

Effect of Nutrio - hormonal Consortia on Growth and Yield in Groundnut

ABSTRACT

This study effectively addresses a knowledge gap concerning the interplay of nutrients and plant growth regulators on groundnut, which play a direct role in various crucial morpho-physiological processes essential for achieving enhanced productivity. The primary objective of this research was to assess the influence of nutrio-hormonal combinations on the growth and physiological traits of groundnut. The experiment was conducted in pot culture at glasshouse, the Department of Crop Physiology, TNAU, Coimbatore, utilizing a factorial completely randomized design. Two distinct genotypes, namely BSR 2 and VRI 8, were subjected to five different treatments, each with four replications. Treatments encompassed: T₁ - control (foliar water spray), T₂ - Nutrio hormonal consortia 1, T₃ - Nutrio hormonal consortia 2 (T₂ + K₂SO₄), T₄ - Groundnut booster 1 (FeSO₄, K₂SO₄, MgSO₄, Borax), and T₅ - Groundnut booster 2 (T₄ + Salicylic acid + NAA-Naphthalene Acetic Acid). Application of T₅ - Groundnut booster 2 through foliar means on the VRI 8 genotype recorded significant outcomes, characterized by higher leaf area (2297.83 cm²) and a specific leaf weight of 19.87 mg/cm². In contrast, when applied to the BSR 2 genotype, the leaf area was measured at 872.86 cm² with a specific leaf weight of 51.55 mg/cm². Despite BSR 2 demonstrating a higher number of pods per plant (37) as opposed to VRI 8 (26 pods/plant), the pod yield favored VRI 8, producing 8.16 g/plant compared to BSR 2's 7.07 g/plant. In conclusion, the foliar application of T₅ - Groundnut booster 2 in conjunction with the VRI 8 variety holds promising potential for enhancing groundnut yield.

Keywords: Groundnut; nutrients; salicylic acid; NAA; BSR 2; VRI 8; growth; yield.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a vital oilseed crop grown mainly in the summer across 108 countries in tropical and subtropical areas. It's a significant staple legume with economic and nutritional benefits. Many small-scale farmers value this crop. About two-thirds of its global production is used for oil, while the remaining one-third is a dietary staple. Belonging to the Leguminosae family, it's often called the "Poor Man's Almond," contributes substantially to the agricultural landscape [1]. In India, groundnut covers 40% of the total area for oilseed cultivation and makes up 60% of the total production. Kernels have around 44-50% oil, 26% protein, and 10-20% carbohydrates. They're also rich in essential nutrients like Vitamin E, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine, and potassium, in significant amounts. The oil from groundnut seeds is used for cooking. After extracting the oil, the leftover material, called oil cake, is valuable. It contains about 7-8% nitrogen (N), 1.5% phosphorus pentoxide (P₂O₅), and 1.2% potassium oxide (K₂O). This material can be repurposed as nutrient-rich organic fertilizer [2].

Potassium is a vital nutrient for plants, increasing crop yield and stress tolerance. It's crucial for growth, assimilation, transport, and storage tissue development. Groundnut absorbs potassium, aiding in various processes like water status maintenance, energy synthesis, and pod growth. Sulphur is the fourth major

nutrient and is important in the nutrition of oil-seed crops, as well as constituent of the sulphur-containing amino acids cysteine, cysteine, and methionine. They hypothesized that oil-seeds require more sulphur than other crops, and that its concentration and uptake vary with soil sulphur availability [1].

Mg supplementation in groundnut resulted in increased pod yield. The increase was due to greater no of pods/plant, and pod weight (g/plant) as a result of improved root growth and nodulation. It has a significant impact on groundnut growth and production [3]. Boron is crucial for groundnut growth, influencing pollen germination, growth, and fruit development. It's essential for various physiological processes like carbohydrate metabolism, protein synthesis, and seed development, maintaining optimal flowering patterns and fruit development [4].

Iron deficiency affects nutrient quality and crop productivity. Iron plays a role in chlorophyll production, active compounds in plants, and metal-binding proteins. Its involvement in biochemical processes highlights its importance in plant physiology and function, potentially enhancing groundnut yields [2]. The purpose of this study was to determine the effect of different levels of nutrients with plant growth regulators on groundnut yield and quality.

2. MATERIALS AND METHODS

The current research was conducted primarily to investigate the physiological basis of yield improvement in groundnut by nutrio-hormonal consortia. The research was carried out in pot culture at the Department of Crop Physiology, TNAU, Coimbatore. Five treatment combinations comprising T₁ - control (foliar water spray), T₂ - Nutrio hormonal consortia 1, T₃ - Nutrio hormonal consortia 2 (T₂ + K₂SO₄), T₄ - Groundnut booster 1 (FeSO₄, K₂SO₄, MgSO₄, Borax), and T₅ - Groundnut booster 2 (T₄ + Salicylic acid + NAA-Naphthalene Acetic Acid) were tried in factorial completely randomized design with four replications. The seeds of Groundnut (*Arachis hypogea* L) genotypes BSR 2 and VRI 8 were collected from Department of Oil seeds, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Groundnut seeds were treated with talc formulation of *Trichoderma viridae* @ 4g/ kg of seed. Pots were filled with mixture of red soil, sand and farmyard manure in 3:1:1 ratio. Seeds (3 to 4 number) were placed in a pot containing pot mixture and life irrigation was given. Thinning and gap filling was carried out at seven days after germination. Recommended crop management and plant protection measures are followed during the crop growth stage as per TNAU Crop production guide. At flowering stage the plants were sprayed with different treatments. Plants sprayed with water are treated as control. Physiological parameters were observed at 15 days after spraying. NDVI is related to leaf area, leaf angle, leaf color, leaf thickness and leaf moisture. The average values of NDVI were recorded using a hand-held green seeker (optical sensor), placed and run with a triggering button pressed 60-65 cm above the crop canopy. The total leaf area was measured using a Leaf Area Meter (LICOR, Model LI 3000), and the results were expressed as cm² plant⁻¹. Specific leaf weight is the ratio of leaf dry weight to its area of assimilating surface. SLW is calculated by the formula of by Pearce *et al.* (1968) and the results are expressed in mg cm⁻².

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

For total dry matter production plant samples were uprooted, after washing the root portion, were first shade dried and then oven dried at 80 °C for 48 hrs. The dry weight of the whole plant was recorded and expressed as g plant⁻¹. Yield and yield components were recorded at harvesting stage. Number of pods per plant was taken randomly from three different plants in control and treatments and the results are expressed in Number of pods plant⁻¹. Pod yield was recorded in control and various treatments and the results are expressed in g plant⁻¹. The data collected from pot culture experiment on various parameters was analyzed statistically in FCRD (Factorial Completely Randomized Design) by Gomez and Gomez (1984). Treatment combinations are given in Table 1.

Table 1. Treatment combinations

S No.	Treatment combinations
1.	T ₁ – Control (Water spray)
2.	T ₂ – Nutrio-hormonal consortia 1
3.	T ₃ – Nutrio-hormonal consortia 2 (T ₂ + K ₂ SO ₄)
4.	T ₄ – Groundnut Booster 1 (FeSO ₄ , K ₂ SO ₄ , MgSO ₄ , Borax)
5.	T ₅ – Groundnut Booster 2 (T ₄ + Salicylic acid + Naphthalene acetic acid)

3. RESULTS AND DISCUSSION

3.1 Normalized difference vegetation index (NDVI)

The values for both crop varieties were between 0.81 and 0.88. In VRI 8 there is significant increase in NDVI values from control (0.82) to T₅ (0.88). There was slight decrease in NDVI values at 75 days after sowing compared to 50 days after sowing. The values were similar for both crop types. This means that there wasn't a significant difference in the treatments or the crop varieties. Values of normalized difference vegetation index, which are indicators of N content in the crop canopy and crop vigor, were considerably higher when treated with N-containing fertilizers [5].

3.2 Leaf area

There is significant difference between T₁ and T₅. In VRI 8, higher leaf area were recorded in T₄ (2297.14 cm²) on par with T₅ (2245.2cm²). Foliar application of nutrients with PGRs (T₅) increased the leaf area up to 19% compared to control. Leaf area in groundnut refers to the total surface area of the leaves on a plant. It's an important measure because it indicates the overall photosynthetic capacity of the plant, which directly affects its growth, development, and yield. The percentage of leaf area on a groundnut plant indicates photosynthesis activity by regulating the amount of sunlight absorbed. At the flowering and pod-formation stages, foliar sprays of zinc and boron increased leaf area by 55% and 29%, respectively. Salicylic acid and naphthalene acetic acid are plant growth regulators that can influence various aspects of plant development. When applied to plants, they can stimulate cell elongation, leading to increased leaf size and, consequently, an increase in leaf area.[6]

3.3 Specific leaf weight (SLW)

When compared to VRI 8, foliar application of T₅ in BSR 2 resulted in higher specific leaf weight (63.87mg cm⁻²). This also indicates that more photo assimilates were retained in the leaf and only a small amount was translocated to the sink. As a result, it is concluded that VRI 8 is the superior genotype for photo assimilate translocation from source to sink. There is a significant difference between all treatments in both varieties. SLW is a valuable parameter for assessing the physiological state and health of plants, as it provides insights into the thickness and density of leaves, which are directly related to their capacity for photosynthesis and overall metabolic activity.

3.4 Total dry matter production (TDMP)

The dry biomass of groundnut varied significantly among all the treatments in Table 5. Foliar spray of potassium, sulphur, boron and NAA resulted in higher biomass yield (251 g plant⁻¹) in T₅ when compared to all other treatments. In soybean, foliar application of B and Mo @ 0.5% concentration also improved the dry matter production and leaf area index [5]. Application of N @ 50 kg/ha + S @ 40kg/ha in

groundnut resulted in highest dry matter production [7]. Application of gypsum @ 400kg/ha + boron @10 kg/ha enhanced dry weight in groundnut [8].

3.5 Pods per plant

Highest number of pods/plant (37) were significantly recorded in BSR 2 with foliar application of T₅ in figure 1. Application of iron had a positive impact on crop growth and yield attributes, which in turn affected seed and haulm yield with a corresponding increase in the B: C ratio. With two foliar applications of ferrous sulphate @0.5% + 0.1% citric acid at 45 and 60 days after sowing along with recommended dose of fertilizers, the maximum number of pods/plant, no. of kernels/pod and yield were recorded [9]. Foliar spray of boron in groundnut during pod formation stage resulted in greater number of plants/plant [5]

3.6 Pod yield

Genotype VRI 8 recorded significantly higher pod yield (8.16 g/plant) in T₅ shown in figure 2. Foliar application of nutrients with PGRs (T₅) increased the pod yield up to 13% compared to control. Foliar spray of FeSO₄ @ 0.5% at 45 and 75 DAS + Citric acid @ 0.1% at 45 and 75 DAS + 5 t FYM/ha significantly increased pod yield, haulm yield, biological yield, pod/plant, shelling percentage, and seed index of groundnut [10]. The progressive effect of potassium and magnesium on yields could be attributed to potassium's important role in carbohydrate synthesis, photosynthesis, and cell elongation. These results were also found similar with Sandeep *et al.* (2023) [4].

Table 2. Effect of foliar application of nutrio-hormonal consortia on NDVI values in groundnut

Treatment/variety	50 DAS*			75 DAS		
	BSR 2	VRI 8	MEAN	BSR 2	VRI 8	MEAN
T ₁ – Control (Water spray)	0.81	0.82	0.82	0.80	0.81	0.81
T ₂ – Nutrio-hormonal consortia 1	0.83	0.85	0.84	0.82	0.83	0.83
T ₃ – Nutrio-hormonal consortia 2 (T ₂ + K ₂ SO ₄)	0.86	0.86	0.86	0.84	0.84	0.84
T ₄ – Groundnut Booster 1 (FeSO ₄ , K ₂ SO ₄ , MgSO ₄ , Borax)	0.87	0.87	0.87	0.84	0.85	0.85
T ₅ – Groundnut Booster 2 (T ₄ + Salicylic acid + Naphthalene acetic acid)	0.88	0.88	0.88	0.86	0.86	0.86
MEAN	0.85	0.86	0.85	0.83	0.84	0.84
SEd	T* 0.33	V* 0.021	TxV* 0.047	T 0.32	V 0.02	TxV 0.045
CD (P=0.05)	0.68	0.043	0.098	0.66	0.041	0.093

*DAS: Days after sowing *T: Treatment *V: Variety *TxV: Interaction effect

Table 3. Effect of foliar application of nutrio-hormonal consortia on leaf area (cm²) in groundnut

Treatment/variety	50 DAS*	75 DAS
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	BSR 2	VRI 8	MEAN	BSR 2	VRI 8	MEAN
T ₁ – Control (Water spray)	593.14	1779.14	1186.14^c	630.85	1862.22	1246.53^b
T ₂ – Nutrio-hormonal consortia 1	694.32	1871.30	1282.81^b	709.89	1929.24	1319.56^b
T ₃ – Nutrio-hormonal consortia 2 (T ₂ + K ₂ SO ₄)	739.10	1884.25	1311.68^b	745.63	1938.17	1341.90^b
T ₄ – Groundnut Booster 1 (FeSO ₄ , K ₂ SO ₄ , MgSO ₄ , Borax)	904.61	2297.14	1600.88^a	948.61	2387.44	1668.03^a
T ₅ – Groundnut Booster 2 (T ₄ + Salicylic acid + Naphthalene acetic acid)	829.81	2245.22	1537.52^a	862.09	2297.83	1579.97^a
MEAN	752.20	2015.41	1383.80	779.42	2082.98	1431.20
SEd	T* 59.65	V* 37.73	TxV* 84.37	T 61.789	V 39.08	TxV 87.38
CD (P=0.05)	124.44	78.70	175.9	128.88	81.52	182.27

Table 4. Effect of foliar application of nutrio-hormonal consortia on specific leaf weight (mg cm⁻²) in groundnut

Treatment/variety	50 DAS*			75 DAS		
	BSR 2	VRI 8	MEAN	BSR 2	VRI 8	MEAN
T ₁ – Control (Water spray)	35.40	19.11	27.26^c	28.53	16.65	22.59^d
T ₂ – Nutrio-hormonal consortia 1	43.21	20.84	32.02^b	39.44	18.66	29.05^c
T ₃ – Nutrio-hormonal consortia 2 (T ₂ + K ₂ SO ₄)	46.00	21.76	33.88^b	44.26	19.61	31.93^b
T ₄ – Groundnut Booster 1 (FeSO ₄ , K ₂ SO ₄ , MgSO ₄ , Borax)	46.43	20.90	33.66^b	40.06	19.69	29.87^{bc}
T ₅ – Groundnut Booster 2 (T ₄ + Salicylic acid + Naphthalene acetic acid)	63.87	23.16	43.52^a	54.52	21.32	37.92^a
MEAN	46.98	21.15	34.07	41.36	19.18	30.27
SEd	T* 1.38	V* 0.88	TxV* 1.96	T 1.23	V 0.78	TxV 1.73
CD (P=0.05)	2.89	1.83	4.08	2.56	1.62	3.67

*DAS: Days after sowing *T: Treatment *V: Variety *TxV: Interaction effect

Table 5. Effect of foliar application of nutrio-hormonal consortia on total dry matter production (g plant⁻¹) in groundnut

Treatment/variety	50 DAS*			75 DAS		
	BSR 2	VRI 8	MEAN	BSR 2	VRI 8	MEAN
T ₁ – Control (Water spray)	101.0	121.0	111.0^e	116.0	162.0	139.0^d
T ₂ – Nutrio-hormonal consortia 1	106.0	148.0	127.0^d	128.0	173.0	150.5^d
T ₃ – Nutrio-hormonal consortia 2 (T ₂ + K ₂ SO ₄)	147.0	162.0	154.5^c	191.0	185.0	188.0^c
T ₄ – Groundnut Booster 1 (FeSO ₄ , K ₂ SO ₄ , MgSO ₄ , Borax)	182.0	186.0	184.0^b	208.0	206.0	207.0^b
T ₅ – Groundnut Booster 2 (T ₄ + Salicylic acid + Naphthalene acetic acid)	194.0	206.6	200.3^a	231.0	251.0	241.0^a
MEAN	146.0	164.7	155.4	174.8	195.4	185.1
SEd	T* 6.17	V* 3.90	TxV* 8.73	T 7.24	V 4.58	TxV 10.24
CD (P=0.05)	12.87	8.14	18.20	15.11	9.56	21.37

*DAS: Days after sowing *T: Treatment *V: Variety *TxV: Interaction effect

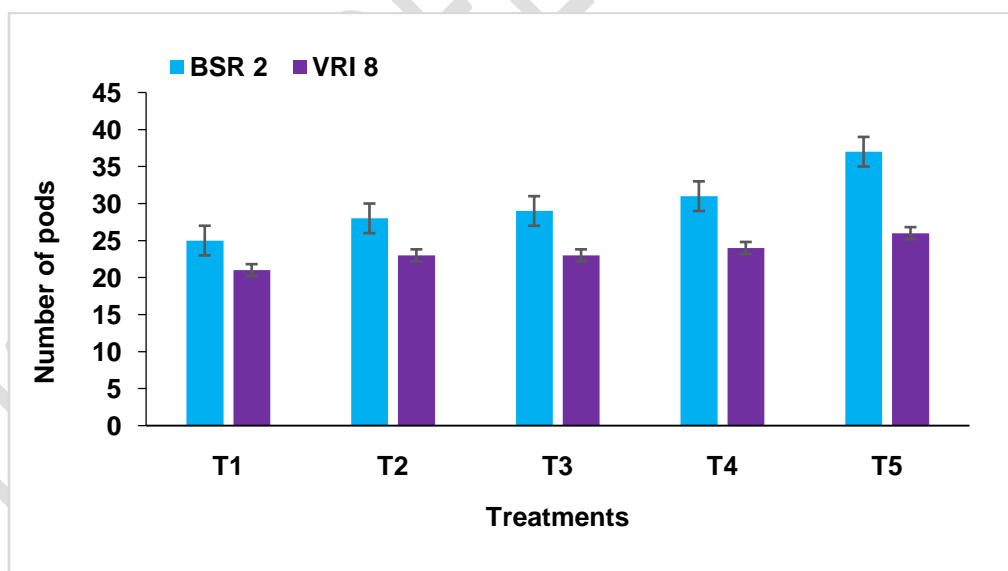


Figure 1. Effect of foliar application of nutrio-hormonal consortia on number of pods per plant in groundnut

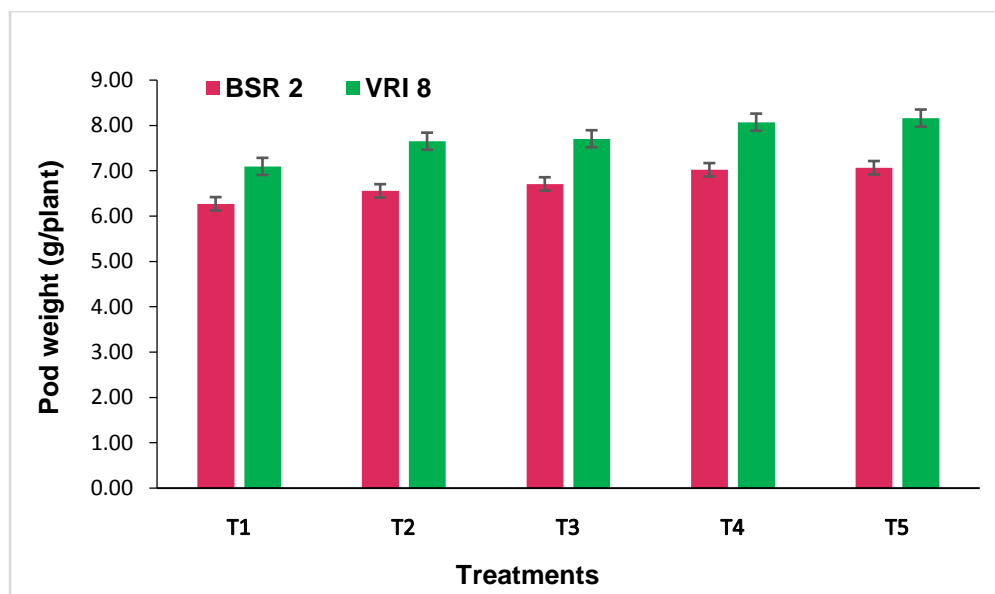


Figure 2. Effect of foliar application of nutrio-hormonal consortia on pod yield (g plant⁻¹) in groundnut

4. CONCLUSION

Foliar application of T₅ – Groundnut Booster 2 (T₄ + Salicylic acid + Naphthalene acetic acid) on VRI 8 recorded higher pod yield compared to all other treatments. The results proved that foliar application of nutrients with plant growth regulators improves growth and yield. Thus, to realize potential yields and profits groundnut crop needs foliar application of nutrients with plant growth regulators.

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