

RESEARCH PAPER

# Effect of Plant Geometry on the Growth and Yield of Maize (*Zea mays* L.)-Green Gram (*Vigna radiata* L.) Intercropping System

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## ABSTRACT

A field experiment was conducted during *pre-kharif* season (February to May) of 2023 and 2024 at Instructional Farm of Seacom Skills University, Kendradangal, Bolpur, West Bengal, India to assess the different ratio of intercropping system on growth and yield of maize and green gram over sole cropping. The experiment was laid out in randomized block design (RBD) with three replications comprising 8 different combinations of intercropping of maize and green gram. As per the results, different growth parameters, crop growth rate along with nodulation pattern, yield parameters in green gram recorded significantly superior values in alternate rows of green gram and maize growing plots. Maize crop also showed such significant variation among different treatments regarding growth parameters alongside yield attributes where higher values were recorded in alternate rows of green gram and maize in the experiment like in green gram. Highest grain (5150 kg ha<sup>-1</sup>) and stover yield (6170 kg ha<sup>-1</sup>) of maize along with quiet good seed yield (428 kg ha<sup>-1</sup>) of green gram was also observed in the same treatment mentioned for growth and yield parameters of both the crops. In maize, alternate rows of green gram and maize treatment recorded highest LER (1.05) where corresponding LER of green gram was 0.64 and their total being 1.69. Maximum gross return, net return and B:C ratio had been received in the treatment where maize and green gram were grown in alternate rows. Thus, in such intercropping system, alternate rows of green gram and maize where 50% space of land could be shared by both crops and could be recommended for the farming community of this region.

## HIGHLIGHTS

- ① Cultivation of dual crops (cereal + legume) rather than single cropping add beneficial elements in soil as well as increasing the sustainability.
- ① It is a suitable replacement to summer rice especially in such areas of red and lateritic zone.
- ① It helps to identify a long term suitable option in climate changing scenarios.

**Keywords:** Green gram, maize, growth, intercropping, LER, yield, CER, economics

Meeting the need for fundamental requirements like food, fuel for human consumption, and animal feed is extremely difficult, as seen by the world's constantly growing population and the dwindling

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amount of arable land. There is no possibility of overcoming these obstacles by increasing production through traditional agriculture, that is, by increasing the cultivated area (Baishya *et al.* 2022). Adoption of modern farming technologies such as cultivating stress-resistant crop varieties, implementing novel cultural practices, and maintaining location-specific cropping patterns can be crucial for improving crop productivity. But in dryland regions, intercropping is seen to be the most effective way to stabilize crop production and yield since it boosts land productivity and reduces the chance of crop failure (Roy *et al.* 2015). Indeed, intercropping is a unique system of cropping that involves cultivating two or more crops simultaneously on the same piece of land. This practice contrasts with traditional monoculture system (Inuganti *et al.* 2025). Intercropping generally offers several advantages like better utilization of resources (soil nutrients, sunlight, water etc.), minimizing the risk of pest and disease outbreaks, reduce the risk of nutrient depletion, weed suppression leading to yield advantages (Huss *et al.* 2022). But, it is essential to choose crops that have complementary growth habits, nutrient requirements and time of maturity to optimize the advantages of intercropping (Landschoot *et al.* 2024). Generally, cereal-legume intercropping is a classic and widely practiced form of intercropping due to its compatibility and synergistic effects. The combination of cereals with legumes is well-known for their various benefits like additional nutrient (N) support by nitrogen fixation ability of legumes, complementary growth patterns, risk reduction of crop failure, diversified food production from same piece of land etc (Begam *et al.* 2020). It is also essential to sustainable agriculture because it offers a variety of food crops in both developed and developing nations, especially in regions where irrigation water is scarce (Tsubo *et al.* 2005). It is also important that successful cereal-legume intercropping requires careful consideration of factors such as crop selection, planting density and management practices. Maize (*Zea mays* L.) is the third most important cereal crop after rice and wheat that shows great adaptability to wide range of agro-climatic regions (Roy *et al.* 2023; Patre *et al.* 2024). Since legumes can be grown in the inter row spaces of maize, it is one of the best crops for intercropping. Maize-legume intercropping was

found to be beneficial regarding superior growth and yield parameters and have imposed lesser risk than the maize-legume rotation (Preetham *et al.* 2020; Kamanga *et al.* 2010). Maize-legume intercropping system is widely practiced in India and abroad. Generally, maize is a soil exhaustive crop in nature, thus cultivation of soil replenishing crop which can restore soil fertility is required in the cropping system (Banerjee *et al.* 2020). Thus, green gram seems to be the most suitable companion crop for maize in intercropping system as its growth pattern and canopy structure is likely to complement maize well, allowing both crops to thrive without competing excessively for resources (Hazra *et al.* 2018; Das *et al.* 2023). Also, mungbean stands out for its exceptional adaptability, palatability, and market value and its ease of digestibility further enhances its appeal, making it a sought-after crop (Mondal *et al.* 2025; Gorai and Mondal 2023; Pratihar *et al.* 2023). Intercropping maize with green gram offers several advantages, including efficient resource utilization, minimal competition for sunlight and sequential harvesting that allows both crops to thrive without significantly impacting each other's growth and productivity. Therefore, considering the aforesaid facts and potential, this experiment explored the beneficial effect of Maize-Greengram intercropping on crop growth, yield, and economics of farmers in Red and Lateritic soils of West Bengal.

## MATERIALS AND METHODS

### Environmental Conditions

The field experiment on maize-green gram intercropping was conducted during *pre-kharif* season of 2023 and 2024 at Instructional Farm (23.70°E latitude and 87.64°N longitude with an altitude of 9.75 m above mean sea level) of Seacom Skills University (SSU), Kendradangal, Birbhum, West Bengal, India. The experimental site fell under subtropical and humid climate. The average annual rainfall of this region was 1450 mm, 75% of the which occurred between June and September. Atmospheric temperature started increasing from end of the month of February which lasted up to June in this particular study site. From July onwards, the atmospheric temperature started declining while the relative humidity remained high. The texture of the experimental soil was sandy clay loam (order:



Entisol) with medium fertility and slightly acidic in reaction (pH 5.71).

### Experiment and Treatments

The experiment was laid out in randomized block design (RBD) comprising 8 different combinations of intercropping of maize and green gram as different treatments i.e.: T<sub>1</sub>- Pure Maize (spacing 60×30 cm) \*100% Maize\*, T<sub>2</sub>- Pure Green gram (spacing 30×15 cm) \*100% Green gram\*, T<sub>3</sub>- Alternate rows of Green gram and Maize \*50% Green gram and 50% Maize\*, T<sub>4</sub>- Two rows of Green gram and One row of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>5</sub>- Three rows of Green gram and One row of Maize \*77.77% Green gram and 22.22% Maize\*, T<sub>6</sub>- Two rows of Green gram and Two rows of Maize \*55.55% Green gram and 44.45% Maize\*, T<sub>7</sub>- Three rows of Green gram and Two rows of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>8</sub>-Three rows of Green gram and three rows of Maize. The experimental field was divided into 24 number of plots in 3 replications having plot size of 6×5 m<sup>2</sup> each. There was a main irrigation channel between the two replications that was one meter wide. Planting geometry was maintained as per treatments. Proper care had been taken for the management of both the crops from land preparation to harvest.

### Cultural Operations

The seeds of maize (variety: VNR 4226) and green gram (variety: Samrat) were sown in the field as per space management treatments with recommended seed rate of both the crops. In pure stand of maize, the maintained spacing was 60 × 30 cm<sup>2</sup> but green gram seeds were placed at 30 × 15 cm spacing. Two hand weeding were done at 45 DAS and at 70 DAS for maize and one hand weeding was done at 21 DAS for green gram respectively. The recommended dose of fertilizer was 180:90:90 for maize and 20:60:40 for green gram (both in it's pure stand and intercropping). Doses of potassium, phosphorus and 50% of nitrogen were applied as basal, while the remaining 50% of nitrogen was top dressed at 21 DAS in maize while in pure green gram, the entire doses of potassium, phosphorus and nitrogen were applied as basal. Total three irrigations were given in green gram while five irrigations were applied in maize. The crop was harvested at physiological maturity. After harvesting, threshing, cleaning

and drying, the grains of each plot were weighed separately and yield was determined.

### Observation recorded

The growth indices of green gram like plant height, dry matter production, crop growth rate (CGR), number of branches plant<sup>-1</sup> and number of nodules plant<sup>-1</sup> were recorded periodically. Similarly, the growth parameters of maize like plant height, dry matter production, CGR, number of leaves plant<sup>-1</sup> and LAI were noted. The yield components, seed yield and harvest index of green gram and maize were determined at maturity. The index of agronomic yield advantage like land equivalent ratio (LER) was calculated by the formula  $LER = Y_{ab}/Y_{aa} + Y_{ba}/Y_{bb}$  (Mead and Willey 1980). Where,  $Y_{aa}$ , yield of component a as a sole crop;  $Y_{bb}$ , yield of component b as a sole crop;  $Y_{ab}$ , yield of component a as intercrop grown in combination with component b and  $Y_{ba}$ , yield of component b as intercrop grown in combination with component a. Regarding crop equivalent ratio, the yield of intercrops or crop sequence were converted into equivalent yield of any one crop based on price of the products. Common cost of maize and green gram cultivation in addition to variable (treatment cost) was estimated based on input use as per the treatment details. Gross return was obtained by converting the harvest into monetary term at the prevailing market rate during the course of studies and thereafter net returns and Benefit: Cost ratio was calculated.

### Statistical analysis

The data obtained in the study were analyzed using 'Analysis of Variance' technique (ANOVA) following standard statistical procedures (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

### Growth and yield parameters of green gram

The results obtained in the study conducted in maize-green gram intercropping during summer season revealed significant influence of respective treatments in growth and yield parameters of green gram. Significantly maximum plant height (51.8 cm) was obtained at 60 DAS in T<sub>2</sub> treatment i.e. pure green gram stand followed by T<sub>7</sub> treatment i.e. three

rows of green gram and two rows of maize and T<sub>3</sub> treatment i.e. alternate rows of green gram and maize respectively during 2023–24 (Table 1). This might be due to improved plant geometry enhances plant height in maize by reducing intra-specific competition for light, nutrients, and moisture, thereby allowing individual plants better access to resources and more vertical growth. Dry matter production was significantly influenced by the treatments applied in the study and significantly maximum dry matter production (355.5 g m<sup>-2</sup>) was recorded in T<sub>3</sub> treatment i.e. alternate rows of green gram and maize which was found to be at par with T<sub>2</sub> treatment i.e. pure green gram stand. Proper nutrient supply, sufficient space, adequate light, and adequate water availability without intense competition are necessary for the efficient accumulation of dry matter in a crop or plant. Thus, results conformity to the findings of Latha *et al.* (2008). Significantly highest number of branches plant<sup>-1</sup> (16.7) was found in T<sub>2</sub> treatment i.e. pure green gram stand which was statistically at par with T<sub>4</sub> treatment i.e. two rows of green gram and one row of maize in the experiment (Table 1). The enhancement due to superior space management by the companion crop, which was maize. The crop growth rate in all the treatments were found to have consistent increase from their initial stage (germination) to the last date of observation at 60

DAS during *pre-kharif* season of 2023 and 2024. The rate of growth was maximum in T<sub>4</sub> treatment (two rows of green gram and one row of maize) as per calculation i.e. 0.69 g m<sup>-2</sup> day<sup>-1</sup> between 31–60 DAS respectively. This was closely followed by the T<sub>5</sub> and T<sub>3</sub> treatment respectively. Due to accumulation of superior dry matter in crop, the CGR had also got increased which was also suggested by Seran *et al.* (2010) in their findings. The significant differences in number of nodules plant<sup>-1</sup> were observed at 60 DAS as well due to different combinations of intercropping. Pure crop stands of green gram recorded maximum number of nodules plant<sup>-1</sup> (20.5) which was closely followed by T<sub>7</sub> treatment i.e. three rows of green gram and two rows of maize (18.9) in the study. Due to better spacial arrangements and availability of much amount of water and nutrients by lesser competition from the companion crop, the root got a healthy condition for nodule development and due to which the rhizobium association formed well settled leading to a better nutrient supply to plant.

For better understanding of the production, its causes and effect, the yield attributes of the crop were brought under the study. Number of pods plant<sup>-1</sup> varied significantly due to different combinations of intercropping with maize. Highest number of pods plant<sup>-1</sup> (24.37) was recorded in

**Table 1:** Growth and yield of green gram on space management in maize-green gram intercropping system

Treatment	Plant height (cm) at 60 DAS	Dry matter production (g m <sup>-2</sup> ) at 60 DAS	No. of branches plant <sup>-1</sup> at 60 DAS	CGR (31–60 DAS)	No. of nodules plant <sup>-1</sup> at 60 DAS	No. of Pods Plant <sup>-1</sup>	No. of seeds Pod <sup>-1</sup>	Test Weight (g)	Seed Yield (kg ha <sup>-1</sup> )	Stover Yield (kg/ha)	Harvest Index (%)
T <sub>1</sub>	—	—	—	—	—	—	—	—	—	—	—
T <sub>2</sub>	51.8	308.4	16.7	0.53	20.5	24.00	8.03	34.66	667	2052	24.57
T <sub>3</sub>	50.5	355.5	15.6	0.61	10.7	24.37	7.70	34.49	428	1415	23.20
T <sub>4</sub>	49.8	244.6	16.1	0.69	11.1	24.00	7.09	33.98	445	1101	23.04
T <sub>5</sub>	44.8	255.6	15.6	0.67	9.8	22.60	6.90	33.74	519	1359	22.97
T <sub>6</sub>	46.7	273.3	16.2	0.53	15.4	22.93	6.49	33.51	371	1092	22.86
T <sub>7</sub>	50.8	286.5	15.5	0.60	18.9	21.27	5.99	34.49	428	1270	22.48
T <sub>8</sub>	50.3	285.3	14.7	0.48	14.5	18.30	5.32	32.83	336	840	22.21
S.Em ±	1.4	18.23	0.81	0.03	0.80	0.70	0.3	0.4	29.5	76.2	0.43
CD (p=0.05)	4.3	56.18	2.43	0.08	2.47	2.10	1.0	1.1	91.0	234.9	1.34

[T<sub>1</sub>- Pure Maize (spacing 60 × 30 cm) \*100% Maize\*, T<sub>2</sub>- Pure Green gram (spacing 30 × 15 cm) \*100% Green gram\*, T<sub>3</sub>- Alternate rows of Green gram and Maize \*50% Green gram and 50% Maize\*, T<sub>4</sub>- Two rows of Green gram and One row of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>5</sub>- Three rows of Green gram and One row of Maize \*77.77% Green gram and 22.22% Maize\*, T<sub>6</sub>- Two rows of Green gram and Two rows of Maize \*55.55% Green gram and 44.45% Maize\*, T<sub>7</sub>- Three rows of Green gram and Two rows of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>8</sub> - : Three rows of Green gram and three rows of Maize].



the  $T_3$  treatment having green gram in alternate rows with maize which was at par with that in its pure stand (24 pods plant<sup>-1</sup>) and  $T_4$  (two rows of green gram and one row of maize), while lowest number (18.30 pods plant<sup>-1</sup>) was observed in the treatment  $T_8$  where three rows of green gram and three rows of maize combination had been followed (Table 1). Number of seeds pod<sup>-1</sup> was recorded maximum (8.03 pod<sup>-1</sup>) in its pure culture, which was statistically at par with that in  $T_3$  where green gram was grown in alternate rows with maize (7.7 pod<sup>-1</sup>) and  $T_4$  treatment (7.09 pod<sup>-1</sup>), minimum number (5.32 pod<sup>-1</sup>) being in  $T_8$  treatment respectively during summer season at Birbhum, West Bengal. Similar significant observation was found regarding test weight of green gram seeds where superior value (34.66 g) was obtained in pure crop stand ( $T_2$ ) which was statistically at par with  $T_3$  and  $T_7$  treatment respectively. The results regarding yield attributing parameters were in close proximity with results obtained by Ro *et al.* (2023). Significantly highest grain yield (667 kg ha<sup>-1</sup>) in mung bean was recorded in its pure stand having enjoyed 100% space in the plot, followed by  $T_5$  (519 kg ha<sup>-1</sup>) having enjoyed 77.77% space with maize growing three rows of green gram and one row of maize. The lowest (336 kg ha<sup>-1</sup>) grain yield was received in the treatment  $T_8$  having combination three rows of green gram and three rows of maize during 2023–24 (Table 1). Pure green gram was favoured with 100% space

for its utilization by 100% of its population which led to the maximum grain yield. The stover yield, followed almost the same trend of variation in grain yield due to different combinations, 2052 and 840 kg ha<sup>-1</sup> being highest and lowest in ( $T_1$ ) the pure stand and ( $T_8$ ) with three rows of green gram alternate with three rows of maize, respectively. There has been more space between three rows of green gram having less population with wider space in between the same crop which led to better utilization of resources and also due to more applied NPK, it enjoyed higher nutrients for its growth and development without any scarcity. Although, there was not much significant difference among treatments regarding harvest index (%) of green gram, but superior value (24.57 %) was noted in pure crop stand closely followed by  $T_3$  treatment in the experimentation (Table 1).

### Growth and yield parameters of maize

The intercropping treatments of maize-green gram also had significant influence on growth and yield components of maize tested during *pre-kharif* season at Instructional Farm of SSU, Bolpur. Significantly highest plant height (183.2 cm) at 90 DAS was recorded in  $T_1$  treatment i.e. pure maize stand followed by  $T_3$  treatment i.e. alternate rows of green gram and maize respectively during 2023 and 2024 (Table 2). It was basically happened due to better space and availability of important sources

**Table 2:** Growth and yield of maize on space management in maize green gram intercropping system

Treatment	Plant height (cm) at 90 DAS	No. of leaves plant <sup>-1</sup> at 90 DAS	Dry matter production (g m <sup>-2</sup> ) at 90 DAS	CGR (61–90) at 90 DAS	LAI at 90 DAS	No. of Cobs Plant <sup>-1</sup>	No. of seeds cob <sup>-1</sup>	Seed Index (g)	Grain Yield (kg ha <sup>-1</sup> )	Stover Yield (kg ha <sup>-1</sup> )	Harvest Index (%)
$T_1$	183.2	12.9	1480.7	10.34	4.09	1.02	331	30.00	4898	5795	45.81
$T_2$	—	—	—	—	—	—	—	—	—	—	—
$T_3$	178.6	13.3	1364.2	9.41	3.78	1.02	322	29.44	5150	6170	45.49
$T_4$	160.2	12.6	918.0	6.05	3.76	1.0	295	29.92	4098	4892	45.58
$T_5$	166.1	12.3	526.7	3.37	3.61	1.0	259	30.01	3580	4332	45.25
$T_6$	161.4	11.4	1168.0	8.05	3.56	1.0	252	29.85	2865	3580	44.45
$T_7$	163.2	12.5	848.9	5.90	3.35	1.0	260	29.07	2387	2932	44.88
$T_8$	163.2	12.0	1376.7	9.88	3.06	1.0	230	27.00	2295	2896	44.21
S.Em ±	3.0	0.44	45.79	0.38	0.08	0.06	9.9	1.1	139	215	0.67
CD ( $p=0.05$ )	9.2	1.37	141.10	1.16	0.25	0.18	30.4	3.4	430	663	2.08

[ $T_1$ - Pure Maize (spacing 60 × 30 cm) \*100% Maize\*,  $T_2$ - Pure Green gram (spacing 30 × 15 cm) \*100% Green gram\*,  $T_3$ - Alternate rows of Green gram and Maize \*50% Green gram and 50% Maize\*,  $T_4$ - Two rows of Green gram and One row of Maize \*66.66% Green gram and 33.33% Maize\*,  $T_5$ - Three rows of Green gram and One row of Maize \*77.77% Green gram and 22.22% Maize\*,  $T_6$ - Two rows of Green gram and Two rows of Maize \*55.55% Green gram and 44.45% Maize\*,  $T_7$ - Three rows of Green gram and Two rows of Maize \*66.66% Green gram and 33.33% Maize\*,  $T_8$ - : Three rows of Green gram and three rows of Maize].

by the companion crop. Superior number of leaves plant<sup>-1</sup> (13.3) was counted to be in T<sub>3</sub> treatment and lowest value (11.4) regarding this leaf count was in T<sub>6</sub> treatment i.e. two rows of green gram and two rows of maize respectively in the study. At 90 DAS, highest dry matter (1480.7 g m<sup>-2</sup>) was produced by pure crop followed by T<sub>8</sub> treatment (1376.7 g m<sup>-2</sup>) which was found to be at par with T<sub>3</sub> treatment in the experiment. Large amount of nutrients got available due to better spatial arrangement along with the legume crop i.e. green gram which played the vital role in availability of nutrients to maize for its growth and development. Such results also matched with the findings of Begam *et al.* (2024) in West Bengal of India. Almost the same trend of variations of crop growth rate in maize was observed like other growth parameters due to treatment variation was observed between 61–90 DAS as well at Kendradangal, Birbhum where T<sub>3</sub> treatment recorded CGR value of 9.41 g m<sup>-2</sup> day<sup>-1</sup> which was the second best after pure maize stand in the experiment (Table 2). This was due to accumulation of higher amount of dry matter in maize and CGR had also got increased which was also suggested by Jan *et al.* (2023). LAI of maize varied significantly between the treatments like other growth attributes and highest value (4.09) was recorded in pure maize stand (T<sub>1</sub>) which was closely followed by T<sub>3</sub> treatment (3.78) i.e. 50% sharing of space between both crops during summer season. Due to better availability of support by the companion crop, the dry matter got accumulated in a good percentage in the plant leading to a broad canopy comparatively leading to more leaf area index. The findings were in close proximity with Mandal *et al.* (2014) and Naik *et al.* (2017) experiments.

In maize crop density, number of cobs plant<sup>-1</sup>, number of seeds cob<sup>-1</sup>, seed index generally observed to have accurate information to the practical extent. Significant variation was observed regarding number of cobs plant<sup>-1</sup> in maize where higher value (1.02) was recorded in T<sub>3</sub> treatment alongside pure stand of maize (T<sub>1</sub>) in the study. Number of grains cob<sup>-1</sup> was highest (331 cob<sup>-1</sup>) in its pure stand which was at par with that of T<sub>3</sub> treatment (322 cob<sup>-1</sup>) where maize and green gram were grown in alternate rows respectively (Table 2). Seed index followed similar trend like

other yield parameters though not much variation was observed in different treatments as compared to pure crop stand during growing seasons. The yield attributing parameters were superior in the treatment having green gram in alternate rows with maize might be due to more nutrient advantage as result of synergistic effect of the legume. Such type of findings was also observed by Kaushal *et al.* (2015) previously. Highest grain and stover yield of maize (5150 and 6170 kg ha<sup>-1</sup>) was observed in T<sub>3</sub> treatment where 50% sharing of space between both crops was given during summer among the eight treatments at Bolpur. The results were in conformity with the results and observations given by Demie *et al.* (2022) where they observed that cereal-legumes system of cropping was found to be mostly complementary and had synergistic relation. The calculated harvest index of maize showed statistically at par results among the selected treatments with highest value in 100% crop stand followed by T<sub>4</sub> and T<sub>3</sub> treatments respectively in the study (Table 2).

### Land and crop equivalent ratio

Land Equivalent Ratio (LER) provided us with the idea as to the relative area of land under its sole cropping required to produce the same yield as obtained under the intercropping under the same level of management. So far as the crop green gram, highest LER (1.17) was observed in T<sub>5</sub> treatment i.e. 77.77% green gram and 22.22% maize where corresponding LER of maize was 0.70 while their total being 1.87 respectively. In maize, alternate rows of green gram and maize treatment (T<sub>3</sub>) recorded highest LER (1.05) where corresponding LER of green gram was 0.64 and their total being 1.69 (Table 3). It was interesting to observe that none of the combinations had its total LER less than one minimum being in T<sub>6</sub> treatment (1.41) in the cereal-legume intercropping system. Crop equivalent ratio (CER) was calculated to be maximum (2.78 and 1.36) in T<sub>3</sub> treatment in green gram and maize respectively. Lowest CER in both crops (1.46 and 0.71) was observed in T<sub>8</sub> treatment i.e. three rows of green gram and three rows maize had been grown during 2023–24 at Kendradangal, Birbhum (Table 3). The results conformity to the findings Thinley *et al.* 2024, they reported that intercropping was more productive and efficient over sole cropping and also improved the LER.

**Table 3:** Land equivalent ratio, crop equivalent ratio and economics on maize- green gram intercropping system

Treatment	Land Equivalent Ratio			Crop equivalent ratio		Economics			
	Green gram	Maize	Total	Green gram	Maize	Cost of cultivation ( $\times 10^3 \text{ ₹ ha}^{-1}$ )	Gross return ( $\times 10^3 \text{ ₹ ha}^{-1}$ )	Net return ( $\times 10^3 \text{ ₹ ha}^{-1}$ )	B:C ratio
T <sub>1</sub>	—	—	—	—	—	35.2	109.9	74.7	3.12
T <sub>2</sub>	—	—	—	—	—	21.7	60.1	38.4	2.76
T <sub>3</sub>	0.64	1.05	1.69	2.78	1.36	40.7	154.5	113.8	3.80
T <sub>4</sub>	1.04	0.84	1.88	2.37	1.16	39.0	137.4	98.4	3.52
T <sub>5</sub>	1.17	0.70	1.87	2.26	1.11	37.8	133.7	95.9	3.54
T <sub>6</sub>	0.71	0.70	1.41	1.75	0.85	40.1	106.7	66.6	2.66
T <sub>7</sub>	1.15	0.67	1.82	1.63	0.80	39.0	105.2	66.2	2.70
T <sub>8</sub>	0.79	0.80	1.59	1.46	0.71	40.7	91.9	51.2	2.26

[T<sub>1</sub>-Pure Maize (spacing 60 × 30 cm) \*100% Maize\*, T<sub>2</sub>-Pure Green gram (spacing 30 × 15 cm) \*100% Green gram\*, T<sub>3</sub>-Alternate rows of Green gram and Maize \*50% Green gram and 50% Maize\*, T<sub>4</sub>-Two rows of Green gram and One row of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>5</sub>-Three rows of Green gram and One row of Maize \*77.77% Green gram and 22.22% Maize\*, T<sub>6</sub>-Two rows of Green gram and Two rows of Maize \*55.55% Green gram and 44.45% Maize\*, T<sub>7</sub>- Three rows of Green gram and Two rows of Maize \*66.66% Green gram and 33.33% Maize\*, T<sub>8</sub>-Three rows of Green gram and three rows of Maize].

[Maize ₹ 25 kg<sup>-1</sup>, Green gram ₹ 90 kg<sup>-1</sup>].

### Economic analysis of maize green gram intercropping

Yield and production was the goal, while economic study was the main target to evaluate the crop and system to be adopted by the farming community. As per the calculated results, lowest cost of cultivation (₹ 21,700 and 35,200) was found in pure green gram and maize stand which was closely followed by T<sub>5</sub> and T<sub>4</sub> treatment respectively (Table 3). Maximum gross return (₹ 1,54,500) and net return (₹ 1,13,800) had been received in the treatment T<sub>3</sub> where maize and green gram were grown in alternate rows and lower gross return (₹ 91,900) and net return (₹ 51,200) was observed in T<sub>8</sub> treatment among maize-green gram combinations after sole crop stand in this experiment. Highest B:C ratio (3.80) was also found to be in T<sub>3</sub> treatment closely followed by T<sub>5</sub> (3.54) and T<sub>4</sub> (3.52) treatment which were intercropping treatments also.

### CONCLUSION

The combination of alternate rows of maize and green gram was superior to all systems be it pure or intercropping in respect of growth parameters, yield attributes, yield, and higher profit. Therefore, alternate rows of Green gram and Maize \*50% Green gram and 50% Maize\* could be more effecting in

augmenting better yield, profit and soil health in the Red and Lateritic soils of West Bengal.

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