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# Effect of weed management practices on nutrient removal and productivity of irrigated green gram (*Vigna radiata* L.)

**A Udhaya, S Rathika, T Ramesh, D Janaki and R Jagadeesan**

**Abstract**
A field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli during *Summer*, 2021 to evaluate the weed management practices in green gram. The study comprised of eleven weed management practices with different combination *viz*., pre emergence (PE) application of Diclosulam at 17.5 g/ha, Pendimethalin + Imazethapyr 1 kg/ha, post emergence (POE) application of Fluazifop-p-butyl + Fomesafen 313 g/ha, Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Diclosulam 17.5 g/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha, PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha, PE Diclosulam 17.5 g/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Pendimethalin 1 kg/ha *fb* HW on 30 DAS, HW on 20 and 40 DAS and unweeded control (UWC) in green gram. The results revealed that lower nutrient removal by weeds, higher nutrient uptake by crop and yield parameters *viz.*, number of pods plant$^{-1}$, pod length, number of seeds pod$^{-1}$ were registered in application of PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha. The highest grain and haulm yield were also registered in application of PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha and it was on par with PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha**.**

**Keywords:** Green gram, crop nutrient uptake, weeds nutrient removal, yield attributes, yield

## Introduction
Green gram (*Vigna radiata* L.) is one of the most important pulse crops in India, ranks third in production. Green gram can be grown in all the seasons of the year *viz.*, *kharif*, *rabi* and *summer* (Rathika *et al.*, 2023) [14]. Weed infestation is one of the major constraints in green gram production. In green gram, heavy weed competition causes yield loss of about 60-80 percent (Kumar *et al*., 2017) [8]. It is estimated that weed competition in green gram during first 30 days of sowing (Guriqbal Singh *et al*., 2019) [3]. The control of weeds during critical period of crop weed competition is very important so as to avoid yield loss (Ramesh and Rathika, 2016) [11]. The poor yield of green gram is mainly attributed to the use of poor quality seeds, water stress at flowering stage, less/non adoption of DAP spraying and improper weed management (Ramesh *et al.*, 2016) [12].
Nutrient addition through fertilizers is one of the costlier inputs in crop production, which may greatly influence the cost of cultivation. If proper weed management practices are not adopted, the weeds can make use of the inputs leaving the crop deprived which ultimately results in poor yield. Due to more weed biomass nutrient uptake by the crop was reduced (Stoimenova, 1995) [17]. The manual weeding is the most effective method for controlling weeds but it is laborious, time consuming and costly. During peak period of weed infestation, the unavailability of labour and increasing labour wages necessitates the herbicidal application for weed control in green gram (Rathika *et al.*, 2023) [14]. Herbicides are used extensively in Indian agriculture nowadays to control or kill weeds and to have timely weed management (Janaki *et al.*, 2013) [6]. Keeping in this view, the present investigation was carried out to evaluate the different weed management practices for irrigated green gram.

## Materials and Methods
A field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu during *Summer*, 2021. The experimental field was located at 10˚ 45’ N latitude, 78˚36’ E longitude and at an altitude of 85 m above MSL.

The soil of the experimental field was sandy loam in texture, moderately drained and classified as *Vetric Ustropept*. The experimental soil was low in available nitrogen, medium in available phosphorus and high in available potassium.

The field experiment was laid out in randomized block design (RBD) with three replications and eleven treatments. The treatments comprised of pre emergence (PE) application of Diclosulam at 17.5 g/ha, Pendimethalin + Imazethapyr 1 kg/ha, post emergence (POE) application of Fluazifop-p-butyl + Fomesafen 313 g/ha, Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Diclosulam 17.5 g/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha, PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha, PE Diclosulam 17.5 g/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha, PE Pendimethalin 1 kg/ha *fb* HW on 30 DAS, HW on 20 and 40 DAS and unweeded control (UWC). The variety used for the experiment was VBN (Gg) 4.

Observations recorded during the course of investigation were NPK removal by weeds (15, 30 and 40 DAS), NPK uptake by crops (30, 45 DAS and at harvest stage). Plant and weed samples were collected from the sampling area of individual plots for analysis. The collected samples were oven dried, ground in a willey mill and analyzed for nutrient contents. Nutrient uptake and removal were computed from their respective NPK concentration and dry matter production (DMP) and denoted as kg/ha. For estimating, Nitrogen - Microkjeldhal method (Humphries, 1956) [4], Phosphorus - triple acid digestion with colorimetric estimation (Jackson, 1973) [5] and Potassium - flame photometer (Jackson, 1973) [5] methods were used, respectively. The number of pods plant$^{-1}$, pod length, number of seeds pod$^{-1}$ and test weight were recorded during the harvest stage of crop. The grain and haulm yields were recorded and expressed in kg/ha.

## Results and Discussion

### Nutrient removal by weeds

The extent of weed competition in irrigated green gram was assessed through nutrient removal by weeds. Nutrient depletion is a function of dry weight and nutrient content in weeds. Removal of nutrients by weeds was significantly influenced by different weed management practices at all the stages of observation (Table 1). Lower nutrient (NPK) removal was registered with PE application of Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha. This might be due to the effective control of first and second flush of weeds by the application of pre emergence herbicide along with early post emergence herbicide. This could be attributed to lower dry weight of weeds as a result of reduced crop weed competition for nutrients, light, moisture and space throughout the crop growth which results in lower NPK removal by weeds. This is in agreement with the findings of Shanmugapriya *et al.* (2021) [16]. Throughout the crop period, maximum nutrient removal by weeds was recorded in UWC. This might be due to higher weed population and dry weight accumulation throughout crop growing period. This is in consonance with the findings of Kuldeep Singh *et al.* (2021) [7].

### Nutrient uptake by crops

Nutrient uptake by green gram was increased due to reduced weed density as well as weed biomass which helped the crop to grow well and absorb more nutrients from the soil. The highest nutrient (NPK) uptake of green gram was recorded with PE application of Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha and it was on par with PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha (Table 2). There was significant increase in NPK uptake by green gram due to increased weed control, less competition by weeds for nutrients, higher nutrient concentration and dry matter accumulation by crop. This is in consonance with the findings of Rukinderpreet Singh and Guriqbal Singh (2020) [15]. UWC registered vigorous weed growth resulted in higher NPK removal by weeds which results in lower NPK uptake by green gram. This is in agreement with the findings of Mousumi Dash and Basudev Behera (2018) [9].

### Yield parameters

Yield parameters *viz.*, number of pods plant$^{-1}$, pod length and number of seeds pod$^{-1}$ were significantly altered by different weed management practices (Table 3). The highest number of pods plant$^{-1}$, pod length and number of seeds pod$^{-1}$ were recorded with PE application of Pendimethalin + Imazethapyr at 1 kg ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen at 313 g ha$^{-1}$. The effective control of weeds in these treatments resulted in lesser competition by weeds for nutrients, space and light ultimately resulting in increased number of pods plant$^{-1}$, pod length and number of seeds pod$^{-1}$. Pre and post emergence herbicides were applied under sequential manner, reduced the weed competition during critical stages and increased yield attributes. This in accordance with the findings of Dinesh Jinger *et al*. (2016) [2]. This might be due to the broad spectrum control of weeds by the herbicides during early stages resulted in lesser weed competition that favoured better growth and yield parameters. This is in accordance with the findings of Ramesh and Rathika (2016) [11].

### Yield

Adoption of different weed management practices produced distinct variations in grain and haulm yields of green gram (Table 3). The highest grain yield were recorded by PE application of Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha and it was on par with PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha. This might be due to the cumulative effect of increased level of yield attributes which was due to lesser weed competition at critical stages, better uptake of nutrients and good crop stand. These results were in conformity with the findings of Ramesh and Rathika (2020) [13].

Haulm yield was also influenced by different weed management practices as that of grain yield. The highest haulm yield was registered in PE application of Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha and it was comparable with PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Acifluorfen sodium + Clodinafop propargyl 187.5 g/ha. This might be due to cumulative effect of increased levels of growth and yield attributes which was due to lesser weed competition and reduced weed population and dry weight. This is in agreement with the findings of Algotar *et al*. (2014) [1] and Ramesh and Rathika (2015) [10]. UWC registered lower grain and haulm

yields. This could be due to severe weed infestation creates crop weed competition, result in crop plants unable to express their genetic potential. This is in corroborates with findings of Sudesh Kumar *et al.* (2019) [18].

**Table 1:** Effect of weed management practices on nutrient removal by weeds in irrigated green gram

| Treatments | | Nitrogen removal by weeds (kg ha$^{-1}$) | | | Phosphorus removal by weeds (kg ha$^{-1}$) | | | Potassium removal by weeds (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS |
| $T_1$ | PE Diclosulam @ 17.5 g ha$^{-1}$ | 9.45 | 14.12 | 23.54 | 2.79 | 3.96 | 5.11 | 2.72 | 7.77 | 11.14 |
| $T_2$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ | 7.33 | 11.57 | 21.28 | 0.46 | 3.07 | 3.90 | 0.57 | 5.51 | 7.33 |
| $T_3$ | POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 13.45 | 11.90 | 22.88 | 3.82 | 3.25 | 4.67 | 15.10 | 5.95 | 7.78 |
| $T_4$ | POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 13.99 | 12.13 | 23.08 | 4.07 | 3.41 | 4.98 | 15.61 | 6.40 | 8.27 |
| $T_5$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 9.72 | 9.77 | 18.33 | 2.86 | 1.99 | 2.99 | 3.00 | 3.13 | 5.37 |
| $T_6$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 7.59 | 6.48 | 11.32 | 0.58 | 0.40 | 0.95 | 0.87 | 0.45 | 1.99 |
| $T_7$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 9.86 | 10.35 | 19.51 | 2.97 | 2.16 | 3.23 | 3.31 | 3.52 | 5.75 |
| $T_8$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5g ha$^{-1}$ | 7.72 | 7.03 | 13.24 | 0.61 | 0.56 | 1.17 | 0.99 | 0.67 | 2.44 |
| $T_9$ | PE Pendimethalin @ 1 kg ha$^{-1}$ *fb* HW on 30 DAS | 8.90 | 9.15 | 17.42 | 1.64 | 1.45 | 1.54 | 1.77 | 2.01 | 3.28 |
| $T_{10}$ | HW at 20 and 40 DAS | 14.15 | 8.95 | 16.64 | 4.53 | 1.08 | 1.28 | 15.89 | 1.57 | 2.86 |
| $T_{11}$ | UWC | 15.00 | 25.89 | 43.76 | 3.33 | 4.76 | 5.54 | 16.24 | 21.35 | 24.12 |
| SEd | | 0.42 | 0.50 | 0.97 | 0.10 | 0.11 | 0.14 | 0.30 | 0.24 | 0.33 |
| CD (P=0.05) | | 0.84 | 1.01 | 1.93 | 0.19 | 0.22 | 0.28 | 0.61 | 0.48 | 0.66 |

**Table 2:** Effect of weed management practices on nutrient uptake by irrigated green gram

| Treatments | | Nitrogen uptake (kg ha$^{-1}$) | | | Phosphorus uptake (kg ha$^{-1}$) | | | Potassium uptake (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 45 DAS | Harvest | 30 DAS | 45 DAS | Harvest | 30 DAS | 45 DAS | Harvest |
| $T_1$ | PE Diclosulam @ 17.5 g ha$^{-1}$ | 25.15 | 31.73 | 34.77 | 3.31 | 4.97 | 5.49 | 6.93 | 7.62 | 15.31 |
| $T_2$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ | 28.01 | 34.96 | 37.86 | 3.72 | 5.65 | 6.63 | 9.46 | 11.63 | 20.74 |
| $T_3$ | POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 27.24 | 33.47 | 36.9 | 3.56 | 5.42 | 6.17 | 8.77 | 10.31 | 18.80 |
| $T_4$ | POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 26.21 | 32.06 | 35.84 | 3.44 | 5.20 | 5.84 | 7.88 | 9.00 | 17.30 |
| $T_5$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 30.66 | 38.33 | 42.74 | 4.20 | 6.32 | 7.82 | 11.76 | 15.02 | 26.23 |
| $T_6$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 34.88 | 45.49 | 51.01 | 4.87 | 7.33 | 9.70 | 15.50 | 20.15 | 36.73 |
| $T_7$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 29.70 | 36.86 | 41.64 | 4.02 | 6.10 | 7.36 | 10.86 | 13.86 | 24.24 |
| $T_8$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 33.91 | 43.99 | 50.13 | 4.75 | 7.11 | 9.24 | 14.83 | 19.12 | 34.82 |
| $T_9$ | PE Pendimethalin @ 1 kg ha$^{-1}$ *fb* HW on 30 DAS | 31.65 | 41.03 | 45.24 | 4.41 | 6.68 | 8.42 | 13.10 | 16.79 | 30.97 |
| $T_{10}$ | HW at 20 and 40 DAS | 32.83 | 42.5 | 49.21 | 4.56 | 6.87 | 8.85 | 14.01 | 17.96 | 32.93 |
| $T_{11}$ | UWC | 21.47 | 29.97 | 37.74 | 2.49 | 2.94 | 3.31 | 4.99 | 6.12 | 10.22 |
| SEd | | 1.13 | 1.57 | 1.87 | 0.15 | 0.25 | 0.32 | 0.48 | 0.60 | 1.01 |
| CD (P=0.05) | | 2.25 | 3.13 | 3.75 | 0.30 | 0.50 | 0.64 | 0.96 | 1.20 | 2.02 |

**Table 3:** Effect of weed management practices on yield parameters and yield of irrigated green gram

| Treatments | | Yield parameters | | | | Yield (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|---|
| | | No. of pods plant$^{-1}$ | Pod length (cm) | No. of seeds pod$^{-1}$ | Test weight (g) | Grain | Haulm |
| $T_1$ | PE Diclosulam @ 17.5 g ha$^{-1}$ | 16.0 | 7.1 | 7.2 | 2.7 | 313 | 812 |
| $T_2$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ | 21.4 | 7.2 | 8.9 | 2.8 | 377 | 1047 |
| $T_3$ | POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 19.6 | 7.2 | 8.7 | 2.8 | 345 | 982 |
| $T_4$ | POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 17.2 | 7.1 | 8.4 | 2.7 | 332 | 885 |
| $T_5$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 25.4 | 7.3 | 9.5 | 2.8 | 445 | 1421 |
| $T_6$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Fluazifop-p-butyl + Fomesafen @ 313 g ha$^{-1}$ | 32.2 | 7.5 | 11.7 | 2.9 | 708 | 1602 |
| $T_7$ | PE Diclosulam @ 17.5 g ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 23.7 | 7.3 | 9.4 | 2.8 | 411 | 1378 |
| $T_8$ | PE Pendimethalin + Imazethapyr @ 1 kg ha$^{-1}$ *fb* POE Acifluorfen sodium + Clodinafop propargyl @ 187.5 g ha$^{-1}$ | 31.7 | 7.5 | 10.5 | 2.9 | 673 | 1531 |
| $T_9$ | PE Pendimethalin @ 1 kg ha$^{-1}$ *fb* HW on 30 DAS | 26.5 | 7.4 | 9.7 | 2.9 | 544 | 1464 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $T_{10}$ | HW at 20 and 40 DAS | 28.3 | 7.4 | 10.1 | 2.9 | 645 | 1502 |
| $T_{11}$ | UWC | 14.1 | 6.8 | 6.3 | 2.7 | 281 | 745 |
| SEd | | 1.1 | 0.4 | 0.4 | 0.1 | 21 | 54 |
| CD (P=0.05) | | 2.2 | NS | 0.8 | NS | 41 | 108 |

## Conclusion

Based on experimental results, application of PE Pendimethalin + Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl + Fomesafen 313 g/ha could effectively enhanced the crop nutrient uptake, yield attributes and yield of irrigated green gram with reduced nutrient removal by weeds under sodic soil condition.

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