Original Research Article

Foliar application of Nutrient and Hormonal consortia boost-up the growth parameters in greengram plants

ABSTRACT

Aim: To understand the influence of nutrients and plant growth regulators on growth attributes of greengram.
Study design: Factorial and arranged in a randomized complete block design.
Place and Duration of Study: Wetland farms, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore; April - June 2023.
Methodology: A field experiment was conducted on clay soil fields located at Wetlands farm, TNAU, Coimbatore. Two greengram varieties CO 8 and VBN 4 were taken for the experiment. The treatments were Control – Water spray (T_1), Nutrio-hormonal consortia 1 (T_2), Nutrio-hormonal consortia 2 (T_3), Pulse consortia 1 (T_4), Pulse consortia 2 (T_5). The treatments were applied as foliar spray at flowering stage of the crop. The observations are recorded after 10 days of spraying. Growth parameters were recorded. Two-way ANOVA was used to analyze the data.
Results: The significant difference between the treatments was observed at $p < 0.05$. Foliar application of Pulse consortia 2 (T_5) resulted in higher growth attributes such as leaf area, leaf area index, leaf area duration, specific leaf weight and crop growth rate in both the greengram varieties and resulted in improved growth attributes over control.
Conclusion: The present study concluded that foliar application of the Pulse consortia 2 (T_5) exhibit highest growth attributes in greengram. Improved growth parameters might attribute to improve the yield.

Keywords: Greengram; foliar spray; nutrients; plant growth regulators; leaf area; leaf area index; leaf area duration; specific leaf weight; crop growth rate.

1. INTRODUCTION

Pulses are one of the important food crops and they are rich in protein content. Pulses are important group of crops in India, which is also responsible for yielding large financial gains by amounting for a large part of the exports. Pulses are the major sources of protein in the diet. Keeping in view large benefits of pulses for human health, the Food and Agriculture Organization (FAO) of the United Nations declared the year “2016” as the International Year of Pulses. India is the largest producer and consumer of pulses in the World, contributing nearly 24 per cent to the Global output. India is currently in midway of achieving self-sufficiency in pulses production (Singh *et al.,* 2013). Among pulses greengram (*Vigna radiata* L.) is popular and commonly grown crop in India. The productivity of greengram in India is very less compared to other countries. Greengram is highly responsive for fertilizers.
Nutrients play a crucial role in growth and physiology of the crops. Nitrogen is a primary component of amino acid and protein building blocks, nucleic acids and chlorophyll.

(Shrestha, et al. 2020). Phosphorus (P) is an essential and vital plant nutrient, second only to nitrogen, and it is required in significant quantities for the optimal growth of leguminous plants. As a constituent of high-energy phosphate bonds in ATP phosphorus plays a fundamental role in the formation and translocation of carbohydrates, fatty acids, and other crucial compounds within the plant's metabolic processes (Bala Prasad Mishra, 2016). Potassium has an impact on several processes, including respiration, photosynthesis, chlorophyll development, water content of leaves, assimilation of carbon dioxide (CO_2), and carbon movement. The movement of photosynthates from source to sink depends on potassium (Cakmak, et al. 1994). Micronutrients like B, Fe, Zn etc.., play distinct and vital roles in plant physiology and biochemical processes (Putra et al. 2012; Rab and Haq 2012).
Plant growth hormones can increase physiological efficiency, particularly photosynthetic ability, and thereby promote the development of fruit, seeds and flowers eventually increasing agricultural yield (Solamani, et al. 2001). PGRs improved the sink development, characterized by an increase in the number of pods per plant, seeds per pod, seed weight, harvest index, and other important yield attributes (Nithila and Shivakumar, 2017).
Nutrient balance is very important to improve the crop yield. Imbalance in nutrient application leads to nutrient mining from the soil, deteriorated crop productivity and soil health. The nutrients should be replenished through organic and inorganic fertilizers, which improves crop productivity and preserves soil health. With this background, the present study was conducted to find out the effect of nutrients and plant growth regulators on physiology and yield of greengram crop.

2. MATERIAL AND METHODS

2.1 Study Area

A field experiment was conducted during the month of April – June, 2023 on clay soil fields located at Wetland farms in Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India situated at 11^0 N latitude and 77^0 E longitude with an altitude of about 426.72 m above mean sea level. The main objective of this experiment was to increase the growth attributes of greengram by foliar application of nutrients and plant growth hormones.

2.2 Experimental Design

The experiment was laid out in Factorial Randomized Complete Block Design (FRBD) with two factors viz., two greengram varieties and five treatments. Two greengram varieties CO 8 and VBN 4 were taken for the experiment. The plot size was 3 x 3 m. The greengram seeds were sown with a spacing of 30 x 10 cm.

2.3 Treatment Details

The treatments are Control – Water spray (T_1), Nutrio-hormonal consortia 1 (T_2), Nutrio-hormonal consortia 2 (T_3), Pulse consortia 1 (T_4), Pulse consortia 2 (T_5). Treatments are prepared as a 1% foliar spray solution. The treatments were sprayed on flowering stage of the crop. The observations are recorded after 10 days of spraying. Growth parameters were recorded under different treatments.

2.3.1 Leaf Area

The total leaf area was measured using a Leaf Area Meter (LICOR, Model LI 3000), and the results were expressed as **cm^{-2} $plant^{-1}$**.

2.3.2 Leaf Area Index (LAI)

Leaf Area Index is the measure of available photosynthetic surface per unit land area. Leaf Area Index was measured by the formula of Watson (1956).

$$\textbf{LAI} = \frac{\textbf{Leaf area per plant}}{\textbf{Land area occupied by a plant (spacing)}}$$

2.3.3 Leaf Area Duration (LAD)

Leaf Area Duration is the ability of the plant to maintain the green leaves over unit area of land throughout its life. It also measures the persistence of the assimilating surface. LAD is measured by the formula of Power *et al*. (1967) and results are expressed in **days**.

$$\textbf{LAD} = \frac{L_1+L_2}{2} \text{ X } t_2 - t_1$$

Where,

L_1 - LAI at time t_1

L_2 - LAI at time t_2

$t_2 - t_1$ -Time interval between two consequent stages

2.3.4 Specific Leaf Weight (SLW):

Specific Leaf Weight is the ratio of leaf dry weight to its area of assimilating surface. SLW was calculated by the formula of by Pearce *et al.* (1968) and the results are expressed in **mg cm^{-2}.**

$$\textbf{SLW} = \frac{\textbf{Leaf dry weight/plant}}{\textbf{Leaf area/plant}}$$

2.3.5 Crop Growth Rate (CGR)

Crop Growth Rate is the rate of increase of dry weight per unit land area per unit time. CGR is calculated by the formula of Watson (1958) and the results are expressed in **g m^{-2} day^{-1}**.

$$\textbf{CGR} = \frac{W_2 - W_1}{P\,(t_2 - t_1)}$$

Where,

W_2 & W_1 - Dry weight of the whole plant at stage 2 & 1 respectively

$t_2 - t_1$ - Time interval between the two stages

P – Spacing between plants

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

3.1.1 Leaf Area (LA)

Highest leaf area (878.69 cm^{-2}) was observed in greengram plants sprayed with Pulse consortia 2 (T_5) when compared to control (T_1) with an area of (391.83 cm^{-2}) as indicated in Table 1. The reason for the increased leaf area is that nitrogen and other micronutrients prevented the degradation of chlorophyll, induced the synthesis of photosynthetic enzymes, and maintained the levels of auxin higher in the leaves. These factors may have improved and maintained the assimilatory surface area for a longer period of time. The increase in leaf area was in consistent with the findings of (Thakur, et al.2017; Sritharan, et al. 2015; Mishra, et al. 2016; Singh and Jambukiya, 2020).

3.1.2 Leaf Area Index (LAI)

Among various treatments, greengram plants sprayed with Pulse consortia 2 (T_5) recorded higher LAI (2.93) than control (T_1) with a LAI of (1.31) (Table 1). This is due to application of nutrients and plant growth regulators that increased leaf area that can be contributed to the higher LAI. The findings of increase in leaf area index were in accordance with the findings of (Sachin, et al. 2019; Banerjee, et al. 2022; Mishra, et al. 2016; Deol, et al.2018; Dayana, et al. 2022; Kunjammal and Sukumar, 2019)

3.1.3 Leaf Area Duration (LAD)

From the study, it was observed that T_5 (Pulse consortia 2) has the highest LAD of (75.3 days) than control (T_1) (23.1days) as depicted in Table 1 . This increase is due to improved longevity of leaf by application of nutrients and plant growth regulators which delayed the senescence of leaf by preventing the breakdown of chlorophyll. The increased LAD may be due to increased photosynthetic surface area. These results from our experiment were supported by findings of (Paramesh, et al. 2013; Sritharan, et al. 2015; Deol, et al. 2018)

3.1.4 Specific leaf weight (SLW)

Pulse consortia 2 (T_5) showed highest specific leaf weight of (7.05 mg cm^{-2}) than control (T_1) with a SLW of (3.36 mg cm^{-2}) as shown in the Figure 1. Increased SLW might be due to increased cell surface to volume ratio may be linked to increased SLW, which reduces mesophyll resistance to CO_2 entry and boost photoassimilate accumulation. Thicker leaves would have a better capability for photosynthesizing than thinner leaves because they would have a bigger number of mesophyll cells with a significant amount of chlorophyll. Findings of improved specific leaf weight from the experiment were in accordance with results of (Sritharan, et al. 2015; Sachin, et al. 2019).

3.1.5 Crop growth rate (CGR)

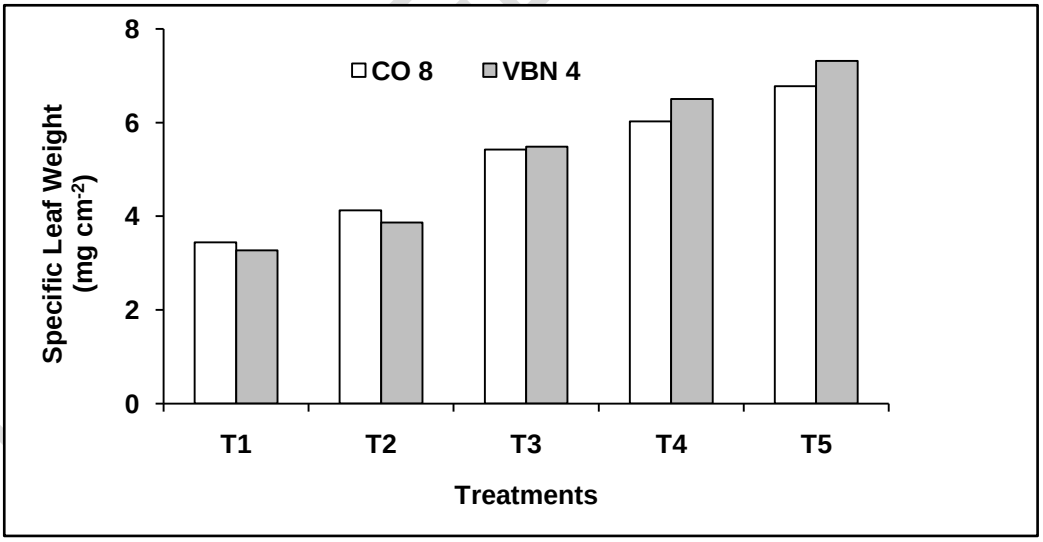
In the present study, Figure 2 indicates that Pulse consortia 2 (T_5) showed highest crop growth rate (5.36 g m^{-2} day^{-1}) when compared to control (T_1) with a CGR of 2.45 g m^{-2} day^{-1}. The elevated crop growth rate (CGR) when nutrients are applied through foliar methods could be attributed to the rise in leaf area index (LAI) and enhanced chlorophyll synthesis, ultimately leading to greater biomass generation. The increase in CGR due to this spray may be attributed to increased LAD produced by them.

Table 1. Effect of nutrients and plant growth regulators on Leaf Area, Leaf Area Index and Leaf Area Duration (days) of greengram

Treatments	Leaf Area (cm^{-2})			Leaf Area Index			Leaf Area Duration (days)		
	Greengram Varieties			Greengram Varieties			Greengram Varieties		
	CO 8	VBN 4	Mean	CO 8	VBN 4	Mean	CO 8	VBN 4	Mean
T_1	375.30	408.36	391.83	1.25	1.36	1.31	21.3	24.8	23.1
T_2	408.44	644.34	526.39	1.36	2.15	1.75	27.4	38.1	32.7
T_3	446.18	770.52	608.35	1.49	2.57	2.03	34.3	48.1	41.2
T_4	591.67	984.58	788.12	1.97	3.28	2.63	50.2	63.1	56.7
T_5	751.52	1005.86	878.69	2.51	3.35	2.93	71.4	79.2	75.3
Mean	**514.62**	**762.73**	**638.68**	**1.72**	**2.54**	**2.13**	**40.9**	**50.7**	**45.8**
	T	**V**	**T × V**	**T**	**V**	**T × V**	**T**	**V**	**T × V**
SEd	76.96	48.67	108.84	0.26	0.16	0.36	3.15	1.99	4.46
CD (p< 0.05)	161.69	102.26	228.66	0.54	0.34	0.76	6.62	4.19	9.36

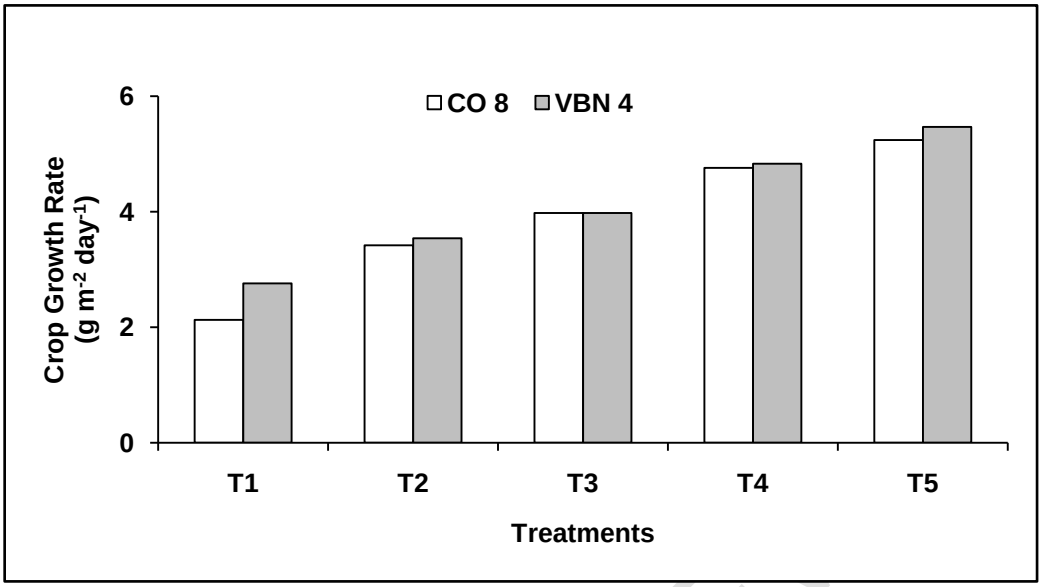
T_1 – Control (Water spray); T_2 – Nutrio-hormonal consortia 1; T_3 – Nutrio-hormonal consortia 2; T_4 – Pulse Booster 1; T_5 – Pulse Booster 2; T = Nutrient and plant growth regulator treatment; V = Greengram varieties; T × V = Interaction between Nutrient and plant growth treatment and Greengram varieties; SEd = Standard Error Difference; CD = Critical Difference

Figure 1. Effect of nutrients and plant growth regulators on Specific Leaf Weight of greengram



T_1 – Control (Water spray); T_2 – Nutrio-hormonal consortia 1; T_3 – Nutrio-hormonal consortia 2; T_4 – Pulse Booster 1; T_5 – Pulse Booster 2

Figure 2. Effect of nutrients and plant growth regulators on Crop Growth Rate of greengram



T_1 – Control (Water spray); T_2 – Nutrio-hormonal consortia 1; T_3 – Nutrio-hormonal consortia 2; T_4 – Pulse Booster 1; T_5 – Pulse Booster 2

4. CONCLUSION

In this study, foliar application of nutrients and plant growth regulators has improved the growth and development of greengram. The present study concludes that application of Pulse consortia 2 (T_5) @ 1% at flowering stage have improved the growth attributes like leaf area, leaf area index, leaf area duration, specific leaf weight and crop growth rate in both greengram varieties. Improved growth might attribute to improve the yield of greengram.

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