of 250:75:75 kg N, P and K ha-1 was applied as a split dose.

**2.2 Treatment details**

The field experiment was conducted in Randomized Block Design (RBD) and the treatments were replicated thrice. The treatments comprised of T1 - Hand weeding twice on 20 and 40 DAS,   
T2 - Intercropping of cowpea in maize, T3 - Mulching with water hyacinth @ 6 t ha-1 *fb* hand weeding on 30 DAS, T4 - Mulching with sugarcane trash @ 6 t ha-1 *fb* hand weeding on 30 DAS, T5 - Foliar application of 10% sorghum water extract on 15 and 30 DAS, T6 - Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS, T7 - Mechanical weeding by long handled weeder on   
20 and 40 DAS and T8 - Unweeded control.

Manual hand weeding was done at two subsequent critical crop growth stages viz., 20 and 40 DAS. Cowpea was used as intercrop in maize. The mulching materials *viz*., water hyacinth and sugarcane trash were collected, dried and applied immediately after sowing leaving the crop row zone and a hand weeding was carried out at 30 DAS in the mulched treatment plots. Sorghum water extract and aqueous extract of *Lantana camara* were prepared according to standard procedure and used as foliar spray @ 10 % in the study. Mechanical weeding was done using a long-handled weeder (Star wheel type with strip blade) at 20 and 40 DAS, according to the treatment schedule.

**2.3 Preparation of sorghum water extract**

Field-grown sorghum plant herbage was collected at maturity, air-dried, chopped with a fodder cutter into 2 - 3 cm pieces and kept under cover to avoid possible leaching by rainwater. Then the chaffed sorghum material was soaked in distilled water at 1:10 (w/v) ratio for 24 hours at room temperature   
(34 ± 2°C). The mixture (herbage and water) was passed through a screen to prepare the sorghum water extract and the required concentration was prepared for the study (Cheema *et al*., 2004).

**2.4 Preparation of aqueous extract of *Lantana camara***

Fresh leaves of *Lantana camara* L. were collected and washed gently with running tap water to remove dust and other contaminants. Then the leaves were shade-dried at room temperature and oven-dried till complete drying was ensured. After drying, the leaves were ground to powder using the Willey mill. The aqueous extract of *Lantana camara* L. was prepared by soaking 50 g of grounded plant powder in 500 ml of distilled water (1:10 w/v ratio) under mechanical stirring at room temperature for 24 hours. Then the obtained mixture was filtered using Whatman No. 42 filter paper and the required concentration was prepared for the study (Talhi *et al*., 2020).

**2.5 Weed indices**

**2.5.1 Weed Control Efficiency (WCE)**

Weed control efficiency indicates the percentage reduction of weed population by any weed control treatment compared with weedy check plots. This index was used to compare the different weed control treatments, better was the treatment and *vice versa*. Weed control efficiency was calculated by using the formula derived by Mani *et al*. (1973).

WPC - WPT

WCE (%) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ × 100

WPC

Where,

WPC - Weed population in the control plot

WPT - Weed population in the treated plot

**2.5.2 Weed Control Index (WCI)**

Weed control index indicates the percentage reduction of weed dry matter by any weed control treatment compared with weedy check plots. This index was used to compare the different weed control treatments, better was the treatment and vice versa. The weed control index was calculated by using the derived by Das (2008).

WDC - WDT

WCI (%) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ × 100

WDC

Where,

WDC - Weed dry matter in the control plot

WDT - Weed dry matter in the treated plot

**3. RESULTS AND DISCUSSION**

**3.1 Weed flora of the experimental field**

The major floristic composition of the experimental field during the *kharif* season consisted of eight weed species from five different families, of which three were grasses, two were sedges and three were broad-leaved weeds. Grassesinclude *Brachiaria reptans*, *Cynodon dactylon* and *Echinochola colonum* while sedges include *Cyperus rotundus* and *Cyperus iria* and broad-leaved weedsinclude   
*Euphorbia microphylla*, *Phyllanthus maderaspatensis* and *Trianthema portulacastrum*.

*Brachiaria reptans* dominated among the grasses whereas *Cyperus rotundus* dominated among the sedges and *Trianthema portulacastrum* dominated among the broad-leaved weeds in terms of weed density. Overall, *Cyperus rotundus* dominated among all the weed species in the experimental field in terms of weed density.

**3.2 Weed density**

All the weed species recorded in the experimental field were significantly influenced by the   
non-chemical weed management treatments at 30 and 60 DAS in hybrid maize (Table 1 & 2). Among   
the different non-chemical weed management practices, hand weeding twice on 20 and 40 DAS (T1) significantly recorded the lowest weed count of 2.92 m-2 of *Brachiaria reptans*, 1.98 m-2 of   
*Cynodon dactylon*, 1.48 m-2 of *Echinochola colonum*, 4.48 m-2 of *Cyperus iria*, 5.32 m-2 of   
*Cyperus rotundus*, 1.02 m-2 of *Euphorbia microphylla*, 2.44 m-2 of *Phyllanthus maderaspatensis* and 3.56 m-2 of *Trianthema portulacastrum* at 30 DAS in hybrid maize.

Also, this treatment (T1) significantly recorded the lowest weed count of *Brachiaria reptans* (4.79 m-2), *Cynodon dactylon* (2.93 m-2), *Echinochola colonum* (2.25 m-2), *Cyperus iria* (7.23 m-2),   
*Cyperus rotundus* (9.06 m-2), *Euphorbia microphylla* (1.30 m-2), *Phyllanthus maderaspatensis*(3.80 m-2) and *Trianthema portulacastrum* (5.85 m-2)at 60 DAS in hybrid maize. This was likely because the weeds were completely removed at an early stage of the crop, which reduced the weed count.   
Also, weeds were removed before they reach maturity preventing them from contributing to the weed seed bank, thereby lowering the potential for further weed infestations. The investigation’s findings are also supported by Gupta *et al*. (2018).

The highest weed density at 30 and 60 DAS was observed in the unweeded control plot (T8) because weed management practices were not imposed in this plot and the weeds were nurtured profusely and remained undisturbed. Furthermore, the unweeded control plot provides optimum condition for weed seeds to germinate, grow and establish themselves resulting in a higher population. The findings of Singh *et al*.(2024) were consistent with similar results.

**3.3 Weed dry matter production**

On the perusal of the data, it was found that weed dry matter production at 30 and 60 DAS was significantly influenced by different non-chemical weed management strategies in hybrid maize   
(Table 3). The findings of the study revealed that among the different weed management practices tried out, hand weeding twice on 20 and 40 DAS (T1) significantly recorded the lowest weed dry matter production of 32.54 g m-2 and 74.13 g m-2 at 30 and 60 DAS, respectively in hybrid maize. It might be due to the fact that the first and second flushes of weeds were successfully reduced by manual weeding resulting in a reduced weed count that subsequently reduced the amount of dry matter production by weeds. Similar results were documented by Tagour & Mosaad (2017).

The highest weed dry matter production at 30 and 60 DAS in hybrid maize was observed in the unweeded control plot (T8). This might be due to the unrestricted proliferation of weeds persisted at the critical crop weed competition stages. This results in higher dry matter accumulation by the weeds. The investigation’s findings are also supported by Emam *et al*. (2024).

**3.4 Weed indices**

The results of the research revealed that among the different non-chemical weed management approaches, hand weeding twice on 20 and 40 DAS (T1) recorded the highest weed control efficiency of 82.40 % at 30 DAS and 83.49 % at 60 DAS in hybrid maize (Fig. 1). The highest weed control efficiency in hand weeding plot might be due to the congenial environment provided to the maize crop as the outcome of reduction in the weed population. The results are in accordance with the results specified by Baldaniya *et al*. (2018).

The findings of the study showed that the weed control index was remarkably influenced in hand weeding twice on 20 and 40 DAS (T1) which recorded the highest weed control index of 82.81 % and 83.56 % at 30 and 60 DAS respectively, in hybrid maize (Fig. 2). This might be because weeds are subsequently removed by uprooting them, which lowers weed density and dry matter production and ultimately increases the weed control index. The findings of Abdullahi *et al*.(2016) were consistent with similar results. The unweeded control (T8) recorded the lowest weed control efficiency and weed control index both at 30 and 60 DAS in hybrid maize.

**3.5 Nutrient removal by weeds**

Different non-chemical weed management strategies exerted significant influence over the total quantity of nutrients removed by weeds in hybrid maize (Table 4). The results revealed that the hand weeding twice on 20 and 40 DAS (T1) recorded the lowest nutrient removal by weedswith nitrogen removal of 7.52 kg ha-1, phosphorus removal of 3.72 kg ha-1 and potassium removal of 9.25 kg ha-1 in hybrid maize. Weeds were effectively uprooted by hand weeding resulting in the least weed dry matter   
accumulation, which in turn signified the lowest nutrient removal by weeds. The findings are also supported by Arunjith *et al*. (2021).

The unweeded control (T8) recorded the highest nutrient removal by weedsin hybrid maize. This might be because the weeds in the control plot accumulated more dry matter, which increased the weed's ability to remove large quantities of available nutrients. These outcomes concurred with the findings of Ramavath *et al*. (2022).

**4. CONCLUSION**

The present study revealed that hand weeding twice on 20 and 40 DAS significantly influenced the weed dynamics in hybrid maize. Among the various non-chemical weed management strategies evaluated, hand weeding twice on 20 and 40 days after sowing recorded the lowest weed density and weed dry matter production, thereby minimizing crop-weed competition during critical growth stages. The reduction in weed biomass effectively curtailed nutrient depletion by weeds, providing a congenial environment for the growth of hybrid maize. The superiority of hand weeding can be attributed to its effectiveness in removing both early-emerging and later-emerging weed flushes, thereby preventing weed seed bank replenishment and subsequent weed infestation. Although labour-intensive, this method remains an effective and viable option for sustainable maize production.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

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

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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**ABBREVIATIONS**

@ : at the rate of

cal : Calorie

CD (p=0.05) : Critical difference at 5 % probability level

DAS : Days after sowing

*et al*. : and others

*fb* : followed by

g m-2 : Gram per meter square

kg ha-1 : Kilogram per hectare

t ha-1 : tonnes per hectare

w/v : Weight per volume

*viz*. : Namely

**Table 1. Effect of non-chemical weed management practices on weed count (No. m-2) at 30 DAS in hybrid maize**

***\*Data in the parentheses (original values) were subjected to square root transformation and used for statistical analysis***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | ***Brachiaria reptans*** | ***Cynodon dactylon*** | ***Echinochola colonum*** | ***Cyperus iria*** | ***Cyperus rotundus*** | ***Euphorbia microphylla*** | ***Phyllanthus maderaspatensis*** | ***Trianthema portulacastrum*** |
| **T1** **-** Hand weeding twice on 20 and 40 DAS | 1.85  (2.92) | 1.57  (1.98) | 1.41  (1.48) | 2.23  (4.48) | 2.41  (5.32) | 1.23  (1.02) | 1.71  (2.44) | 2.01  (3.56) |
| **T2 -** Intercropping of cowpea in maize | 2.17  (4.22) | 2.04  (3.65) | 1.96  (3.35) | 2.57  (6.11) | 2.78  (7.25) | 1.88  (3.02) | 2.15  (4.11) | 2.47  (5.61) |
| **T3** **-** Mulching with water hyacinth @ 6 t ha-1 *fb* hand weeding on 30 DAS | 1.99  (3.46) | 1.79  (2.71) | 1.68  (2.31) | 2.39  (5.19) | 2.58  (6.17) | 1.56  (1.92) | 1.92  (3.17) | 2.23  (4.48) |
| **T4** **-** Mulching with sugarcane trash @ 6 t ha-1 *fb* hand weeding on 30 DAS | 1.96  (3.33) | 1.75  (2.57) | 1.62  (2.12) | 2.35  (5.04) | 2.55  (6.01) | 1.50  (1.74) | 1.88  (3.02) | 2.20  (4.32) |
| **T5** **-** Foliar application of 10% sorghum water extract on 15 and 30DAS | 3.23  (9.92) | 3.22  (9.88) | 3.19  (9.67) | 3.57  (12.26) | 3.78  (13.82) | 3.18  (9.60) | 3.29  (10.31) | 3.58  (12.35) |
| **T6** **-** Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS | 2.95  (8.20) | 2.88  (7.81) | 2.83  (7.51) | 3.28  (10.23) | 3.47  (11.51) | 2.79  (7.28) | 2.96  (8.26) | 3.23  (9.92) |
| **T7** **-** Mechanical weeding by long handled weeder on 20 and 40 DAS | 2.14  (4.07) | 2.00  (3.50) | 1.91  (3.16) | 2.54  (5.95) | 2.75  (7.08) | 1.83  (2.84) | 2.11  (3.95) | 2.44  (5.44) |
| **T8** **-** Unweeded control | 4.20  (17.12) | 3.86  (14.39) | 4.01  (15.57) | 4.26  (17.68) | 4.47  (19.50) | 4.01  (15.59) | 3.91  (14.78) | 4.20  (17.17) |
| **S. Ed** | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.04 | 0.04 | 0.05 |
| **CD (p=0.05)** | 0.09 | 0.09 | 0.09 | 0.10 | 0.11 | 0.09 | 0.09 | 0.10 |

**Table 2. Effect of non-chemical weed management practices on weed count (No. m-2) at 60 DAS in hybrid maize**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | ***Brachiaria reptans*** | ***Cynodon dactylon*** | ***Echinochola colonum*** | ***Cyperus iria*** | ***Cyperus rotundus*** | ***Euphorbia microphylla*** | ***Phyllanthus maderaspatensis*** | ***Trianthema portulacastrum*** |
| **T1** **-** Hand weeding twice on 20 and 40 DAS | 2.30  (4.79) | 1.85  (2.93) | 1.66  (2.25) | 2.78  (7.23) | 3.09  (9.06) | 1.34  (1.30) | 2.07  (3.80) | 2.52  (5.85) |
| **T2 -** Intercropping of cowpea in maize | 2.78  (7.22) | 2.67  (6.65) | 2.03  (3.62) | 3.37  (10.89) | 3.66  (12.93) | 1.81  (2.79) | 2.61  (6.30) | 2.98  (8.39) |
| **T3** **-** Mulching with water hyacinth @ 6 t ha-1 *fb* hand weeding on 30 DAS | 2.54  (5.97) | 2.23  (4.48) | 1.85  (2.92) | 3.08  (8.99) | 3.38  (10.90) | 1.58  (1.99) | 2.35  (5.01) | 2.75  (7.05) |
| **T4** **-** Mulching with sugarcane trash @ 6 t ha-1 *fb* hand weeding on 30 DAS | 2.45  (5.51) | 2.13  (4.05) | 1.80  (2.74) | 2.98  (8.39) | 3.28  (10.24) | 1.50  (1.74) | 2.25  (4.58) | 2.68  (6.68) |
| **T5** **-** Foliar application of 10% sorghum water extract on 15 and 30DAS | 4.30  (17.97) | 4.60  (20.67) | 3.76  (13.64) | 4.92  (23.72) | 5.17  (26.25) | 3.67  (12.97) | 4.27  (17.76) | 4.53  (19.99) |
| **T6** **-** Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS | 3.94  (15.05) | 3.98  (15.37) | 3.46  (11.46) | 4.43  (19.14) | 4.68  (21.40) | 3.33  (10.62) | 3.86  (14.36) | 4.12  (16.49) |
| **T7** **-** Mechanical weeding by long handled weeder on 20 and 40 DAS | 2.69  (6.74) | 2.59  (6.20) | 1.98  (3.43) | 3.28  (10.24) | 3.57  (12.25) | 1.74  (2.52) | 2.52  (5.85) | 2.92  (8.00) |
| **T8** **-** Unweeded control | 5.35  (28.11) | 4.96  (24.06) | 4.82  (22.74) | 5.93  (34.64) | 6.15  (37.31) | 4.64  (21.03) | 5.19  (26.42) | 5.62  (31.12) |
| **S. Ed** | 0.06 | 0.05 | 0.05 | 0.06 | 0.07 | 0.04 | 0.05 | 0.06 |
| **CD (p=0.05)** | 0.12 | 0.11 | 0.10 | 0.14 | 0.15 | 0.09 | 0.11 | 0.13 |

***\*Data in the parentheses (original values) were subjected to square root transformation and used for statistical analysis***

**Table 3. Effect of non-chemical weed management practices on weed dry matter production (g m-2) at 30 and 60 DAS in hybrid maize**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Weed dry matter production (g m-2)** | |
| **30 DAS** | **60 DAS** |
| **T1 -** Hand weeding twice on 20 and 40 DAS | 5.75  (32.54) | 8.64  (74.13) |
| **T2 -** Intercropping of cowpea in maize | 7.13  (50.35) | 10.90  (118.30) |
| **T3 -** Mulching with water hyacinth @ 6 t ha-1 *fb* hand weeding on 30 DAS | 6.38  (40.19) | 9.76  (94.81) |
| **T4 -** Mulching with sugarcane trash @ 6 t ha-1 *fb* hand weeding on 30 DAS | 6.26  (38.64) | 9.39  (87.67) |
| **T5 -** Foliar application of 10% sorghum water extract on 15 and 30 DAS | 10.73  (114.60) | 15.69  (245.63) |
| **T6 -** Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS | 9.59  (91.44) | 13.93  (193.67) |
| **T7 -** Mechanical weeding by long handled weeder on 20 and 40 DAS | 7.01  (48.65) | 10.56  (110.94) |
| **T8 -** Unweeded control | 13.78  (189.29) | 21.25  (450.92) |
| **S. Ed** | 0.14 | 0.22 |
| **CD (p=0.05)** | 0.31 | 0.47 |

***\*Data in the parentheses (original values) were subjected to square root transformation and used for statistical analysis***

**Fig. 1. Effect of non-chemical weed management practices on weed control efficiency (%) at 30 and 60 DAS in hybrid maize**

**Fig. 2. Effect of non-chemical weed management practices on weed control index (%) at 30 and 60 DAS in hybrid maize**

**Table 4. Effect of non-chemical weed management practices on nutrient removal by weeds (kg ha-1) in hybrid maize**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Nutrient removal by weeds (kg ha-1)** | | |
| **Nitrogen**  **(kg ha-1)** | **Phosphorus (kg ha-1)** | **Potassium (kg ha-1)** |
| **T1** **-** Hand weeding twice on 20 and 40 DAS | 7.52 | 3.72 | 9.25 |
| **T2 -** Intercropping of cowpea in maize | 12.60 | 6.72 | 15.19 |
| **T3** **-** Mulching with water hyacinth @ 6 t ha-1*fb* hand weeding on 30 DAS | 9.85 | 5.07 | 12.00 |
| **T4** **-** Mulching with sugarcane trash @ 6 t ha-1*fb* hand weeding on 30 DAS | 9.04 | 4.59 | 11.05 |
| **T5** **-** Foliar application of 10% sorghum water extract on 15 and 30DAS | 27.22 | 14.79 | 32.13 |
| **T6** **-** Foliar application of 10% aqueous extract of *Lantana camara* on 15 and 30 DAS | 21.01 | 11.23 | 25.10 |
| **T7** **-** Mechanical weeding by long handled weeder on 20 and 40 DAS | 11.73 | 6.18 | 14.18 |
| **T8** **-** Unweeded control | 50.73 | 28.14 | 59.52 |
| **S. Ed** | 0.47 | 0.26 | 0.55 |
| **CD (p=0.05)** | 1.01 | 0.56 | 1.18 |