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## Effect of chemical weed management on weed growth and yield of summer greengram in red and lateritic soil of West Bengal

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### Abstract

A field experiment was conducted at Nildiganta Baganbari Farm, Bariadihi village near Santiniketan, Birbhum, West Bengal during the summer season of 2024 to study the efficacy of different herbicides against complex weed flora and impact on weed growth, yield and profitability of summer green gram. Eight treatments viz, pre-emergence application (PE) of pendimethalin @ 0.75 kg ha<sup>-1</sup> at 1 day after sowing (DAS), post-emergence application (PoE) of imazethapyr @ 50 g ha<sup>-1</sup> at 20 DAS, quizalofop-p-ethyl @ 50 g ha<sup>-1</sup> PoE at 20 DAS, fenoxaprop-p-ethyl @ 60 ml ha<sup>-1</sup> PoE at 25 DAS, propaquizafop @ 60 ml ha<sup>-1</sup> PoE at 20 DAS, ready mix sodium acifluorfen + clodinafop-propargyl @ 0.245 kg ha<sup>-1</sup> PoE at 25 DAS, two hand weeding at 15 and 30 DAS and unweeded control were assigned under randomized block design replicated thrice. The dominant weed species infesting the greengram were *Digitaria sanguinalis*, *Echinochloa colona*, among grasses, *Amaranthus viridis* among broad leaved and *Cyperus iria*, *Cyperus rotundus* among sedges. Experimental results revealed that sodium acifluorfen + clodinafop-propargyl @ 245 ml ha<sup>-1</sup> recorded the lowest weed count and biomass of all categories of weed. The weed control efficiency was found to be 100% in hand weeding at 15 and 30 DAS. But among the herbicides, sodium acifluorfen + clodinafop-propargyl @ 245 ml ha<sup>-1</sup> exhibited the highest efficacy in controlling weeds with a total weed control efficiency of 86.1% and 72.6% at 30 DAS and 45 DAS, respectively. Sodium acifluorfen + clodinafop-propargyl @ 245 ml ha<sup>-1</sup> also recorded higher values of plant growth and yield attributes, which in turn resulted in highest seed yield (746 kg ha<sup>-1</sup>) and economic return. Application of sodium acifluorfen + clodinafop-propargyl @ 245 ml ha<sup>-1</sup> was found to be effective for management of diverse weed flora and higher yield of greengram in lateritic soil of West Bengal.

**Keywords:** Clodinafop propargyl, greengram, pre-emergence herbicide, post emergence herbicide, ready mix herbicide, sodium acifluorfen, weed control efficiency, weed management

### Introduction

Greengram (*Vigna radiata* L. Wilczek) is one of the most ancient and extensively grown leguminous crops of India. It is grown in 35.43 lakh ha area in India with a production of 3.82 million tonnes. It is an important short duration legume crop extensively grown in West Bengal and is mainly cultivated in pre-kharif/summer season. The crop has high yield potential but the productivity is reduced due to various biotic and abiotic stresses. Weed infestation is one of the major limitations for obtaining higher yield of greengram. Being a short stature in nature, the crop faces intense weed competition during the initial period of crop growth (Patel *et al.*, 2020) [6]. Greengram is a poor competitor against weeds (Kumar *et al.*, 2005) [5], specially during its initial stages of growth and therefore, weed management is essential for proper crop growth and development. Depending on the cultivars, growing season, soil type, nature, density and duration of weed competition, the magnitude of yield reduction due to weeds varies from 7.16 to 37% in greengram (Duary *et al.*, 2014) [1]. While manual hand weeding has been the most efficient and safe but it requires high physical energy, involves higher cost. Non-availability of labour in time is also major concern for its implementation in large areas. Recently herbicides are gaining popularity for cost effective and timely management of weeds. Pre-emergence herbicides have a narrow window of application for which farmer may miss the chance of timely application. Pre-

emergence herbicides aid in creating an ideal environment for the crop by preventing weed growth (Duary *et al.*, 2016) <sup>[2]</sup> whereas, weeds emerging at a later stage needs to be controlled with a post-emergence herbicide. Summer greengram is infested with wide range of weed species under different categories (Duary *et al.*, 2014) <sup>[1]</sup> and all the herbicides may not be effective against all the species. Therefore, it is essential to study the efficacy of available herbicides against different weed species in greengram to have alternative options for effective control of weeds. Pendimethalin, a dinitroaniline herbicide applied as pre-emergence at 0.75 kg ha<sup>-1</sup> (Kaur *et al.*, 2010) <sup>[3]</sup> or at 1.0 kg ha<sup>-1</sup> (Patil *et al.*, 2014) <sup>[7]</sup> has been found to reduce the weed population as well as dry weight without affecting the yield of crop. Similarly, application of imidazolinone herbicide such as imazethapyr at 50 and 70 g ha<sup>-1</sup> (Kaur *et al.*, 2016) <sup>[4]</sup> or at 50 and 75 g ha<sup>-1</sup> (Singh *et al.*, 2014) <sup>[8]</sup> as post-emergence can significantly reduce the growth of dominant weeds. With this perspective the present experiment was set to study the effect of herbicides and their impact on weed growth, yield and profitability of summer greengram.

### Materials and Methods

A field experiment was conducted out during summer season of 2024 at Nildiganta Baganbari Farm, Bariadihi village near Santiniketan, Birbhum, West Bengal. The field is located at 23.6763° N latitude and 87.6650° E longitude and 55 m above mean sea level. Soil of the experimental field was sandy loam in texture and the initial pH and EC of the soil were 5.12 and 0.2 dsm<sup>-1</sup>, respectively. The field experiment was planned to execute in randomized block design with three replications each consisting of eight treatments viz. pendimethalin at 0.75 kg ha<sup>-1</sup> as pre-emergence (PE) at 1 day after sowing (DAS) (T<sub>1</sub>), imazethapyr at 50 g ha<sup>-1</sup> at 20 DAS (T<sub>2</sub>), quizalofop-p-ethyl at 50 g ha<sup>-1</sup> at 20 DAS (T<sub>3</sub>), fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup> at 25 DAS (T<sub>4</sub>), propaquizafop at 60 ml ha<sup>-1</sup> at 20 DAS (T<sub>5</sub>), ready mix sodium acifluorfen + clodinafop-propargyl at 0.245 kg ha<sup>-1</sup> at 25 DAS (T<sub>6</sub>), hand weeding twice at 15 and 30 DAS (T<sub>7</sub>) and unweeded control (T<sub>8</sub>). The variety of greengram used in the experiment was "Vikram". The crop was sown using a seed rate of 25 kg ha<sup>-1</sup> with row spacing of 25 cm and the seeding depth of 3-4 cm. The gross plot size was maintained as 3.5 × 3.5 m. Herbicide was applied using a knapsack sprayer and the spray volume was 500 litres of water ha<sup>-1</sup>. Recommended dose of nutrients N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O at 20:40:20 kg ha<sup>-1</sup> were applied to the greengram crop. Total amount of recommended dose of nitrogen, phosphorus and potash was applied as basal. All the agronomic practices were followed in the experimental field as per the recommendation and under plant protection measures chlorpyrifos 50%+ cypermethrin 5% insecticide at 1.0 Liter ha<sup>-1</sup> was sprayed to control pest. The data on weeds were subjected to square root transformation before statistical analysis to normalise their distribution. Weed count was taken at 30 and 45 DAS by placing 50 × 50 cm quadrat from the earmarked area of sampling (1.0 m<sup>2</sup>) of each plot and after drying them in hot air oven at 70 °C, weed dry weight (biomass) was recorded. Yield attributes and seed yield of greengram were recorded at harvest and the data were statistically analysed at 5% level of significance. During harvesting the pods were picked twice at an interval of 10 days. The harvested pods of these two pickings were sun dried for 3-4 days. These dried pods were then manually threshed separately from each experimental plot and then seed weight was taken.

### Results and Discussion

Weed flora in the experimental field comprised of grasses,

sedges and broadleaved weeds (BLW). The dominant weed species in the experimental field were *Digitaria sanguinalis*, *Echinochloa colona* among grasses, *Cyperus iria*, *Cyperus rotundus* among sedges and *Amaranthus viridis* among broad leaved weeds. Similar weed flora in summer greengram was also reported earlier by Duary *et al.* (2014) <sup>[1]</sup>.

### Effect on weeds

Adoption of different weed management practices significantly influenced the total weed density and biomass (Fig.1 and Table-1). Among the different herbicidal treatments, significantly the lowest total weed count was recorded under T<sub>6</sub> (Sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup>) with 14.93 and 19.58 no.m<sup>-2</sup> at 30 and 45 DAS, respectively. During both the stages of observations (30 and 45 DAS) the lowest weed biomass was recorded under the treatment sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>). The pre-emergence pendimethalin at 750 ml ha<sup>-1</sup> recorded the lowest biomass of grassy weeds (18.27 g m<sup>-1</sup>) but it was unable to control broadleaved and sedges to that extent at 45 DAS, resulting in higher total weed population under this treatment. Whereas at 30 DAS, application of sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) resulted with lowest grassy weed biomass (7.17 g m<sup>-1</sup>). The herbicide imazethapyr at 50 ml ha<sup>-1</sup> (T<sub>2</sub>) resulted with zero count of broadleaved weeds at both the stages of observations. Sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) also exhibited higher effectiveness against broadleaved weeds with zero count as well as biomass at 30 and 45 DAS. Quizalofop-p-ethyl @ 50 ml ha<sup>-1</sup>, fenoxaprop-p-ethyl @ 60 ml ha<sup>-1</sup> and propaquizafop @ 60 ml ha<sup>-1</sup> were unable to suppress BLW because these are basically grass killers. Sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) resulted with no sedge count at 45 DAS though it registered a certain level of sedges (6.91 no.m<sup>-2</sup>) at 30 DAS and the same trend was also followed in weed biomass. Application of pre-emergence herbicide (Pendimethalin at 750 ml ha<sup>-1</sup>) was found to be less efficient in suppressing total weeds over the application of post emergence herbicide.

The weed control efficiency was found to be the highest in hand weeding at 15 and 30 DAS. But among the herbicides sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) exhibited the highest efficacy in controlling weeds with a total weed control efficiency of 86.1% and 72.6% at 30 DAS and 45 DAS, respectively (Fig. 2).

### Effect on plant growth

Among the different chemical weed management strategies, the plant height, leaf area index (LAI) and dry matter accumulation were found to be the highest under the treatment two hand weeding at 15 and 30 DAS (T<sub>7</sub>). Whereas, among the herbicidal treatments sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) registered the higher values of LAI, dry matter accumulation and it remained statistically similar with the treatment fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup> (T<sub>4</sub>) except plant height (Table 2). A good increment in plant parameters was observed due to the reduction in crop-weed competition by the application of herbicides which created a favourable condition for better plant growth.

### Effect on yield attributes and yield

The yield attributing characters viz. pods/plant and seeds/pod were found to be the highest under two hand weeding at 15 and 30 DAS (T<sub>7</sub>) which remained statistically similar with the treatment comprising sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) and fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup> (T<sub>4</sub>). On

the other hand, significantly the highest value of test weight was registered under the treatment hand weeding twice at 15 and 30 DAS (T<sub>7</sub>). Higher values of yield attributing characters might be due to the effective control of complex weed flora which provided a favourable condition for better plant growth. Two times hand weeding at 15 and 30 DAS (T<sub>7</sub>) recorded the highest the seed yield (840 kg ha<sup>-1</sup>) and was followed by the application of sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (746 kg ha<sup>-1</sup>) and fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup> (650 kg ha<sup>-1</sup>). These outcomes were probably due to the good weed control efficiency during the critical periods of growth which facilitated better plant growth and subsequently a greater number of pods/plants, seeds/pod and test weight resulting in higher seed yield of greengram (Table-3).

### Economics of greengram cultivation

Economic evaluation of the applied treatments revealed that by the application of herbicides a good profit can be obtained in greengram (Table-4). The gross return was found to be significantly highest under the two-hand weeding at 30 and 45 DAS (T<sub>7</sub>-Rs.74836). Across the herbicidal treatments, sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) gave the highest net return (Rs. 32843) but it remained statistically similar with application of fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup>-T<sub>4</sub> (Rs. 25736). Sodium acifluorfen + clodinafop-propargyl at 245 ml ha<sup>-1</sup> (T<sub>6</sub>) also fetched the highest return per rupee invested (2.09) and was statistically similar with application of fenoxaprop-p-ethyl at 60 ml ha<sup>-1</sup> (T<sub>4</sub>- 1.96).

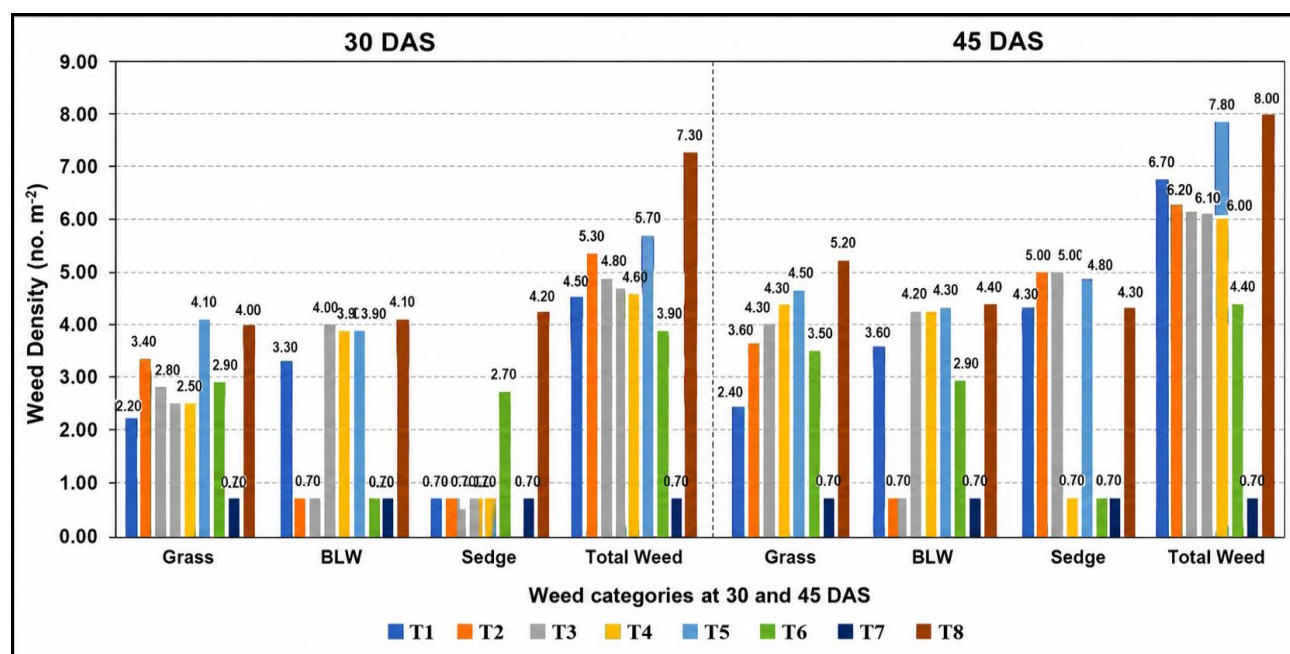


Fig 1: Category wise weed density as influenced by different herbicidal treatments (transformed value)

Table 1: Category wise and total weed biomass as influenced by different herbicidal treatments

| Treatments                                                                           | Weed biomass (g m <sup>-1</sup> ) |                 |                |                 |                 |                 |                 |                   |
|--------------------------------------------------------------------------------------|-----------------------------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|-------------------|
|                                                                                      | 30 DAS                            |                 |                |                 | 45 DAS          |                 |                 |                   |
|                                                                                      | Grass                             | Broad leaved    | Sedge          | Total           | Grass           | Broad leaved    | Sedge           | Total             |
| T <sub>1</sub> - Pendimethalin @ 750 ml ha <sup>-1</sup>                             | 2.97<br>(8.29)                    | 2.19<br>(4.29)  | 1.97<br>(3.39) | 4.08<br>(16.15) | 4.33<br>(18.27) | 6.20<br>(37.93) | 6.50<br>(41.79) | 9.96<br>(98.77)   |
| T <sub>2</sub> - Imazethapyr @ ml ha <sup>-1</sup>                                   | 4.16<br>(16.84)                   | 0.71<br>(0.00)  | 2.57<br>(6.09) | 4.84<br>(22.95) | 5.85<br>(33.69) | 0.71<br>(0.00)  | 5.93<br>(34.72) | 8.32<br>(68.77)   |
| T <sub>3</sub> - Quizalofop-p-ethyl @ 50 ml ha <sup>-1</sup>                         | 3.24<br>(10.01)                   | 4.44<br>(19.24) | 0.71<br>(0.00) | 5.46<br>(29.27) | 5.47<br>(29.40) | 8.24<br>(67.35) | 0.71<br>(0.00)  | 9.86<br>(96.81)   |
| T <sub>4</sub> - Fenoxaprop-p-ethyl @ 60 ml ha <sup>-1</sup>                         | 2.81<br>(7.37)                    | 4.33<br>(18.23) | 0.71<br>(0.00) | 5.11<br>(25.62) | 4.84<br>(22.96) | 8.13<br>(65.57) | 0.71<br>(0.00)  | 9.46<br>(89.06)   |
| T <sub>5</sub> - Propaquizafop @ 60 ml ha <sup>-1</sup>                              | 4.24<br>(17.51)                   | 4.42<br>(19.07) | 0.71<br>(0.00) | 6.11<br>(36.79) | 6.16<br>(37.51) | 8.17<br>(66.17) | 4.07<br>(16.04) | 10.99<br>(120.31) |
| T <sub>6</sub> - Sodium acifluorfen + Clodinafop-propargyl @ 245 ml ha <sup>-1</sup> | 2.77<br>(7.17)                    | 0.71<br>(0.00)  | 1.78<br>(2.68) | 3.23<br>(9.92)  | 5.55<br>(30.29) | 4.14<br>(16.67) | 0.71<br>(0.00)  | 6.95<br>(47.85)   |
| T <sub>7</sub> - Hand weeding twice at 15 and 30 DAS                                 | 0.71<br>(0.00)                    | 0.71<br>(0.00)  | 0.71<br>(0.00) | 0.71<br>(0.00)  | 0.71<br>(0.00)  | 0.71<br>(0.00)  | 0.71<br>(0.00)  | 0.71<br>(0.00)    |
| T <sub>8</sub> - Unweeded control                                                    | 6.23<br>(38.37)                   | 5.06<br>(25.06) | 2.99<br>(8.43) | 8.52<br>(72.04) | 8.52<br>(72.17) | 8.58<br>(73.04) | 5.45<br>(29.19) | 13.25<br>(175.13) |
| S.E.m. ±                                                                             | 0.23                              | 0.12            | 0.08           | 0.18            | 0.44            | 0.28            | 0.12            | 0.24              |
| CD (p = 0.05)                                                                        | 0.60                              | 0.30            | 0.20           | 0.46            | 1.11            | 0.70            | 0.30            | 0.60              |

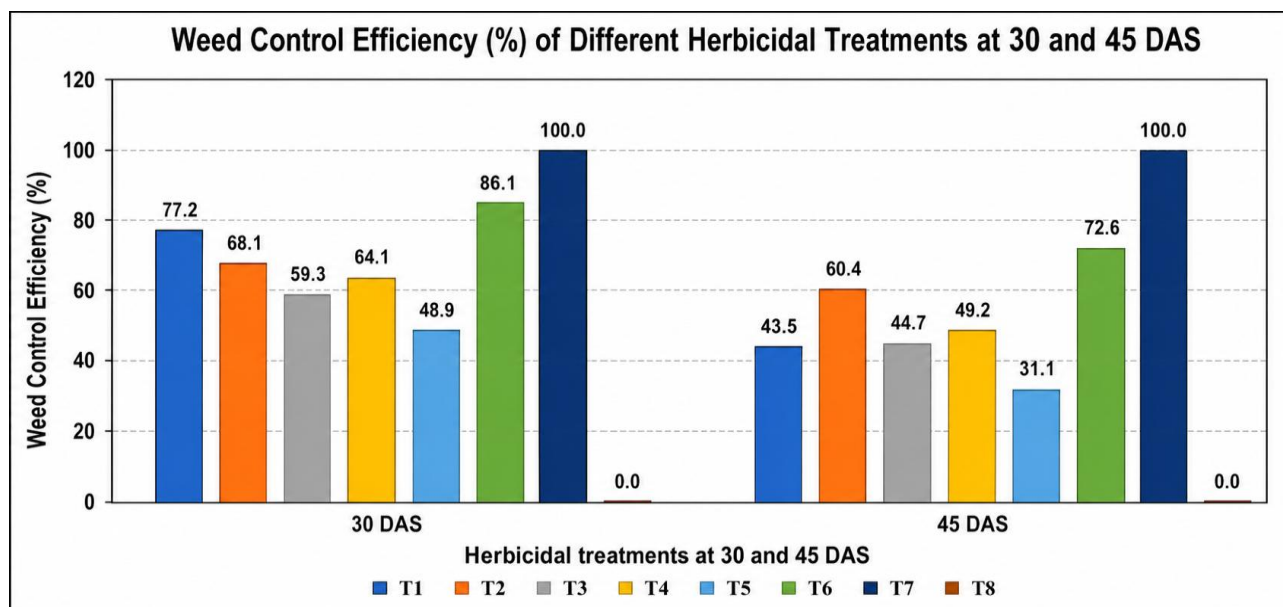


Fig 2: Total Weed control efficiency of different treatments

Table 2: Effect of treatments on plant growth attributes of greengram

| Treatments                                                                           | Plant height (cm) |        |         | Leaf Area Index (LAI) |        | Dry matter accumulation (g m <sup>-2</sup> ) |        |         |
|--------------------------------------------------------------------------------------|-------------------|--------|---------|-----------------------|--------|----------------------------------------------|--------|---------|
|                                                                                      | 30 DAS            | 45 DAS | Harvest | 30 DAS                | 45 DAS | 30 DAS                                       | 45 DAS | Harvest |
| T <sub>1</sub> - Pendimethalin @ 750 ml ha <sup>-1</sup>                             | 44.1              | 53.9   | 61.0    | 1.34                  | 2.71   | 233.2                                        | 584.1  | 957.5   |
| T <sub>2</sub> - Imazethapyr @ 50 ml ha <sup>-1</sup>                                | 48.7              | 56.4   | 59.2    | 1.64                  | 2.16   | 218.4                                        | 554.6  | 1007.8  |
| T <sub>3</sub> - Quizalofop-p-ethyl @ 50 ml ha <sup>-1</sup>                         | 46.6              | 53.7   | 56.2    | 1.31                  | 2.24   | 247.9                                        | 645.1  | 1213.7  |
| T <sub>4</sub> - Fenoxaprop-p-ethyl @ 60 ml ha <sup>-1</sup>                         | 50.4              | 65.7   | 68.1    | 1.84                  | 2.46   | 268.0                                        | 703.7  | 1405.3  |
| T <sub>5</sub> - Propaquizafop @ 60 ml ha <sup>-1</sup>                              | 46.1              | 54.7   | 58.3    | 1.47                  | 2.19   | 251.2                                        | 685.4  | 1050.6  |
| T <sub>6</sub> - Sodium acifluorfen + Clodinafop-propargyl @ 245 ml ha <sup>-1</sup> | 48.3              | 53.7   | 57.7    | 2.01                  | 2.73   | 283.9                                        | 762.9  | 1486.1  |
| T <sub>7</sub> - Hand weeding twice at 15 and 30 DAS                                 | 49.5              | 55.3   | 60.7    | 2.65                  | 3.41   | 399.2                                        | 847.5  | 1587.6  |
| T <sub>8</sub> - Unweeded control                                                    | 44.4              | 57.5   | 55.1    | 0.57                  | 2.03   | 137.6                                        | 493.4  | 837.2   |
| S.E.m. ±                                                                             | 1.5               | 2.8    | 2.3     | 0.15                  | 0.20   | 12.47                                        | 47.10  | 42.22   |
| CD (p = 0.05)                                                                        | 3.8               | 6.8    | 5.9     | 0.38                  | 0.51   | 31.07                                        | 117.29 | 105.15  |

Table 3: Yield attributes and yield of greengram as influenced by different herbicidal treatments

| Treatments                                                                           | Pods plant <sup>-1</sup> | Seeds pod <sup>-1</sup> | Test weight (g) | Seed yield (kg ha <sup>-1</sup> ) |
|--------------------------------------------------------------------------------------|--------------------------|-------------------------|-----------------|-----------------------------------|
| T <sub>1</sub> - Pendimethalin @ 750 ml ha <sup>-1</sup>                             | 13.7                     | 6.0                     | 42.83           | 464                               |
| T <sub>2</sub> - Imazethapyr @ 50 ml ha <sup>-1</sup>                                | 14.5                     | 6.3                     | 43.07           | 497                               |
| T <sub>3</sub> - Quizalofop-p-ethyl @ 50 ml ha <sup>-1</sup>                         | 15.8                     | 7.0                     | 43.77           | 638                               |
| T <sub>4</sub> - Fenoxaprop-p-ethyl @ 60 ml ha <sup>-1</sup>                         | 16.9                     | 7.7                     | 44.37           | 650                               |
| T <sub>5</sub> - Propaquizafop @ 60 ml ha <sup>-1</sup>                              | 15.5                     | 6.7                     | 43.20           | 569                               |
| T <sub>6</sub> - Sodium acifluorfen + Clodinafop-propargyl @ 245 ml ha <sup>-1</sup> | 17.7                     | 8.0                     | 44.60           | 746                               |
| T <sub>7</sub> - Hand weeding twice at 15 and 30 DAS                                 | 19.0                     | 9.3                     | 44.70           | 840                               |
| T <sub>8</sub> - Unweeded control                                                    | 12.9                     | 5.0                     | 42.56           | 446                               |
| S.E.m. ±                                                                             | 0.9                      | 0.7                     | 0.32            | 37.1                              |
| CD (p = 0.05)                                                                        | 2.3                      | 1.9                     | 0.80            | 92.6                              |

Table 4: Economics of greengram cultivation as influenced by different herbicidal treatments

| Treatments                                                                           | Cost of cultivation (Rs. ha <sup>-1</sup> ) | Gross return (Rs. ha <sup>-1</sup> ) | Net return (Rs. ha <sup>-1</sup> ) | Return per rupee investment |
|--------------------------------------------------------------------------------------|---------------------------------------------|--------------------------------------|------------------------------------|-----------------------------|
| T <sub>1</sub> - Pendimethalin @ 750 ml ha <sup>-1</sup>                             | 32902                                       | 41853                                | 8951                               | 1.49                        |
| T <sub>2</sub> - Imazethapyr @ 50 ml ha <sup>-1</sup>                                | 32710                                       | 44616                                | 11906                              | 1.59                        |
| T <sub>3</sub> - Quizalofop-p-ethyl @ 50 ml ha <sup>-1</sup>                         | 33010                                       | 57033                                | 24023                              | 1.73                        |
| T <sub>4</sub> - Fenoxaprop-p-ethyl @ 60 ml ha <sup>-1</sup>                         | 32530                                       | 58266                                | 25736                              | 1.96                        |
| T <sub>5</sub> - Propaquizafop @ 60 ml ha <sup>-1</sup>                              | 33650                                       | 51043                                | 17393                              | 1.53                        |
| T <sub>6</sub> - Sodium acifluorfen + Clodinafop-propargyl @ 245 ml ha <sup>-1</sup> | 33810                                       | 66652                                | 32843                              | 2.09                        |
| T <sub>7</sub> - Hand weeding twice at 15 and 30 DAS                                 | 54060                                       | 74836                                | 20776                              | 1.52                        |
| T <sub>8</sub> - Unweeded control                                                    | 31560                                       | 40207                                | 8647                               | 1.27                        |
| S.E.m. ±                                                                             | -                                           | 3207                                 | 3207                               | 0.08                        |
| CD (p = 0.05)                                                                        | -                                           | 7989                                 | 7989                               | 0.22                        |

## Conclusion

From the experiment it revealed that, though hand weeding twice at 15 and 30 DAS produced highest yield of greengram but it was not economically viable. So, the application of herbicides Sodium aciflourfen + Clodinafop-propargyl @ 245 ml ha<sup>-1</sup> and Fenoxaprop-p-ethyl @ 60 ml ha<sup>-1</sup> appeared to be effective option for managing complex weed flora, higher productivity, and profitability of greengram in lateritic belt of West Bengal.

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