Weed growth and productivity of Greengram (*Vignaradiata*L.) under different weed control practices

Abstract

A field experiment was conducted during summer season 2022 and 2023 to study the weed growth and productivity of greengram under different herbicidal treatments at agricultural research station, faculty of agricultural sciences, Bhubaneswar, Odisha, India to study the effect of different weed control practices on weed growth and productivity of greengram. The experiment conducted under eight treatments viz., pendimethalin 0.75 kg ha^{-1} at 1 DAS, imazethapyr 75 g ha^{-1} at 20 DAS, pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS, quizalofop ethyl 50 g ha^{-1} at 20 DAS, fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS, acifluorfen Na 16.5%+clodinafoppropargyl 8% 245 g ha^{-1} at 20 DAS, two hand weeding at 15 and 30 DAS and weedy check, were replicated thrice in the randomized block design. The findings showed that two hand weeding at 15 and 30 DAS registered significantly lowest weed density and biomass among the weed control practices and it was at par with pre-emergence application of ready-mix pendimethalin+imazethapyr 0.75 kg ha^{-1}. Weed competition resulted in 58.17% reduction in grain yield of greengram. Two hand weeding at 15 and 30 DAS recorded the highest seed and stover yield of greengram along with higher growth attributing characters like plant height, dry matter production and branches plant^{-1} and it was closely followed by application of ready-mix pendimethalin+imazethapyr at 0.75 kg ha^{-1} PE.

Keywords: Greengram, weed flora, seed yield, herbicides, pendimethalin+imazethapyr

Introduction

Food legumes are often acknowledged as poor man’s meat. In India, they constitute a comparatively less expensive source of dietary protein. Pulses are an excellent source of critical amino acids, vitamins, fiber, iron, zinc, and magnesium, among other vital minerals and nutrients to human health (Yadav*et al*., 2017). Among the pulses, green gram (*Vignaradiata*(L.) Wilczek) enjoys significant consumer preference due to its palatability and nutritious levels (Nirmala*et al*., 2018). During the summer and rainy seasons, weeds are the main factor that reduces mungbean yield (Singh *et al*., 2021). According to Singh *et al*. (2019), weed competition in green grams is expected to occur during the first 30 days of sowing. “The total annual agricultural production losses were mainly caused by weeds (45%), followed by insects (30%), diseases (20%), and other causes (5%)” (Ghorai*et al*., 2020). Effective weed management practices are more critical for green gram cultivation. Summer greengram often faces intense crop-weed competition, mainly when grown in an irrigated environment (Mukherjee, 2015). “A major obstacle to growing more summer greengram is weed infestation since weeds compete with crop plants for nutrients, moisture, light, and space. Weeds are a significant challenge to its production since they grow more quickly. The initial 70–80% of crop development occurs within the first 20–30 days after sowing. Hence, pre-emergence herbicides are of paramount importance during the initial growth period. Pre-emergence herbicides prevent weeds from emerging, creating an ideal habitat for growth in weed-free conditions” (Mohanty*et al*., 2023). The weeds that appear during the critical growth period must also be suppressed to prevent weed flushing. This can be done by hand weeding, using post-emergence herbicides, or doing interculture activities. This all-encompassing strategy guarantees that every growth stage is efficiently controlled to optimize yields within the allotted time frame. With this background the present experiment was conducted to study the effect of different weed control practices on weed growth and productivity of greengram.

Materials and Methods

The field experiment was conducted in the summer of 2022 and 2023 at the Agricultural Research Station, Binjhagiri, Chatabar, Institute of Agricultural Sciences, Odisha, India. The research farm is located within the East and South Eastern Coastal Plain Agroclimatic Zone of Odisha. The soil of the experimental plot was sandy loam in texture with pH 5.4, low in organic carbon (0.43%), available nitrogen (230 kg ha^{-1}), available phosphorus (21 kg ha^{-1}) and medium in available potassium (143 kg ha^{-1}). “The experiment was laid out in randomized block design with eight treatments viz.pendimethalin 0.75 kg ha^{-1} PE at 1 DAS, post-emergence application (PoE) of imazethapyr 75 g ha^{-1} at 20 DAS, pendimethalin+imazethapyr 0.75 kg ha^{-1} PE at 1 DAS, quizalofop ethyl 50 g ha^{-1}PoE at 20 DAS , fenoxapropp-ethyl 50 g ha^{-1}PoE at 20 DAS, sodium-acifluorfen Na 16.5%+clodinafop-propargyl 8% 245 g ha^{-1}PoE at 20

DAS, hand weeding twice at 15 and 30 DAS and weedy check.The cultivar of greengram was Virat, and recommended dose of fertilizer was 20-40-20 kg ha^{-1} N, P_2O_5 and K_2O, respectively. Herbicide was applied using a knapsack sprayer and the spray volume was 500l of water ha^{-1}. Weed density was assessed at 40 days after sowing (DAS) using a 50x50 cm quadrat (0.25 m^2) randomly placed within the sampling area. The weeds were cleaned by rinsing with water, exposed to sunlight for several hours, and subsequently dried in a hot air oven at 72°C for 72 hours" (Mohantyet al., 2023). The experimental data relating to each character of crop and weed were analyzed by the technique of "Analysis of variance" using MSTAT The pooled analysis of two year's data on weed growth and crop parameters has been done and presented in tables. The weed data were subjected to a square root transformation to normalize their distribution.

Results and Discussion

Effect on weed

The prominent weed flora viz. *Poaannua*, *Digitariasanguinalis* and *Echinochloacolona* among the grasses and *Cleome viscose* and *Melochiacorchorifolia* among the broadleaved weeds were observed throughout the crop growing period in experiment field. Similar weed flora in greengram has also been reported by Aliveni*et al*. (2016). Kavad*et al*. (2016), Jinger*et al*. (2016)

Two hand weeding at 15 and 30 DAS recorded the lowest density and dry weight of grasses, broadleaved, and total weeds at 40 DAS, and it was at par with the pre-emergence application of premix pendimethalin+imazethapyr at 0.75 kg ha^{-1}(Table 2). Kundu*et al*. (2011) reported that hand weeding twice at 15 and 30 days after sowing had shown a maximum reduction of grasses in greengram. Application of ready-mix pendimethalin+imazethapyr recorded 49.23% and 46.55% lower density and 65.64% and 59.60% lower biomass of total weeds compared to sole application of pendimethalin at 0.75 kg ha^{-1} and imazethapyr at 75 g ha^{-1} respectively (Table 2).
At the initial stage of crop growth, the treatments post emergence application of quizalofop ethyl and fenoxaprop-p-ethyl registered a lower population of grassy weeds. Though the herbicide fenoxaprop-p-ethyl is a grass killer, the weed species *Digitariasanguinalis* was not controlled by the herbicide. Similar observations were made by Mundra and Maliwal (2012).

Effect on Green Gram

The maximum plant height, branches plant^{-1}, and dry matter production were recorded under two hand weeding twice at harvest, and it was at par with pre-mix pendimethalin+imazethapyr 0.75 kg ha^{-1} PE(Table 1). Pre-emergence application of premix pendimethalin+imazethapyr recorded a 9.84% and 13.41% higher number of branch plant^{-1} at harvest compared to the sole application of imazethapyr and pendimethalin, respectively, at harvest. Chhodavadia et al. (2013) reported that two hand weeding significantly increase number of branches plant^{-1} compared to unweeded condition in summer greengram. This might be due to severe competition by weeds for resources, which made the crop plant inefficient in taking up more moisture and nutrients, and ultimately, growth was adversely affected due to a lower supply of carbohydrates. At harvest, the application of pendimethalin+imazethapyr recorded 14.71% and 19.24% higher values of dry matter accumulation than the sole application of imazethapyr and pendimethalin, respectively. Imazethapyr at 75 g ha^{-1} and pendimethalin at 0.75 kg ha^{-1} were recorded at par value of dry matter accumulation at harvest.

Two-hand weeding at 15 and 30 DAS registered the highest seed and stover yield than other treatments, but it was at par with the pre-emergence application of premix pendimethalin+imazethapyr 0.75 kg ha^{-1} (Table 2). The lowest seed and stover yield was recorded under weedy check plots. Pre-emergence application of ready-mix pendimethalin+imazethapyr recorded 13.26% and 18.97% higher seed yield than sole application of pre-emergence pendimethalin 0.75 kg ha^{-1} and post emergence imazethapyr 75 g ha^{-1}. Weed check plots recorded 58.17% and 57.07% lower seed yield of greengram in compared to two hand weeding at 15 and 30 DAS and ready-mix pendimethalin+imazethapyr 0.75 kg ha^{-1}respectively. The competition between green gram and weeds for nutrients, water, light, and space was less under the above treatments, which facilitated greater utilization of sunlight, higher synthesis of photosynthates, and better partitioning towards seed formation, ultimately leading to higher seed yield of green gram. Singh et al. (2017) also reported that among the herbicides, pre-emergence application of pre-mix pendimethalin+imazethapyr at 1.0 and 0.75 kg ha^{-1} recorded higher seed yield (1.41 and 1.31 t ha^{-1}, respectively).

IMPACT ASSESSMENT

The least amount of weed persistence was observed with two-hand weeding at 15 and 30 DAS. Acifluorfen Na 16.5%+Clodinafoppropargy l 8% 245 g ha^{-1} at 20 DAS had the greatest weed management index (Agronomic management index and Integrated weed management index), followed by Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS. Moreover, Pendimethalin+imazethapyr0.75 kg ha^{-1} at 1 DAS had the lowest weed index.

Conclusion

On the basis of two year experiment we can be concluded that application of ready-mix pendimethalin+imazethapyrat0.75 kg ha^{-1} appeared to be promising for effective weed management and higher productivity in summer greengram.

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Treatment	**Weed density (No. m^{-2}) at 40 DAS**			**Weed biomass (g m^{-2}) at 40 DAS**		
	Grasses	Broad leaved	Total	Grasses	Broad leaved	Total
Pendimethalin 0.75 kg ha^{-1} at 1 DAS	2.26 (4.67)	2.76 (7.33)	3.51 (12.00)	2.03 (3.64)	3.13 (9.40)	3.66 (13.04)
Imazethapyr 75 g ha^{-1} at 20 DAS	2.54 (6.00)	2.11 (4.00)	3.23 (10.00)	2.19 (4.32)	2.69 (6.77)	3.40 (11.09)
Pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS	1.68 (2.33)	1.46 (1.67)	2.11 (4.00)	1.48 (1.71)	1.80 (2.10)	2.22 (4.48)
Quizalofop ethyl 50 g ha^{-1} at 20 DAS	3.19 (9.67)	3.38 (11.00)	4.59 (20.67)	2.43 (5.43)	3.86 (13.44)	4.50 (19.87)
Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS	3.28 (11.00)	3.57 (12.33)	4.88 (23.33)	2.63 (6.55)	4.01 (14.66)	4.77 (22.22)
Acifluorfen Na 16.5%+Clodinafop propargyl 8% 245 g ha^{-1} at 20 DAS	3.75 (13.67)	3.89 (14.67)	5.37 (28.33)	3.04 (8.80)	4.32 (17.22)	5.25 (27.02)
Two hand weeding at 15 and 30 DAS	1.56 (2.00)	1.34 (1.33)	1.93 (3.33)	1.38 (1.41)	1.44 (1.59)	1.87 (3.00)
Weedy check	5.04 (25.00)	4.63 (21.00)	6.82 (46.00)	4.77 (22.41)	5.24 (27.00)	7.06 (49.41)
S.Em (±)	0.17	0.19	0.16	0.16	0.18	0.16
CD (p=0.05)	0.52	0.58	0.51	0.50	0.54	0.49

Treatment	Plant height (cm)	Branches plant^{-1}	Dry matter accumulation (g m^{-2})	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})

Table 1: Weed density and biomass at 40 DAS as influenced by different weed control practices in greengram (pooled data)

Figures in parentheses are the original values. The data was transformed to SQRT (√x+0.5) before analysis

Table 2: Effect of weed control practices on growth and yield of greengram (pooled data)

Treatment	WI (%)	WPI	WMI	AMI	IWMI
Pendimethalin 0.75 kg ha^{-1} at 1 DAS	36.82	7.38	211.33	881.11	2724.44
Imazethapyr 75 g ha^{-1} at 20 DAS	37.17	7.62	219.67	925.56	2778.89
Pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS	41.17	8.37	252.00	1048.33	3231.66
Quizalofop ethyl 50 g ha^{-1} at 20 DAS	36.14	6.71	188.00	760.56	2390.56
Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS	34.71	6.46	177.67	741.67	2318.33
Acifluorfen Na 16.5%+Clodinafoppropargyl 8% 245 g ha^{-1} at 20 DAS	33.81	5.74	165.67	712.22	2267.56
Two hand weeding at 15 and 30 DAS	42.27	8.88	263.67	1076.11	3276.11
Weedy check	24.19	4.65	113.33	450.06	1698.06
S.Em (±)	1.14	0.19	5.23	38.82	110.73
CD (*p*=0.05)	3.46	0.58	15.46	117.75	335.89

Treatment					
Pendimethalin 0.75 kg ha^{-1} at 1 DAS	18.12	1.01	4.07	3.07	5.60
Imazethapyr 75 g ha^{-1} at 20 DAS	13.99	1.02	3.97	2.97	5.45
Pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS	2.58	1.02	3.40	2.40	4.60
Quizalofop ethyl 50 g ha^{-1} at 20 DAS	29.32	0.95	4.66	3.66	6.49
Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS	31.08	0.94	5.08	4.08	7.12
Acifluorfen Na 16.5%+Clodinafoppropargy l 8% 245 g ha-1 at 20 DAS	33.82	0.94	6.17	5.17	8.76
Two hand weeding at 15 and 30 DAS	0.00	0.94	3.25	2.25	4.38

Table 3: impact assessment indices of different treatments

WI,Weed Index ;WPI, Weed persistence index;WMI, Weed management index; AMI,Agronomic management index; IWMI, Integrated weed management index