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Effect of Different Weed Management Practices on Growth and Economics of Green Gram (*Vigna radiata* L.) under the Medium Land Situation of Manipur

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ABSTRACT

Background: Green gram is one of the oldest and third-most significant traditional pulse crop grown in India. Green gram growthand economics are mostly hampered by weeds, however these effects can be reduced by using appropriate weed control techniques.

Methods: A field experiment entitled "Growth, yield and nutrient uptake of green gram (*Vigna radiata* L.) as influenced by weed management practices under medium land situation on manipur" was conducted at Agronomy Research Farm, College of Agriculture, Central Agricultural University, Imphal, Manipur during *Kharif* season 2023-24. The experiment was consist of Nine treatments in randomized block design (RBD) replicated thrice.

Result: The result revealed that T_8: hand weeding at 20 and 35 DAS recorded higher growth parameters like plant height, fresh and dry weight of plant, number of nodules plant^{-1}, fresh and dry weight of nodules plant^{-1} leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) which was statically at par with T_4: Oxyflurofen @ 150 g/ha (PE-2DAS) + Hand weeding (35 DAS). While, maximum net return (104373.98) and B: C ratio (2.22) was found under the treatment T_4 (Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS) + Hand weeding 35 DAS).

Key words: Economics, Green gram, Growth, Weed management.

INTRODUCTION

Pulses are playing an important role in Indian economy as well as socio-economic condition. Pulses are rich source of protein, vitamins, fibers and minerals (iron, zinc and magnesium) and some essential amino acids which are plays a important role in human health (Yadav *et al*., 2017). Most of Indian populations are vegetarian and pulses also contribute to about 14% of total protein supplementation of a usual diet of India. Pulses occupy a leading place in various cropping system and grow as main crop, cover crop, catch crop, inter crop and green manure crop (Mallikarjun *et al*., 2021). Pulses improve soil health by enhanced soil physical, biological and chemical properties as well as soil fertility status due to biological nitrogen fixing with symbiotic association with rhizobium from the atmosphere and mushrooming the soil microorganism population in soil (Peoples *et al*., 2018).

Green gram [(*Vigna radiate* (L.) Wilczek] or mung or mungbean is a crucial short duration legume crop which belong to family Fabaceae. Among the pulses, green gram is one of the ancient and the third important conventional pulses crop cultivated throughout India and is adopted and acclimatized over wide range of agro-climatic zones for its multipurpose uses as vegetable, pulses, fodder and green manure crop with soil restorative characteristics. It is quite versatile crop can be grown for seeds, green manure and forage as mixed or sole crop. Mungbean contains about 51.6% carbohydrate, 26 to 27% protein, 4 to 5% minerals and 3 to 4% vitamins (Dhakal *et al*., 2015). Green gram generally grown in *kharif* season. The tender pods of green gram are also eaten as vegetable. Green gram is esteemed as food as it does not produce having and flatulence. Pulses are used as a light diet administered during fever and considered to have a cooling and astringent effect. Being leguminous crops they have beneficial effect on improving soil fertility through fixation of atmospheric nitrogen. An important feature of the green gram crop its ability to establish a symbiotic partnership with specific bacteria for

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setting up the biological nitrogen fixation in root nodules that supply the plants need for nitrogen.

Weeds are one of the most important reason to reduce yield of mungbean during summer and rainy season (Singh *et al*., 2021). Being a short duration crop, it faces heavy weed competition right from the early growth stages (Pandey *et al*., 1999). Weed competition is very high during initial 25-30 days of mungbean (Raghvani *et al*., 1985). Weeds alone reduce mungbean yield up to 90% depending upon cultivars, soil moisture level, soil types, field condition and other environmental constraints (Kumar *et al*., 2006 and Ali *et al*., 2011). The yield loss of mungbean mainly depends upon types of weed flora, its intensity and period of crop-weed competition (Choudhary *et al*., 2016). The progressive conversion of agriculture concerning intensive use of herbicides is gaining status in recent years controlling weeds (Butter *et al*., 2008). Chemical weed controls an excellent alternative to manual as well as mechanical weeding and supply weed-free environment during early growing stage up to 30-35 days (Dungarwal *et al*., 2003, Das and Yaduraju, 2012). Thus, with the aforementioned details in mind, the current investigation was carried out to evaluate the effect of different weed management practices on growth, yield and nutrient uptake of green gram under medium land situation of Manipur to determine which is better combination of weed control means to get higher growth and quality of seed.

MATERIALS AND METHODS

The experiment was conducted at Agronomy Research Farm, College of agriculture, Central Agricultural University, Imphal, Manipur, India. Institute, located at 24°80′N latitude and of 93°89′E longitude with an altitude of 775.1 m above mean sea level in the Eastern Himalayan Region (II) and the agro climatic zone is Sub-Tropical Zone (NEH-4) of Manipur during *Kharif* season, 2023-24. The soil of experiment field was clay loam in texture having high pH (5.11), high in Walkley-Black organic carbon (1.26%) and low in $KMnO_4$ Oxidizable nitrogen (257.15 kg ha^{-1}), medium in 0.5 M $NaHCO_3$-extractable phosphorus(19.16 kg ha^{-1}) and 1N NH_4OAC extractable potassium (235.47 kg ha^{-1}). The experiment was conducted in randomized block design consisting of nine treatments *viz*., T_1 - Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS), T_2- Oxyflurofen @150 g ha^{-1} (PE- 2 DAS) + Fenoxoprop-ethyl @100 g ha^{-1} (PoE-20 DAS), T_3 - Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS) + Clodinafop-Propargyl @100 g ha^{-1} (PoE-20 DAS), T_4- Oxyflurofen@150 g ha^{-1} (PE-2 DAS)+ Hand weeding (35 DAS), T_5 - Clodinafop-Propargyl @100 g ha^{-1} (PoE-20 DAS) + Rice husk @10 tons ha^{-1}, T_6 - Fenoxoprop-ethyl @100 g/ha (PoE-20 DAS) + Rice husk @10 tons ha^{-1}, T_7- Rice husk @10 tons ha^{-1}, T_8- Hand weeding at 20 and 35 DAS, T_9- Weedy check. The recommended dose of fertilizer (20:30:20 kg NPK ha^{-1}) was applied as basal in the form of Urea, SSP (Single super phosphate) and MOP (Murate of potash) respectively. The required quantity of seeds (20 kg ha^{-1}). The seeds were sown in row drawn 30×10 cm^2 apart with 5cm deep of variety Shikha the herbicides were applied as per treatments using knapsack sprayer fitted with a flat-fannozzle. Hand weeding was done at 20 and 35 days after sowing as per treatment. One irrigation was given to the crop at 14 days after sowing. To eliminate border effect; two rows on both sides and 0.5 m length at each end of the plot was not included in the experiment and net plot area (4.2×1.5 m) was harvested separately from each plot. Seed samples were collected from seed lot of each treatment and stored in cloth bags.

The plant height was measured at distinct phases *i.e*. 20 days interval from sowing up to harvest from the five randomly selected tagged plants. The height was measured from the ground base to tip of the plant and the average height of the plant was work out. The fresh and dry weight of plant was recorded at crop stage of 20 days interval from sowing till harvest, for this purpose, five plant samples from second row of each row were uprooted. The plants were washed properly and weighed to record the fresh weight after that the samples were placed in oven for 72 hrs at 60°C until a constant dry weight was acquired and dry weight of the plants were weighed on electronic balance. Mean fresh and dry weighting/plant was computed.

Number of nodules were measured five plant samples were uprooted with the help of khurpi randomly from each plot at 20 days interval from sowing of the crop till harvest. Plants were uprooted carefully so that no nodules were left in the soil. The roots were washed thoroughly with clean water kept in a bucket in order to remove the soil particles adhered to the roots and then the nodules were removed and counted and the average of the nodules was recorded. Fresh and dry weight of nodules- For this observation the nodules collected from five randomly selected plant samples at the crop stage of 20 days interval from sowing till harvest were weighed to record the fresh weight and kept them in oven at 60°C until constant dry weight were acquired after that dry weight of the nodules were weighed. Mean fresh and dry weight of the nodules in mg $plant^{-1}$ was recorded.

Leaf area Index was recorded at 20, 40, 60 DAS and at harvest. It was calculated by using the following formulae given by Watson (1958):

$$LAI = \frac{\text{Leaf area}}{\text{Ground area}}$$

CGR

The rate of dry matter production per unit land area per unit time or crop growth rate (CGR) was worked out by using formula proposed by Watson (1952) and expressed as g/cm^2/day.

$$CGR = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{1}{S}$$

Where:

W_1 and W_2 = Dry weight of plant at time t_1 and t_2 respectively.

S = Land area (cm^2) over which dry matter was recorded.

RGR

Weight per unit dry weight expressed in gg^{-1} day^{-1} was calculated using the formula suggested by Blackman (1919).

$$RGR = \frac{\log w_2 - \log w_1}{t_2 - t_1}$$

Where:

W_1 and W_2 = Plant dry weights of plant at time t_1 and t_2, respectively.

NAR

It indirectly indicates the rate of net photosynthesis. It was determined by the formula given by Vernon and Allison (1963) and expressed as g of dry matter production per day per cm^2 leaf area:

$$NAR = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{\log L_2 - \log L_1}{L_2 - L_1}$$

Where:

W_1 and W_2 = Dry weight of plant.

L_1 and L_2 = Leaf area at time t_1 and t_2, respectively.

Economics

Cost of cultivation

The cost of cultivation for each treatment was work out by adding the cost of operations right from the preparatory tillage till harvesting and threshing and the cost of variable inputs involved.

Gross income (₹/ha)

Gross income refers to the total monetary value of economic produce and by-products derived from the crop grown in different treatments that are calculated on the basis of prevailing market rates.

Net income (₹/ha)

Net income is calculated by subtracting the cost of cultivation from gross return obtained from main product (seed) and by-product (stover) and it reflects the farmer's real income. Monetary returns from distinct treatments were calculated using existing market rates of produce and distinct inputs used in the experiments.

Net income = Gross income - Cost of cultivation

Benefit: Cost ratio

Benefit: Cost ratio was worked out as:

$$B:C\ ratio = \frac{Net\ income}{Cost\ of\ cultivation}$$

Data on growth and Economics were subjected to analysis of variance (ANOVA) given by (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effects on growth parameters

An investigation of data indicated that (Table 1 and 2) effect of different weed management practices was influence the growth parameters of green gram *i.e.*, plant height, fresh weight of plant, dry weight of plant, number of nodules/ plant, fresh weight of nodules/plant, dry weight of nodules/ plant at 20,40,60 DAS and at harvest and leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) at 20-40, 40-60 DAS and 60-at harvest. The results revealed that maximum plant height (14.11, 51.67, 62.81 and 63.20 cm), fresh weight of plant (5.23, 45.77, 91.14 and 98.28 g/plant), dry weight of plant (0.64, 11.12, 27.88 and 30.42 g/plant), No.of nodules (16.0, 57.67, 66.17 and 35.40/plant), fresh weight of nodules (26.99, 135.7, 164.6 and 82.57 mg/plant) dry weight of nodules (5.80, 42.02, 57.2 and 27.8 mg/plant) was observed with the treatment T_8 (Hand weeding at 20 and 35 DAS) at 20, 40, 60 DAS and at harvest, respectively. However, plant height did not vary significantly under the various weed management practices at 20 DAS. and it is statistically on par with treatment T_4 (Oxyflurofen @150 g ha^{-1} (PE- 2 DAS) + Hand weeding at 35 DAS) and minimum under the treatment T_9 (Weedy check). The justification for the highest value on plant height could be attributed to excellent weed control and decreased crop weed competition during the crop growth period, which could have resulted in greater crop moisture and nutrient availability. These results are in conformity with by (Komal *et al*., 2015). The rise in root nodules could be attributed to increasing plant growth, which causes the crop to accumulate more photosynthates. Hand weed was recorded more nodules $plant^{-1}$ and root biomass. Increased in number of nodules and root biomass under hand weeding treatments due to improve aeration of rhizosphere and improve soil condition. These results were similar with findings of (Khairnar *et al*., 2013; Chhodovadia *et al*., 2011).

It is explicit from the data (Table 3) maximum value of LAI (0.87, 3.76, 5.23 and 4.56), CGR (17.46, 27.58 and 4.59 $g/m^2/day$), RGR (61.90, 25.26 and 2.06 $mg/cm^2/day$) and NAR (16.81, 5.88 and 1.09) recorded under the treatment T_8 (Hand weeding at 20 and 35 DAS) at 20-40, 40-60 DAS 60- at harvest, respectively. However, RGR and NAR at 40-60 DAS and 60-at harvest did not vary significant under the different weed management practices and it is statistically on par with treatment T_4 (Oxyflurofen @150 g ha^{-1} (PE- 2 DAS) + Hand weeding at 35 DAS) and minimum under the treatment T_9 (Weedy check). In general the leaf area index increases from 20 DAS up to 60 DAS and then decline till the harvest stage and highest value was observed in 60 DAS. At 80 DAS the leaf area index decline drastically. The results are in conformity with the findings of Dhoke *et al*. (2013) and Shivran *et al*. (2017). It is explicated from the data that at 60 DAS to harvest different treatment did not exert their significant effects on crop growth rate. From 20-40 DAS and 40-60 DAS the crop growth rate increases gradually for all the treatments and highest value was observed in 40-60 DAS. At 60- at harvest the crop growth rate decline drastically. The above results are

Table 1: Effects of different weed management practices on plant height (cm), fresh weight of plant (g/plant) and dry weight of plants (g/plant).

Treatment		Plant height (cm)				Fresh weight of plant (g/plant)				Dry weight of plant (g/plant)			
		20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest
T_1	Oxyflurofen @ 150 g ha^{-1}15.10 (PE- 2 DAS)	44.07	56.70	57.47	5.88	41.84	87.82	95.63	0.71	7.85	23.79	25.15	
T_2	Oxyflurofen @ 150 g ha^{-1} 100 g (PE- 2 DAS) + Clodinafop-Propargyl @ ha^{-1} (PoE-20 DAS)	15.31	46.48	58.21	59.60	5.89	44.34	89.12	96.26	0.73	9.57	25.46	27.38
T_3	Oxyflurofen @ 150g ha^{-1} (PE- 2 DAS)+ Fenoxoprop-ethyl @ 100 g ha^{-1} (PoE-20 DAS)	15.62	46.61	58.50	60.02	5.98	44.41	88.87	96.45	0.74	9.88	25.57	27.71
T_4	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS)+ Hand weeding (35 DAS)	14.95	50.83	61.74	62.27	5.86	45.44	90.58	97.61	0.70	10.53	26.93	29.57
T_5	Clodinafop-Propargyl @ 100g ha^{-1} (PoE-20 DAS) + Rice husk @ 10 tons ha^{-1}	14.21	46.33	57.38	58.68	5.24	43.70	88.89	95.87	0.66	8.97	24.40	26.92
T_6	Fenoxoprop-ethyl @ 100 g ha^{-1} (PoE-20 DAS) + Rice husk @ 10 tons ha^{-1}	14.46	46.43	58.19	59.44	5.55	43.76	89.02	95.91	0.67	9.31	25.20	27.00
T_7	Rice Husk @ 10 tons ha^{-1}	14.57	43.31	56.32	57.10	5.68	40.71	87.54	94.98	0.69	7.71	23.61	24.87
T_8	Hand Weeding at 20 and 35 DAS	14.11	51.67	62.81	63.20	5.23	45.77	91.14	98.28	0.64	11.12	27.88	30.42
T_9	Weedy Check (Control)	13.83	31.60	43.80	43.93	5.07	27.74	43.67	46.21	0.62	5.63	18.21	18.66
	SEd(±)	0.27	0.42	0.56	0.44	0.43	0.36	0.57	0.80	0.03	0.30	0.45	0.45
	C.D (P=5%)	NS	1.18	0.99	0.94	NS	0.77	1.21	1.70	NS	0.63	0.95	0.97

Table 2: Effects of different weed management practices on number of nodules plant^{-1}, fresh weight of nodules (mg/plant) and dry weight of nodules (mg/plant).

Treatment		Number of nodules (No/Plant)				Fresh weight of nodules (mg/plant)				Dry weight of nodules (mg/plant)			
		20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest
T_1	Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS)	18.67	52.94	62.34	32.21	29.64	130.6	160.7	78.84	6.27	40.08	55.1	26.1
T_2	Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS) + Clodinafop- Propargyl@ 100 g ha^{-1} (PoE-20 DAS)	19.67	54.62	63.96	33.82	30.18	132.9	161.5	80.04	6.31	40.49	55.6	26.5
T_3	Oxyflurofen @ 150 g ha^{-1} (PE- 2 DAS)+ Fenoxoprop-ethyl @ 100 g ha^{-1} (PoE-20 DAS)	20.33	55.72	64.22	34.14	31.21	133.5	162.5	81.29	6.42	40.64	55.8	26.7
T_4	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS)+ Hand weeding (35 DAS)	18.33	56.95	65.35	34.61	28.95	134.7	163.8	82.33	6.18	41.39	56.4	27.4
T_5	Clodinafop-Propargyl @ 100 g ha^{-1} (PoE-20 DAS) + Rice husk @ 10 tons ha^{-1}	16.67	53.75	63.42	33.16	27.95	130.8	160.9	79.48	5.81	40.36	55.1	26.1
T_6	Fenoxoprop-ethyl @ 100 g ha^{-1} (PoE-20DAS) + Rice husk @ 10 tons ha^{-1}	17.00	54.39	63.51	33.38	29.52	131.4	161.1	79.69	5.90	40.43	55.4	26.4
T_7	Rice Husk @ 10 tons ha^{-1}	17.67	51.46	61.71	31.28	28.70	129.9	159.4	77.45	5.96	39.59	54.5	25.3
T_8	Hand Weeding at 20 and 35 DAS	16.00	57.67	66.17	35.40	26.99	135.7	164.6	82.57	5.80	42.02	57.2	27.8
T_9	Weedy Check (Control)	15.67	38.00	47.57	23.19	26.23	116.9	133.5	55.86	5.78	25.79	38.6	15.7
	SEd(±)	0.12	0.53	0.63	0.44	0.05	0.51	0.61	0.32	0.34	0.36	0.41	0.32
	C.D (P=5%)	NS	1.11	1.34	0.93	NS	1.09	1.30	0.68	NS	0.76	0.87	0.67

Table 3: Effects of different weed management practices on leaf area index, crop growth rate (g/m²/day), relative growth rate (mg/cm²/plant), net assimilation rate (mg/cm²/plant).

Treatment		Leaf area index				Crop growth rate (g/m²/day)			Relative growth rate (mg/cm²/plant)			Net assimilation rate (mg/cm²/plant)		
		20 DAS	40 DAS	60 DAS	Harvest	20-40 DAS	40-60 DAS	60-Harvest	20-40 DAS	40-60 DAS	60-Harvest	20-40 DAS	40-60 DAS	60-Harvest
T_1	Oxyflurofen @ 150g ha^{-1} (PE- 2 DAS)	1.02	2.75	4.46	3.63	11.98	25.56	2.27	52.41	20.38	1.21	8.86	8.57	0.60
T_2	Oxyflurofen @ 150g ha^{-1} (PE- 2 DAS) + Clodinafop-Propargyl@ 100 g ha^{-1} (PoE-20 DAS)	0.90	2.99	4.59	3.41	14.74	26.48	3.20	56.97	21.25	1.58	11.62	7.28	0.95
T_3	Oxyflurofen @ 150g ha^{-1} (PE- 2 DAS) + Fenoxoprop-ethyl @ 100g ha^{-1} (PoE-20 DAS)	0.99	3.01	4.83	3.76	15.24	26.50	3.57	57.08	20.65	1.74	11.88	8.33	0.93
T_4	Oxyflurofen @150g ha^{-1} (PE- 2 DAS)+ Hand weeding (35 DAS)	1.01	3.52	5.00	4.53	16.48	27.33	4.40	59.47	24.09	2.04	13.34	6.23	1.31
T_5	Clodinafop-Propargyl @ 100 g ha^{-1} (PoE-20 DAS) + Rice husk @ 10 tons ha^{-1}	0.81	2.91	4.72	3.27	13.85	26.21	4.21	56.38	21.72	2.15	11.12	7.63	1.07
T_6	Fenoxoprop-ethyl @ 100 g ha^{-1} (PoE-20 DAS) + Rice husk @ 10 tons ha^{-1}	0.86	2.97	4.75	3.32	14.39	26.38	3.00	56.66	21.62	1.49	11.58	8.45	0.80
T_7	Rice Husk @ 10 tons ha^{-1}	0.89	2.60	4.24	3.06	11.70	25.15	2.10	52.12	20.07	1.13	8.37	8.58	0.62
T_8	Hand Weeding at 20 and 35 DAS	0.87	3.76	5.23	4.65	17.46	27.58	4.59	61.90	25.65	2.06	16.81	5.88	1.09
T_9	Weedy Check (Control)	0.78	1.13	2.71	1.97	8.34	20.96	0.75	47.64	19.79	0.49	2.14	12.10	0.23
	SEd±	0.15	0.22	0.25	0.50	0.48	0.42	1.09	1.19	1.07	0.62	1.61	1.93	0.36
	C.D 5%	NS	0.46	0.53	1.05	1.02	0.89	NS	2.52	NS	NS	3.41	NS	NS

Table 4: Effects of different weed management practices on Economics of green gram.

Treatment		Total Cost of cultivation (₹/ha)	Gross income (₹/ha)	Net income (₹/ha)	B:C ratio
T_1	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS)	41706.02	115306.67	73600.65	1.76
T_2	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS) + Clodinafop-Propargyl @100 g ha^{-1} (PoE-20 DAS)	44562.02	135768.00	91205.98	2.05
T_3	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS)+ Fenoxoprop-ethyl @100 g ha^{-1} (PoE-20 DAS)	45902.02	140637.33	94735.31	2.06
T_4	Oxyflurofen @150 g ha^{-1} (PE- 2 DAS)+ Hand weeding (35 DAS)	47218.02	151992.00	104773.98	2.22
T_5	Clodinafop-Propargyl @100 g ha^{-1} (PoE-20 DAS) + Rice husk @10 tons ha^{-1}	46850.02	123432.00	76581.98	1.63
T_6	Fenoxoprop-ethyl @100 g ha^{-1} (PoE-20 DAS) + Rice husk @10 tons ha^{-1}	48190.02	126549.33	78359.31	1.63
T_7	Rice Husk @10 tons ha^{-1}	43994.02	113234.67	69240.65	1.57
T_8	Hand Weeding at 20 and 35 DAS	49788.02	153482.67	103704.65	2.08
T_9	Weedy Check (Control)	39602.02	81664.00	26727.98	0.69

also in conformity with the findings of Shivran *et al.* (2017) and Alimamy *et al.* (2022). It is explicated from the data that at 40-60 DAS and 60 DAS to harvest different treatment did not exert their significant effects on RGR and NAR. The highest value of RGR and NAR was observed in 20-40 DAS. At 40-60 DAS and 60-80 DAS the RGR and NAR declined drastically. The findings corroborate to the earlier reported of Alimamy *et al.* (2012).

Effect on economics

Cost of cultivation Among the treatments highest cost of cultivation with the value of ₹ 49,778.02/ha was recorded in the treatment T_8 (Hand weeding at 20 and 35 DAS) which was followed by the treatment T_4 ₹ 47,218.02/ha, T_3 and T_2 and the minimum in the treatment weedy check ₹ 39,602.02/ha (Table 4).

Gross income

Among the different weed management practices highest gross income was recorded in the treatment T_8 ₹ 1,53,482.67/ha followed by treatment T_4 ₹ 1,51,992.00/ha, T_3 and T_2 While the minimum gross income was recorded under weedy check ₹81,664.00/ha (Table 4).

Net income

Among the different weed management practices highest net income was recorded in the treatment T_4 ₹ 1,04,773.98/ ha followed by treatment T_8 ₹1,03,704.65/ha, T_3 and T_2 While the minimum net income was recorded under weedy check ₹26,727.98/ha (Table 4).

B: C ratio

Among the different weed management practices highest B: C ratio was recorded in the treatment T_4 2.22 followed by treatment T_8 2.08, T_3 and T_2 While the minimum B: C ratio was recorded under weedy check (0.69) (Table 4). Similar findings were also reported by Tamng *et al*. (2015) and Joshi *et al*. (2022).

CONCLUSION

In conclusion, the study revealed that different weed management practices significantly affected the growth and productivity of green gram. T_8 (Hand weeding at 20 and 35 DAS) resulted in the highest plant growth parameters, including plant height, fresh and dry weightand number of nodules. Economically, T_4 (Oxyflurofen @150 g ha^{-1} +H and weeding at 35 DAS) achieved the highest net income and B:C ratio, while T_8 also showed high gross income. The weedy check showed the lowest growth and economic returns. Overall, effective weed control through hand weeding and herbicide application enhances both growth and economic outcomes of green gram in the medium land situation of Manipur.

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Conflict of interest

The authors declare that there are no conflict of interest.

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