Weed growth and Productivity of Greengram (*Vigna radiata* L.) under Different Weed Control Practices

Abstract

A field research was performed during summer season (March–May), 2022 and 2023 to evaluate the productivity of greengram under different herbicidal control at Agricultural Research station, Faculty of Agricultural Sciences, SOADU, Bhubaneswar, Odisha, India to study the effect of different weed control practices on weed growth and productivity of greengram. The experiment consisted of 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%+Clodinafop propargyl 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 rice. 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

1. Introduction

Food legumes are often acknowledged as poor man's meat. They are reasonably cheaper source of dietary protein in India, which ranks 102 on the global hunger index (Anonymous, 2019). Pulses are rich sources of protein and strength but in India, these are largely cultivated beneath power starved conditions, totally on marginal and sub-marginal land and more than three-fourth of the area below pulses continues to be rainfed ensuing in low crop productivity (Choudhary et al., 2013). Pulses are rich source of protein, vitamins, fibers and minerals (iron, zinc and magnesium) and some

essential amino acids which plays a vital role in human health (Yadav et al., 2017). Among the pulses, green gram (*Vigna radiata* (L.) Wilczek) enjoys significant consumer preference due to its palatability and nutritious levels (Nirmala et al., 2018). The trend in eastern India is to let the fields remain fallow for 70–80 days during summer after the harvest of winter crops. Sowing of a short-duration legume crop like greengram (60–70 days) in the summer season is gaining popularity as it not only ensures an additional income but also recharges the lost soil nutrients, improves soil fertility and corroborates efficient land utilization (Sar et al., 2023). Weeds are one of the most important factors to reduce yield of mungbean during summer and rainy season (Singh *et al.*, 2021). It is estimated that weed competition in green gram during first 30 days of sowing (Singh et al., 2019). 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 important for green gram cultivation. Summer greengram, particularly when cultivated under irrigated conditions, frequently encounters severe crop-weed competition (Mukherjee, 2015). Infestation of weeds is a significant impediment in achieving higher yield of summer greengram, as these compete with crop plants for nutrients, moisture, light and space. Weeds grow more vigorously and pose as serious threat to its cultivation. Being a rainy season crop, it is heavily infested by a large number of fast growing weeds, especially during the critical period of crop-weed competition (Verma et al., 2017). They limit the availability of light and space for the crop. Weeds mature earlier than the crop and shed their seeds in soil, thereby, increasing weed seed bank in the soil. Weed seeds mixed in with the crop reduce the economic value of yields and serve as a source for further spread of weeds into new areas (Sing and Sing, 2020). Therefore, control of weeds during critical period of crop weed competition is crucial to mitigate severe yield losses. The initial 70–80% of crop development occurs within the first 20–40 days after planting. Hence, pre-emergence herbicides paramount importance during the initial growth period. The application of pre-emergence herbicide suppresses the weed emergence, hence provide favourable environment to grow under weed free condition (Mohanty et al., 2023). The weed emerged during critical growth period also require indispensable attention to control weed flush, which can be controlled either by the use of post-emergence herbicides or hand weeding or inter culture operations. This comprehensive approach ensures that

all growth stages are effectively managed to maximize yields within the specified time frame.

It is widely acknowledged that manual hand weeding is the most effective and environmentally safe method of weed management (Gopakumar and Menon 2022). However, the substantial physical exertion and associated costs pose challenges for its timely implementation over large areas. Recently, due to this problem, chemical weed management is getting space in weed management practices (Udhaya et al., 2021). Pre and post-emergence herbicides or some ready-mix formulations available in the market are able to check the emergence and growth of annual grasses and broadleaved weeds and also reduced the crop-weed competition (Singh et al., 2017). With this background, the present experiment was conducted to study the effect of sole and ready-mixed herbicides on weed dynamics and productivity of green gram. With this background the present experiment was conducted to study the effect of different weed control practices on weed growth and productivity of green gram.

2. Materials and Methods

2.1. Experimental period and location

The field experiment was conducted in the summer (March–May) of 2022 and 2023 at the Agricultural Research Station, Binjhagiri, Chatabar, Institute of Agricultural Sciences, SOADU, Odisha, India. The research farm is located within the East and South Eastern Coastal Plain Agroclimatic Zone of Odisha, positioned at 20°26' N latitude and 85°67' E longitude, with an elevation of 45 meters above mean sea level. 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}).

2.2. Experimental design and treatment details

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.

2.3. Package and practices

The greengram cultivar Virat was raised following the standard recommended package of practices. The crop was fertilized with 20-40-20 kg ha^{-1} N, P_2O_5 and K_2O, respectively. All other recommended agronomic practices were adhered to, and necessary plant protection measures were implemented as required. 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.

2.4. Methods of statistical analysis

The experimental data relating to each character of crop and weed were analyzed by the technique of "Analysis of variance" using MSTAT statistical package and significance was tested by variance ratio i.e. value at 5% level of significance as described by Gomez and Gomez (2010). 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.

3. Results and Discussion

3.1. Effect on weed

In the experimental field five predominant weed species like *Poa annua, Digitaria sanguinalis* and *Echinochloa colona* among the grasses and *Cleome viscose* and *Melochia corchorifolia* among the broadleaved weeds were observed throughout the crop growing period. Similar weed flora in greengram has also been reported by Aliveni et al. (2016). Kavad et al. (2016), Jinger et al. (2016) also reported the dominance of Digitaria sanguinalis in greengram. Kundu et al. (2011) reported that *Eleucine indica*, *Echinochloa colana*, *Echinochloa crusgalli*, Digitaria sanguinalis, Setaria glauca, Cynodon dactylon among the grasses; Cyperus rotundus among the sedges and Cleome viscosa, Euphorbia hirta, Amaranthus viridis and Alternanthera sessilis among the broad leaved weeds were predominant weed species in greengram.

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 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 has showed 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 in 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 lower population of grassy weeds. Though the herbicide fenoxaprop-p-ethyl is a grass killer but the weed species *Digitaria sanguinalis* was not controlled by the herbicide. Similar observations were made by Mundra and Maliwal (2012).

3.2. Effect on Green Gram

The maximum plant height, branches $plant^{-1}$ and drymatter production was 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 9.84% and 13.41% higher number of branch $plant^{-1}$ at harvest in compared to sole application of imazethapyr and pendimethalin, respectively at harvest. Chhodavadia et al. (2013) reported that two hand weeding significantly increase number of branches $plant^{-1}$ as compared to unweeded condition in summer greengram. This might be due to severe competition by weeds for resources, which made the crop plant inefficient to take up more moisture, nutrients and ultimately growth was adversely affected due to less supply of carbohydrates. At harvest, application of pendimethalin+imazethapyr recorded 14.71% and 19.24% higher value of dry matter accumulation than sole application of imazethapyr and pendimethalin, respectively Imazethapyr at 75 g ha^{-1} and pendimethalin at 0.75 kg ha^{-1} both 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 pre-emergence application of premix pendimethalin+imazethapyr 0.75 kg ha^{-1} (Table 2). 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 greengram and weeds for nutrient, water, light and space was less under the above treatments, which facilitated greater utilization of sun light, higher synthesis of photosynthates and better partitioning towards seed formation and ultimately leading to higher seed yield of greengram. 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

Among the treatments Two hand weeding at 15 and 30 DAS has recorded the lowest weed persistent index . The highest weed management index Agronomic management index and Integrated weed management index was recorded under Acifluorfen Na 16.5%+Clodinafop propargy l 8% 245 g ha-1 at 20 DAS which is followed by Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS. And the lowest weed index was recorded under Pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS .

Conclusion

It can be concluded that application of ready-mix pendimethalin+imazethapyr @ 0.75 kg ha^{-1} appeared to be promising for effective weed management and higher productivity in summer greengram.

5.References

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

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

Figures in parentheses are the original values. The data was transformed to SQRT ($\sqrt{x+0.5}$) before analysis

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

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

Table 3: impact assessment indices of different treatments

Treatment	WI(%)	WPI	WMI	AMI	IWMI
Pendimethalin 0.75 kg ha^{-1} at 1 DAS	18.12	1.007	4.07	3.07	5.60
Imazethapyr 75 g ha^{-1} at 20 DAS	13.99	1.017	3.97	2.97	5.45
Pendimethalin+imazethapyr 0.75 kg ha^{-1} at 1 DAS	2.58	1.016	3.40	2.40	4.60
Quizalofop ethyl 50 g ha^{-1} at 20 DAS	29.32	0.947	4.66	3.66	6.49
Fenoxaprop-p-ethyl 50 g ha^{-1} at 20 DAS	31.08	0.944	5.08	4.08	7.12
Acifluorfen Na 16.5%+Clodinafop propargyl 8% 245 g ha-1 at 20 DAS	33.82	0.944	6.17	5.17	8.76
Two hand weeding at 15 and 30 DAS	0.00	0.936	3.25	2.25	4.38

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