Indian Journal of Agronomy **69** (4): 479–483 (December 2024)
DOI: 10.59797/ija.v69i4.5555

Research Communication

Productivity of summer greengram (*Vigna radiata*) under different nitrogen levels and weed management practices

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Received: July 2024; Revised accepted: November 2024

ABSTRACT

A field investigation was carried out during the summer season of 2022 at ARS, Faculty of Agricultural Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, to study the effect of nitrogen levels and weed management practices on the productivity of summer greengram. The experiment was laid out in a split plot design with three replications of fifteen treatment combinations. Treatments consisted of three nitrogen levels (75% N, 100% N and 125% N) in main plot and five weed management practices (Pendimethalin 0.75 kg/ha at 1 DAS, Imazethapyr 75 g/ha at 20 DAS, Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS, Two hand weeding at 15 and 30 DAS and Weedy check) in subplot. Results revealed that the lowest density and dry weight of grasses and broadleaved, weeds were recorded with 75% N application . Among the weed management practices, two hand weeding at 15 and 30 DAS registered significantly lowest density and dry weight of all categories weeds, which was closely followed by pre-emergence application of ready-mix pendimethalin + imazethapyr 0.75 kg/ha at 45 DAS. Application of 125% N registered the highest seed yield and yield attributing characters like pods/plant (and seeds/pod as compared to other treatments, and it was at par with the application of 100% N. Among the weed management practices, two-hand weeding at 15 and 30 DAS recorded the highest seed yield along with higher yield attributing characters, and it was closely followed by pre-emergence application of ready-mix pendimethalin + imazethapyr at 0.75 kg/ha.

Key words: Imazethapyr, Nitrogen levels, Pendimethalin, Weed index, Weed flora

Greengram is regarded as a soil-enriching pulse crop due to its inherent capacity for symbiotic nitrogen fixation and less depletion of nutrients. Growing legumes has considerable advantages for both cropping systems and the environment. 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). One of the reasons for the lower yield of greengram is farmers' imbalanced use of fertilisers, and severe crop weed competition. Farmers apply fertilizers as a blanket recommendation without knowing the fertility level of the soil and the nutrients required by the crop. Only a balanced fertilizer dose based on the soil's fertility will be able to rectify it. In addition to this, weed infestation is one of the main obstacles to greengram cultivation. Summer greengram often suffers from severe crop-weed competition, because it is grown under irrigated conditions. Weeds caused yield reductions ranging from 45.6 to 85% (Mirjha *et al*., 2013). Therefore, weed control is important during the critical crop weed competition period to avoid significant yield losses. It is a well-known truth that manual hand weeding is the most effective and safe method of controlling weeds, but it requires a lot of physical effort, time and money, it is challenging to implement quickly over a big area. Due to this issue, chemical weed management has recently gained popularity among the farmers. Pre- and post-emergence herbicides, as well as easily available ready-mix formulations, can be used to reduce the emergence and growth of annual grasses and broadleaved weeds, thereby reducing crop-weed competition (Mohanty *et al*., 2023). Keeping this in view, a field experiment was carried out to study the productivity of summer greengram under various nitrogen levels and weed management practices.

The experiment was carried out at the Agricultural Re-

Based on a part of M.Sc. Thesis of first author submitted to Faculty of Agricultural Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha in 2022 (Unpublished)

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search Station, Faculty of Agricultural Sciences, SOADU, Odisha, India, in the summer of 2022. The research farm's geographic location is under Odisha's East and South Eastern Coastal Plain Agro-climatic Zone. The location of the farm is 45 metres above mean sea level, between latitude 20°26' N and longitude 85°67' E. The soil of the experimental field was sandy loam in texture with alkaline in reaction (*p*H 6.80) and low in organic C (4100mg/kg). The experiment was laid out in a split plot design with three replications comprising fifteen treatment combinations. Treatments consisted of three nitrogen levels (S_1 – 75%, S_2 – 100% and S_3 – 125%) in main plot and five weed management practices (T_1- Pendimethalin 0.75 kg/ha at 1 DAS, T_2 - Imazethapyr 75 g/ha at 20 DAS, T_3 - Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS, T_4 - 2 hand weeding at 15 and 30 DAS and T_5 - Weedy check) in subplot. Greengram was sown during the summer season (March-May). Greengram variety IPM-205-7, popularly known as "Virat", was used in this experiment. For greengram, a seed rate of 25 kg/ha was used. Recommended doses of nutrients N, P_2O_5, and K_2O at 20:40:20 kg/ha were applied. Herbicides were sprayed with a 500 litres/ha spray volume using a hand-operated backpack sprayer with a flat fan-style nozzle. Plant protection measures were implemented based on necessity and all other suggested agronomic procedures were followed properly. Weed density and dry weight was measured at 45 DAS by inserting a 50 cm × 50 cm quadrat from the designated sampling area of 1.0 m^2 in each plot. The quadrats were then dried in a hot air oven at 70ºC. The data were subjected to a square root transformation to normalize their distribution. The yield components and yield of greengram were also recorded and statistically analyzed at 5% level of significance (Gomez and Gomez, 2010). Different impact indices, viz. weed persistence index (WPI), Weed index (WI), weed management index (WMI), agronomic management index (AMI) and integrated weed management index (IWMI) were worked out as suggested by Mishra and Misra (1997) using the following formulae:

$$WPI = [WD_C \div WD_T] \times [WDM_T \div WDM_C]$$

$$WMI = [Y_T/Y_C] \div [(WDM_C - WDM_T) \div WDM_C]$$

$$AMI = (WMI - 1)$$

$$IWMI = (WMI + AMI) \div 2$$

Where, YT and YC, yield in treated and in weedy check plot, respectively; WDT and WDC, weed density (no./m^2) in treated and weedy check plot, respectively; WDMT and WDMC, weed dry weight (g/m^2) in treated and weedy check plot, respectively

The dominance of weeds varied across different nitrogen levels and weed management practices. Weed flora in the weedy check plots consisted of all nine species. Dur-

Table 1. Category-wise weed density and dry weight in greengram at 45 DAS as influenced by different nitrogen levels and weed management practices

Treatment	Weed density (No./m^2)			Weed dry weight (g./m^2)		
	Grasses	Broad leaved	Total	Grasses	Broad leaved	Total
Nitrogen levels						
75% N	3.94(15.03)	4.01(15.59)	5.61(30.94)	2.93(8.11)	3.37(10.88)	4.65(21.16)
100% N	4.30(18.02)	4.62(20.88)	6.25(38.54)	3.49(11.69)	4.06(15.98)	5.40(28.71)
125% N	4.51(19.80)	4.76(22.19)	6.49(41.63)	3.62(12.61)	4.24(17.46)	5.79(32.99)
SEm±	0.11	0.12	0.15	0.09	0.08	0.12
CD (P=0.05)	0.43	0.45	0.60	0.36	0.32	0.46
Weed management practices						
Pendimethalin 0.75 kg/ha at 1 DAS	4.17(16.87)	4.48(19.55)	6.08(36.51)	2.99(8.43)	4.12(16.50)	5.05(25.05)
Imazethapyr 75 g/ha at 20 DAS	4.40(18.84)	4.28(17.80)	5.97(35.10)	3.30(10.40)	3.82(14.13)	5.97(35.10)
Pendimethalin+ imazethapyr 0.75 kg/ha at 1 DAS	2.85(7.61)	3.60(12.46)	4.54(20.14)	2.32(4.90)	2.63(6.42)	3.44(11.35)
Two hand weeding at 15 and 30 DAS	2.72(6.89)	3.51(11.80)	4.39(18.73)	2.21(4.39)	2.29(4.76)	3.11(9.19)
Weedy check	7.12(50.14)	6.47(41.33)	9.60(91.62)	5.92(34.54	6.58(42.76)	8.83(77.51)
SEm±	0.09	0.11	0.10	0.11	0.12	0.10
CD (P=0.05)	0.25	0.33	0.30	0.32	0.36	0.30

Figures within parenthesis are means of original values. Data was subjected to square root transformation

ing the crop growing season, five common weed species were seen in the experimental field, including *Poa annua*, *Digitaria sanguinalis*, and *Echinochloa colona* among the grasses and *Cleome viscosa* and *Melochia corchorifolia* among the broadleaved weeds. Kavad *et al*. (2016), Choudhary and Sharma (2022), Jinger *et al*. (2016) and Mohanty *et al*. (2023) have noted a similar weed flora in greengram.

Among the nitrogen levels, the lowest density and dry weight of grasses, broadleaved and total weeds were recorded with 75% N, followed by 100% N and 125% N. The dry weight of the total weed was reduced by 35.86 and 26.30 % with the application of 75% N as compared to the application of 125% N and 100% N, respectively. Two-hand weeding at 15 and 30 DAS was found to be significantly more effective than the other weed management practices in reducing the density and dry weight of total weeds at 45 DAS, and it was on par with the application of pendimethalin + imazethapyr at 0.75 kg/ha PE. The dry weight of the total weed was reduced by 85.36% with the application of pendimethalin + imazethapyr (ready-mix) at 0.75 kg/ha PE as compared to weedy check plots. Pendimethalin 0.75 kg/ha PE and imazethapyr 75 g/ha PoE were recorded at par value of grasses, broadleaved, and total weed density and dry weight at 45 DAS. Among the treatment combination applying 75% N with two hand weedings recorded the lowest total wed dry weight as compared to others. The den-

Table 2. Effect of nitrogen levels and weed management practices on yield attributes and yield of greengram

Treatment	Pod length (cm)	Pods/plant	Seeds/pod	Test weight (g)	Seed yield (kg/ha)
Nitrogen levels					
75% N	5.83	21.00	4.81	35.92	632.03
100% N	5.98	24.90	6.18	37.01	826.83
125% N	6.12	25.54	6.39	37.67	832.30
SEm±	0.16	0.57	0.14	0.50	15.93
CD (P=0.05)	NS	2.23	0.53	NS	62.56
Weed management practices					
Pendimethalin 0.75 kg/ha at 1 DAS	6.01	23.14	5.88	36.84	739.22
Imazethapyr 75 g/ha at 20 DAS	6.09	24.20	6.02	37.68	784.44
Pendimethalin+imazethapyr 0.75 kg/ha at 1 DAS	6.16	27.20	7.10	37.36	915.00
2 hand weeding at 15 and 30 DAS	6.24	27.73	7.29	37.80	930.56
Weedy check	5.38	16.76	2.68	34.66	449.39
SEm±	0.21	0.40	0.18	1.01	16.53
CD (P=0.05)	NS	1.17	0.54	NS	48.25

Table 2a: Interaction effect of nitrogen levels and weed management practices on seed yield of greengram (kg/ha)

	Weed-management practices					
N levels	T_1	T_2	T_3	T_4	T_5	Mean
S_1	571.78	665.56	733.00	749.78	440.06	632.03
S_2	817.78	832.22	1,007.33	1,020.11	456.72	826.83
S_3	828.11	855.56	1,004.67	1,021.78	451.39	832.30
Mean	739.22	784.44	915.00	930.56	449.39	

	Nitrogen management practices (N)	Weed management practices (W)	N X W	W X N
SEm±	15.93	16.53	28.63	30.16
CD (P=0.05)	62.56	48.25	40.49	42.65

S_1, 75%; S_2, 100% and S_3, 125%; T_1, Pendimethalin 0.75 kg/ha at 1 DAS; T_2, Imazethapyr 75 g/ha at 20 DAS; T_3, Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS; T_4, 2 hand weeding at 15 and 30 DAS and T_5, Weedy check

sity and dry weight of grasses, broadleaved, and total weed were influenced significantly by the application of different nitrogen levels. The highest density and dry weight of total weeds were recorded under 125% N, which might have been because, under these treatments, higher nitrogen doses were applied as compared to other treatments, which had a better impact on weed growth and resulted in higher weed dry weight. Application of readymix pendimethalin + imazethapyr at 0.75 kg/ha PE significantly decreased the density and dry weight of total weeds. This could be due to better weed control owing to two different chemicals. Pendimethalin + imazethapyr (ready-mix) at 0.75 kg/ha PE caused a significant reduction of density and dry weight of grasses, broad-leaved and total weeds in all the crop growth stages due to better weed control by two constituent herbicides (Mohanty *et al*.,2023). At 45 DAS, two hand weeding at 15 and 30 DAS and pre-mix application of pendimethalin + imazethapyr at 0.75 kg/ha were comparable to one another. The number of pods/plant and seeds/pod of greengram varied significantly due to nitrogen levels and weed management practices (Table 2). Application of 125% N recorded the highest pods/plant and seeds/pod among the various nitrogen levels, and it was on par with the application of 100% N. The lowest number of pods/plant and seeds/pod were recorded under 75% N. The number of pods/plant and seeds/pod was increased by 22.86, 32.84%, and 16.19, 28.48% with the application of 125% N and 100% N as compared to 75% N, respectively. Positive responses regarding yield attributes to nutrient management practices have also been reported by Patel *et al*. (2013).

The highest number of pods/plant and seeds/pod was recorded under two hand weeding at 15 and 30 DAS as compared to other weed management practices, but it was on par with the pre-emergence application of premix pendimethalin + imazethapyr 0.75 kg/ha. Post emergence application of imazethapyr at 75 g/ha and pre-emergence pendimethalin at 0.75 kg/ha were recorded at par number of pods/plant and seeds/pod. The lowest number of pods/plant and seeds/pod was recorded under weedy check plots. Interaction effect was found significant on pods/plant and seeds/pod and it was indicated that applying 125% N with two hand weeding produced the maximum value of pods/plant and seeds/pod as compared to other treatments and it was closely followed by application of 125% N+ premix pendimethalin + imazethapyr 0.75 kg/ha and 100% N with two hand weeding or premix pendimethalin + imazethapyr 0.75 kg/ha. As a result of intense weed competition for nutrients, light, water, and space throughout the crop's growth, the crop under weedy check treatment had the lowest yield attributes. According to Kaur *et al*. (2009), the two hand hoeing at 25 and 40 DAS in the summer mungbean produced significantly the highest number of pods/plant and test weight. Pod length and test weight did not vary significantly due to nitrogen levels and weed management practices. This is corroborated by the findings of Patel *et al*. (2017). The highest seed yield was achieved with 125% N, which was on par with 100% N application. The treatment of 75% N recorded the lowest seed yield. The seed yield increased by 31.64 and 30.69% with 125 and 100% N as compared to 75% N. Improvement in the yield resulted from an adequate supply of photosynthate from source to sink due to a sufficient supply of adequate nitrogen in significant improvements in growth and yield at-

Table 3. Weed assessment indices of different treatment combination in greengram

Treatment combination	WPI	WMI	AMI	IWMI
75% N *fb* Pendimethalin 0.75 kg/ha at 1 DAS	0.7	1.65	0.65	1.15
75% N *fb* Imazethapyr 75 g/ha at 20 DAS	1.1	2.36	1.36	1.86
75% N *fb* Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS	0.4	6.64	5.64	6.14
75% N *fb* 2 hand weeding at 15 and 30 DAS	0.4	1.81	0.81	1.31
100% N *fb* Pendimethalin 0.75 kg/ha at 1 DAS	0.9	2.84	1.84	2.34
100% N *fb* Imazethapyr 75 g/ha at 20 DAS	1.1	3.09	2.09	2.59
100% N *fb* Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS	0.7	2.68	1.68	2.18
100% N *fb* Two hand weeding at 15 and 30 DAS	0.5	2.57	1.57	2.07
125% N *fb* Pendimethalin 0.75 kg/ha at 1 DAS	0.7	2.64	1.64	2.14
125% N *fb* Imazethapyr 75 g/ha at 20 DAS	1.1	3.38	2.38	2.88
125% N *fb* Pendimethalin + imazethapyr 0.75 kg/ha at 1 DAS	0.8	2.80	1.80	2.30
125% N *fb* Two hand weeding at 15 and 30 DAS	0.7	2.78	1.78	2.28

*Weed persistence index (WPI), weed management index (WMI), agronomic management index (AMI) and integrated weed management index (IWMI)

tributes. The present results closely resembled those of Patel *et al*. (2018).

Among the weed management practices, two hand weeding registered significantly the highest seed yield (930.56 kg/ha) and it was at par pendimethalin + imazethapyr 0.75 kg/ha (915 kg/ha). Pre-emergence application of ready-mix pendimethalin + imazethapyr recorded 16.64 and 23.78% higher seed yield than post-emergence imazethapyr 0.75 kg/ha and pre-emergence pendimethalin 0.75 kg/ha alone, respectively. When weeds were not controlled, the yield was 449.39 kg/ha, whereas the yield increased from 739.22 to 930.56 kg/ha when weeds were controlled with different herbicide-based treatments (Table 2). Different herbicidal treatments and two-hand weeding at 15 and 30 DAS resulted in higher seed yield because these treatments effectively reduced the number of dominant weeds, as shown by the data on weed dry weight and density. Under the treatments mentioned above, there was less competition between greengram and weeds for nutrients, water, light, and space, allowing for greater sunlight utilization, higher photosynthetic rates, and better partitioning toward seed formation, all of which helped to increase the seed yield of greengram. The seed yield of greengram was 51.70 and 50.88% lower in weed check plots as compared to two hand weeding at 15 and 30 DAS and ready-mix pendimethalin + imazethapyr 0.75 kg/ha, respectively. The lowest seed yield was obtained with the weedy check treatment, which may have been caused by higher weed density and weed dry weight. The interaction effect was found significant, and it indicated that applying 125% N with two hand weedings produced the highest seed yield as compared to other treatments and it was closely followed by application of 125% N+ premix pendimethalin + imazethapyr 0.75 kg/ha and 100% N with two hand weeding or premix pendimethalin + imazethapyr 0.75 kg/ha (Table 2a).

Among the treatment combinations, 75%N *fb* pendimethalin+imazethapyr 0.75 kg/ha at 1 DAS and 75% N *fb* 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 were recorded under 75%N *fb* pendimethalin+imazethapyr 0.75 kg/ha at 1 DAS.

Thus, it may be concluded that 100 % N along with ready-mix pendimethalin + imazethapyr 0.75 kg/ha appeared to be promising for effective weed management and higher productivity in summer greengram.

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