JFL

Journal of Food Legumes 35(3): 217-220, 2022

Short communication

Effect of sequential application of herbicides on the growth and yield of greengram (*Vigna radiata* L.)

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Received: *July 25, 2022*
Accepted: *November 01, 2022*

Handling Editor:
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ABSTRACT

To study the effect of sequential application of herbicides on weed infestation, growth, yield attributes, and quality of greengram var. PDM-139 (Samrat), a n experiment was conducted in Random Block design using twelve treatments *viz.*, Oxyfluorfen 23.5%EC 125 g; Pendimethalin 30% EC 1000g, Imazethapyr 10% EC 100 g, Oxyfluorfen 23.5%EC 125 g and *fb* Quizalofop -p-ethyl 5% EC 50 g, Pendimethalin 30% EC 1000g and *fb* Quizalofop-p -ethyl 5% EC 50g, Imazethapyr 10% EC 100 g and *fb* Quizalofop-p-ethyl 5% EC 50g, Oxyfluorfen 23.5%EC 125 g and *fb* H W at 40 DAS, Pendimethalin 30% EC 1000g and *fb* HW at 40 DAS, Imazethapyr 10% EC 100 g and *fb* HW at 40 DAS, and Propaquizofop 10% EC 100 ml per hectare, Hand weeding at 20 and 40 DAS and weedy check . Different weed infestation, growth, yield attributes, and quality of green gram were recorded at 60 DAS. The highest dry weight of total weeds was recorded under the weedy check treatment and The plant height was significantly more (20.5 cm) and test weight (20.73) was highest with the hand weeding followed by treatment imazethapyr 10% EC at 1000 g ha^{-1} followed by HW at 40 DAS and among the different weed control treatments influenced the net returns and the benefit-cost ratio was maximum with an application of imazethapyr 10% EC at 1000 g ha^{-1} It can be concluded that the application of Imazethapyr 10 % EC *fb* hand weeding at 40 DAS proved superior with respect to grain yield and economics of the green gram.

Key Words: Economics, Green gram, Herbicides, Mungbean, Weed

Greengram (*Vigna radiata* L.) or mung bean originated in India and is one of the chief pulse crops in the country. It is grown mostly in the Asian region traditionally including Pakistan, Bangladesh, Sri Lanka, etc. although its cultivation has spread to Africa and America continents. India shares about 70% of the world's greengram p roduction (Anonymous, 2016). In India during 2019-20, the crop was grown in an area of about 31.15 lakh ha area with the production and productivity of 0.53 lakh tonnes and 798 kg/ha, respectively. The main producer states in India included Maharashtra (3.28 lakh ha), Madhya Pradesh (1.82 lakh ha), and Telangana (0.66 lakh ha).

It is cultivated in all three seasons *viz. Kharif, rabi*, and *Zaid*. It is not only grown as a sole crop but also as an intercrop, and mixed crop. It is a dwarf statured crop that suffers to a great extent if the weeds are not controlled at critical growth stages, as the weeds compete with the crop plants for all the resources required for growth including space, water, sunlight, air, and result in a decline in crop yield (Verma *et al.,* 2015). Weed seeds multiply rapidly and migrate from one place to other and once established cannot be easily eradicated.The weeds, not only reduce the quantity but also the quality of fodder and seed produced.

Weed control is one of the major operations generally practiced for improving yield in green gram. The critical competition with the weed starts from 20-30days after sowing. Manual weed control methods reduce weed count and eliminate almost all weed species, but the availability of manual labour at a specific time at a cheaper rate is not available. So, there is a need to explore some effective herbicides as an alternative source to control weeds effectively. It was evident that the application of selective herbicides effectively controls certain species or groups of weed species. The major weed species in green gram during the present experiment included

Cynodon dactylon, Dactyloctinum aegpytium, *Cyperus rotundus, Amaranthus virdis, Euphorbia hirta, and Digera arvensis*. Hence, there is a need to find out the effective pre or post-emergence herbicides either alone or in combination with cultural practices for timely control of weeds. Thus, in the present study, efforts have been made to find out effective weed management practices to control weeds in green gram to save the crop from weed infestation.

A field experiment was conducted during the *Kharif* season of 2021 at Crop Research Centre, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India (26.140° N latitude, 78.196° E longitude, and an altitude of 197 meters above mean sea level). The climate of this region was semi-arid, with extremes of temperature in both summers and winters. The average annual rainfall in this region ranges between 650-700 mm, mostly contributed by the South-West monsoon during the last week of June to September. The physico-chemical properties of the soil of the experimental field recorded sand 53.24 (%), silt 24.56 (%), clay 23.11 (%), textural class sandy loam, soil reaction (pH) 7.45, EC 0.42 dSm^{-1}, organic carbon 0.15%, available nitrogen 68 kg ha^{-1}, available phosphorus 16.5 kg ha^{-1} and available potassium 235.4 kg ha^{-1}. The green gram variety PDM-139 (Samrat) (average duration 70-75 days) was used as an experimental crop. The experiment was set up in a randomized block design with three replications. It consisted of pre-emergence and post-emergence application of herbicides viz. T_1- oxyfluorfen at the rate of 23.5% EC 125 g ha^{-1}, T_2 -pendimethalin 30% EC 1000 g ha^{-1}, T_3-imazethapyr 10% EC 100 g ha^{-1}, T_4-T_1 fb quizalofop-p-ethyl 5% EC 50 g ha^{-1}, T_5-T_2 fb quizalofop-p-ethyl 5% EC 50 g ha^{-1}, T_6-T_3 fb quizalofop-p-ethyl 5% EC 50 g ha^{-1}, T_7-T_1 fb Hand weeding, T_8-T_2 fb Hand weeding, T_9-T_3 fb Hand weeding,T_{10}-propoquizofop 10% EC 100 ml ha^{-1}, T_{11}-hand weeding twice at 20 and 40 DAS and T_{12}-weedy check. Nitrogen, phosphorus, and potassium were applied as per recommended dose and method (20:40:20 kg ha^{-1} NPK, respectively, each as basal application). Nitrogen, phosphorus, and potassium were applied through urea, single super phosphate, and muriate of potash, respectively. Treated seed of green gram at the rate of 12 kg ha^{-1} was sown in every treatment using the standard method. Recommended spacing (30 cm X 10 cm) was maintained by gap filling and thinning procedures and practices. Appropriate plant protection measures were followed during the experimentation. The data on weed dry weight and weed control efficiency at 60 DAS of the crop have been included. The plant height, leaf area index (Watson, 1958), the dry weight of the crop at 60 days after sowing (DAS), the yield of grain and straw as well as the economics of the crop using standard techniques were found to reveal the impact of different treatments. For comparing various treatment means, a one–way Analysis of the variance with the replications technique were implemented (Snedecor, and Cochran, 1994). The data were statistically analyzed using a data analysis pack of MS Office excel 2016 (UQ Library, 2016).

Among the different treatments given in (Table 1), the highest dry weight of total weeds was recorded under the weedy check treatment –T_{12}. However, it was found that the treatment T_{11} in which, hand weeding was done at 20 and 30 DAS, recorded a significantly minimum dry weight of weed at 60 DAS, which was at par with imazethapyr 10% EC 100g ha^{-1} HW at 40 DAS treatment-T_9. Minimum weed dry weight in different weed management treatments due to effective weed control succeeded under hand weeding and pre-emergence application of herbicides fb hand weeding at 40 DAS at the initial growth stages of the crop, which resulted in the lower weed density and finally reduced the dry weight of total weeds at 60 DAS .and recorded the highest weed control efficiency. The dense crop canopy might be suppressed the weed growth and did not allow weeds to grow vigorously due to the limiting effect. These results confirm the finding of Chhodavadia *et al.* (2014) in green gram.

The data given in (Table 1) revealed that the plant height was significantly more (20.5 cm) with a lower leaf area index (1.86) and minimum dry weight of crop (175 g m^{-2}) under unweeded plots, it might be due to intense competition weeds for moisture and nutrients; subsequently, the growth of the plant was affected. However, the treatment T9, the plant height was (42.5 cm) with a higher leaf area index (4.17) and maximum dry weight of crop (357 g m^{-2}) which was at par with treatments T11followed by T7 and T8 at 60 DAS of the crop growth stages. This might be due to the combined effect of hand weeding and the pre-emergence application of herbicide. This resulted in better availability of light, moisture, and nutrients to the crop owing to less competition of weeds. These findings are in conformity with Raj *et al.* (2012), and Chaudhari *et al.* (2016).

The highest value of test weight (20.73) was recorded with the hand weeding T_{11} followed by treatment T_9, T_8, and T_7 (Table 1). Hand weeding

Table 1. Infestation of weeds, growth and yield and yield attributes of green gram at 60 DAS as affected by different weed management practices

Treatments	Weed dry weight (g m^{-2})	Weed Control Efficiency (%)	Plant height (cm)	Leaf area index	Dry weight (g m^{-2})	Grain yield (kg/ha)	Straw Stover yield (kg/ha)	Harvest index (%)	Test weight (g/1000 Seeds)	Net return (INR)	B:C
T_1	11.5±0.9^{bc}	37.2	26.1±0.7^{d}	2.42±0.11^{d}	217±10^{d}	630±1^{d}	1984±3^{c}	24.10	34.8±1.5	48299	1.50
T_2	11.4±0.2^{c}	38.7	26.6±1.5^{d}	2.48±0.02^{d}	226±15^{d}	672±1^{d}	1990±13^{c}	25.24	35.3±2.5	51789	1.59
T_3	11.0±0.1^{c}	43.0	27.0±2.5^{d}	2.58±0.12^{d}	232±22^{d}	691±92^{d}	2008±37^{c}	25.60	35.5±2.35	54130	1.68
T_4	9.49±0.28^{d}	58.0	31.6±0.9^{c}	3.06±0.05^{c}	273±2^{c}	802±16^{c}	2298±52^{b}	25.86	35.6±2.75	65216	1.89
T_5	9.35±0.39^{d}	59.3	31.9±1.9^{c}	3.10±0.10^{c}	277±2^{c}	814±2^{c}	2312±135^{b}	26.04	35.7±2.52	66112	1.89
T_6	8.58±0.10^{d}	65.7	33.2±1.4^{c}	3.14±0.15^{c}	281±20^{c}	825±3^{c}	2319±98^{b}	26.24	36.2±1.23	67622	1.96
T_7	6.97±0.14^{e}	77.4	38.2±2.9^{b}	3.76±0.04^{b}	323±15^{b}	935±25^{b}	2610±66^{a}	26.38	36.5±1.41	76927	2.00
T_8	6.38±0.06^{e}	81.1	38.3±0.8^{b}	3.94±0.28^{ab}	337±18^{ab}	951±63^{ab}	2612±220^{a}	26.69	36.6±1.78	78039	2.01
T_9	5.98±0.13^{e}	83.5	42.5±0.43^{ab}	4.17±0.33^{ab}	357±12^{ab}	1012±17^{ab}	2770±64^{a}	26.75	37.0±0.38	86076	2.24
T_{10}	13.0±0.5^{b}	20.2	25.8±0.42^{d}	2.36±0.08^{d}	213±5.60^{d}	607±6^{d}	1878±79^{c}	24.42	34.1±1.41	44048	1.33
T_{11}	4.40±0.08^{e}	91.1	43.9±1.4^{a}	4.24±0.19^{a}	373±6.72^{a}	1049±43^{a}	2789±106^{a}	27.34	37.4±2.04	84414	1.95
T_{12}	14.6±1.3^{a}	0.0	20.5±0.7^{e}	1.86±0.10^{e}	175±14.1^{e}	490±10^{e}	1585±25^{d}	23.62	32.9±1.33	32470	1.06

DAS-days after sowing,

a,b,c,d,e- Values bearing different superscripts within the column differed significantly ($P<0.05$).

recorded considerably higher seed yield (1378 kg ha^{-1}), being at par with treatments T_8 and T_9. as well as significantly superior over the weedy check T_{12}. The per cent increase in seed yield under treatment T_{11} to the tune of 53.2 % over weedy check, while 3.5 %, 9.3%, and 10.86% over the treatments T_9, T_8, and T_7, respectively. The significantly higher stover yield (2789 kg ha^{-1}) was recorded under hand weeding T11, which was at par with T_7, T_8, and T_9 and the higher harvest index was recorded with T11 hand weeding treatment (27.34). Maintaining the weed-free environment, particularly throughout the critical crop growth stages, is primarily responsible for the increase in grain and stover yield. Reducing crop weed competition helped in better growth and development of green gram crops resulting in higher seed and stover yield. The study also shows that reduced weed population initially by pre-emergence herbicide followed by weed control around 21 DAS either by post-emergence herbicide or hand weeding have a lower reduction in yield. This finding showed that a significant increase in seed yield and a decrease in total dry weight of weeds were recorded under these treatments of green gram. These conclusions are close to the assumptions of investigators like Chhodavadia *et al.* (2014).

It is apparent that the results given in Table 1 of the experimentation recorded that the different weed control treatments influenced the net returns and the benefit-cost ratio was maximum with an application of T_9-imazethapyr 10% EC at 1000 g ha^{-1} followed by HW at 40 DAS (Rs.86076 ha^{-1}, Rs.2.24 re -1invested) followed by T_8-Pendimethalin 30%EC followed by Hand Weeding at 40 DAS (Rs.78039 ha^{-1},Rs.2.01re^{-1}invested)andT7-Oxyfluorfen23.5%EC followed by Hand Weeding at 40 DAS (Rs.76927 ha^{-1} Rs.2.00 re^{-1} invested) and rest of the treatments. The sequential application of pre-emergence followed by T_{11}-Hand weeding (Rs. 84414 ha^{-1}, Rs.1.95 re^{-1} invested) gave the maximum net returns in green gram related to other weed control treatments. These results validate the findings of Prakash, (2006), Kumar, (2010) and Singh, (2011).

It may be concluded that the application of Imazethapyr 10% EC fb hand weeding at 40 DAS proved superior with respect to grain yield and economics (Net return and BCR) of the green gram over the rest of the treatments.

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