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# Foliar Application of Nutrient and Hormonal Consortia Boost-up the Growth Parameters in Greengram Plants

**S. Rangasamy [a], V. Babu Rajendra Prasad [a*], A. Senthil [a], G. Prabu Kumar [b], R. Suresh [c] and A. Sumathi [a]**

*[a] Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.*
*[b] Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.*
*[c] Department of Rice, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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***Original Research Article***

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## ABSTRACT

**Aim:** To understand the influence of nutrients and plant growth regulators on growth attributes of greengram.
**Study Design:** Factorial and 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

**Corresponding author: E-mail: vbrprasad@tnau.ac.in;*

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 important group of food 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. The Food and Agriculture Organisation (FAO) of the United Nations designated the year "2016" as the International Year of Pulses in recognition of the significant health advantages of pulses. India is currently midway to being a self-sufficient producer of pulses [1]. 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 [2]. Phosphorus (P) is an essential and vital plant nutrient 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 [3]. 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 [4]. Micronutrients like B, Fe, Zn etc.., play distinct and vital roles in plant physiology and biochemical processes [5,6].

Plant growth hormones can increase physiological efficiency, particularly photosynthetic ability, and thereby promote the development of fruit, seeds and flowers eventually increasing agricultural yield [7]. 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 [8].

Nutrient balance is very important to improve the crop yield. Imbalance in nutrient application leads to nutrient mining from the soil, deteriorated crop productivity. The nutrients should be replenished through organic and inorganic fertilizers, which improve crop productivity [9]. Foliar application of nutrients and plant growth regulators is attributed with the advantages of rapid and effective nutrient utilization, reduction of losses through leaching and fixation, and enhances the uptake of nutrients by plants. 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 11º N latitude and 77º 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 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 ($T_5$). Treatments are prepared as a 1% foliar spray solution. The treatments were sprayed on flowering stage of the crop. The observations were recorded after 10 days of spraying. Growth parameters were recorded under different treatments. (Stage 1 = 10 days after spraying; Stage 2 = 25 days after spraying)

#### 2.3.1 Leaf area

Leaf Area Meter (LICOR, Model LI 3000) was used to calculate the total leaf area of the plant, and the findings were expressed as **$cm^{-2}$ plant$^{-1}$**.

#### 2.3.2 Leaf area index (LAI)

Leaf Area Indexis the measure of available photosynthetic surface per unit land area. The formula of Watson, [10] was used to calculate the Leaf Area Index.

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

#### 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 over the course of its lifetime. It also measures the persistence of the assimilating surface. LAD is measured by the formula by Power et al. [11] and results were expressed in days.

$$LAD = \frac{L_1+L_2}{2} \times t_2 - t_1$$

Where,

$L_1$ – Leaf Area Index at time $t_1$
$L_2$ - Leaf Area Index at time $t_2$
($t_2$ - $t_1$) -Time interval between two consequent stages

#### 2.3.4 Specific leaf weight (SLW)

The ratio of leaf dry weight to its area of assimilating surface is known as Specific Leaf Weight. SLW was determined using the formula of by Pearce et al. [12] and the results were given in mg $cm^{-2}$.

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

#### 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, [13] & the results were expressed in g $m^{-2}$ $day^{-1}$.

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

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 Leaf Area (LA)

The greengram plants treated with Pulse consortia 2 ($T_5$) had the highest leaf area (878.69 $cm^{-2}$) compared to the control ($T_1$) which had the lowest 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 higher levels of auxin in the leaves. These factors might have improved and maintained the assimilatory surface area for a longer period of time [14]. The increase in leaf area was in consistent with the findings of Thakur et al. [15]; Sritharanet al. [7]; Mishraet al. [3]; Singh and Jambukiya, [16].

### 3.2 Leaf Area Index (LAI)

Among various treatments, a greater LAI (2.93) was reported by greengram plants sprayed with Pulse consortia 2 ($T_5$) than the control ($T_1$) which had 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 [14]. The findings of increase in leaf area index were in accordance with the findings of Banerjeeet al. [17]; Mishraet al. [3]; Deolet al. [18]; Dayanaet al. [19]; Kunjammal and Sukumar, [20].

### 3.3 Leaf Area Duration (LAD)

From the study, it was observed that $T_5$ (Pulse consortia 2) had the highest LAD of (75.3 days) than control ($T_1$) (23.1 days) as depicted in

**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 plant$^{-1}$ (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 consortia 1; $T_5$ – Pulse consortia 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*

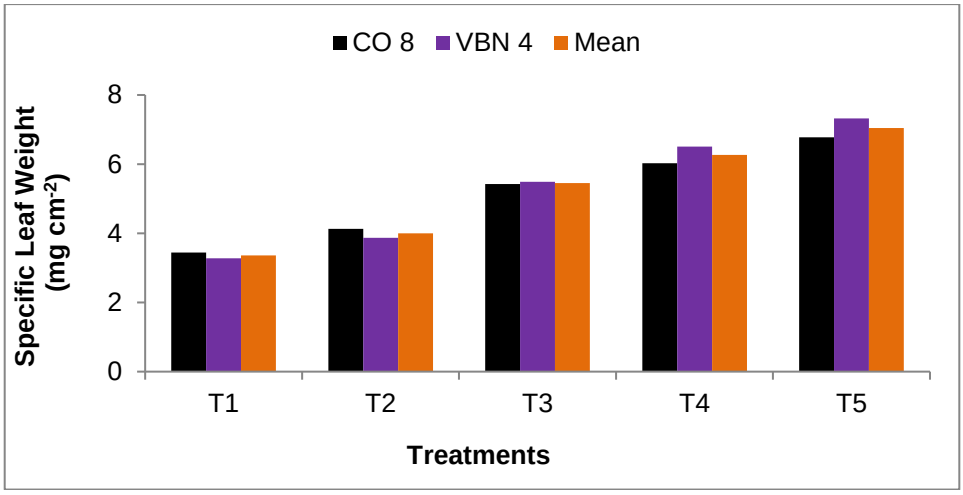


**Fig. 1. Effect of nutrients and plant growth regulators on Specific Leaf Weight of greengram**
*$T_1$ – Control (Water spray); $T_2$ – Nutrio-hormonal consortia 1; $T_3$ – Nutrio-hormonal consortia 2$T_4$ – Pulse consortia 1; $T_5$ – Pulse consortia 2*

Table 1. The increase LAD 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 also due to increased photosynthetic surface area [7]. These results from our experiment were supported by findings of Parameshet al. [21]; Deolet al. [18].

### 3.4 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 Fig. 1 [22]. Increased cell surface to volume ratio might be linked to increase SLW, which reduces mesophyll resistance to $CO_2$ entry and boost photoassimilate accumulation. Thicker leaves would have a better capability to do photosynthesis than thinner leaves because they would have a bigger number of mesophyll cells with a significant amount of chlorophyll [14]. Findings of improved specific leaf weight from the experiment were in accordance with results of Sritharanet al. [7].

### 3.5 Crop Growth Rate (CGR)

In the present study, Fig. 2 revealed that Pulse consortia 2 ($T_5$) showed highest crop growth rate

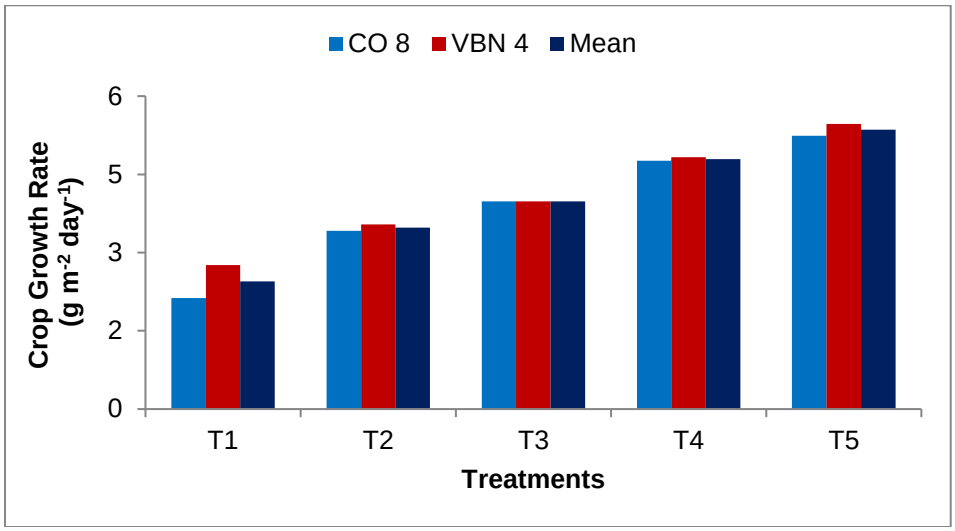


**Fig. 2. Effect of nutrients and plant growth regulators on Crop Growth Rate of greengram**
*$T_1$ – Control (Water spray); $T_2$ – Nutrio-hormonal consortia 1; $T_3$ – Nutrio-hormonal consortia 2; $T_4$ – Pulse consortia 1; $T_5$ – Pulse consortia 2*

(5.36 g $m^{-2}$ $day^{-1}$) when compared to control ($T_1$) (2.45 g $m^{-2}$ $day^{-1}$). The elevated crop growth rate (CGR) might be due to the foliar application of nutrients that attributed to increase 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 attributes to increased LAD [7]. These results were supported by Thakur et al. [15]; Banerjeeet al. [17]; Deolet al. [17]; Kunjammal and Sukumar, [20].

## 4. CONCLUSION

In this study, foliar application of nutrients and plant growth regulators had improved the growth and development of greengram. The present study concludes that foliar 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 (CO 8 and VBN), which leads to yield enhancement.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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