Original Research Article

Evaluating the effect of different *Boron & Molybdenum* micronutrients delivery system on growth in groundnut (*Arachis hypogaea* L.)

ABSTRACT

The present investigation was conducted during Rabi 2019 season at the central farm, Regional Research and Technology Transfer Station, Coastal Zone, OUAT, Bhubaneswar. The fresh seeds of groundnut variety Devi (ICGV - 91114) were used as sowing material. The field was laid out in randomized block design with twelve treatments and three replications with groundnut. The treatments were T_1 (Seed priming with Borax solution @ 0.01%), T_2 (Seed priming with Borax solution @ 0.05%), T_3 (Seed priming with Borax solution @ 0.10%), T_4 (Foliar application of Borax @ 100 ppm), T_5 (Soil application of Borax @ 10 kg/ha), T_6 (Seed priming with Sodium Molybdate @ 0.25 g/l for 2 hours), T_7 (Seed priming with Sodium Molybdate @ 0.50 g/l for 2 hours), T_8 (Seed priming with Sodium Molybdate @ 0.75 g/l for 2 hours), T_9 (Foliar application of Sodium Molybdate @ 50 ppm), T_{10} (Soil application of Sodium Molybdate @ 1.5 kg/ha), T_{11} (T_2 + T_7) and T_{12} (Control). The results revealed that observations taken in different growth phases have shown profound effect reported. Morphological characters of the T_{11} showed significant increase in the plant height, number of branches, number of leaves and leaf area. Physiological analysis of treatments revealed T_{11} significantly higher increment as compare to other treatments in the dry weight of the plant and leaf area index. It was revealed that the treatment T_{11} has shown as superior performance over other treatments in groundnut.

Keywords: Groundnut, Seed priming, foliar application, Soil application, Morphological characters, Physiological parameters, Borax, Sodium Molybdate, Boron, Molybdenum.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.), is a leguminous crop plant which is widely cultivated in the tropics and subtropics between 40°N and 40°S latitudes. It is native to South America (Brazil). Groundnut is also known as “KING OF OILSEEDS”, which is used in confectionary nut flour production, protein and peanut milk [1]. Seed oil content of groundnut is 46-52 %, while carbohydrates and protein percentage are 18 and 30% respectively. Pure form of groundnut seed oil is mainly use as cooking oil, as a salad oil and margarine while raw oil is use in soap manufacturing. Groundnut is not only an important oilseed crop of India but also an important agricultural export commodity.

There are reasons and factors that lead to low yield in groundnut, one of the major reasons for low yield is a deficiency of nutrients**??.** The introduction of high yielding varieties for exploiting their potential led to a widespread deficiency of micronutrients, especially for Boron, and also Molybdenum. Completely neglecting the application of micronutrients and overuse of macronutrient fertilizers results in a reduction of yield and export quality of groundnut. Another prime reasons for the low yield of the groundnut is because of intensive cropping which leads to a deficiency of secondary and micronutrients. Seed priming has been found to involve complex molecular pathways, including changes in gene expression, enzyme activity, and metabolite synthesis [2]. Several studies have investigated the mechanisms involved in seed priming, and have identified key pathways that play a role in this process.

One of the pathways involved in seed priming is the regulation of stress-responsive genes. Seed priming has been found to induce the expression of stress-responsive genes, such as those involved in the synthesis of protective molecules like antioxidants and osmoprotectants [3]. These molecules help protect the seed against various stresses, such as dehydration, oxidative stress, and high salinity,

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which can occur during germination. Another pathway involved in seed priming is the modulation of hormone signaling pathways. Seed priming has been shown to alter the levels of various plant hormones, such as abscisic acid (ABA), gibberellins (GA), and cytokinins (CK) [2]. The modulation of hormone signaling pathways can affect various aspects of seed germination, such as the regulation of dormancy, cell division, and differentiation. In addition to these pathways, seed priming has also been found to affect enzyme activity and metabolite synthesis. For example, priming has been shown to enhance the activity of enzymes involved in the breakdown of stored reserves, such as α-amylase and protease [2]. Priming can also enhance the synthesis of metabolites, such as polyamines, which are involved in various processes, such as stress tolerance and cell proliferation [4]. Overall, the pathways involved in seed priming are complex and interconnected, and involve changes in gene expression, enzyme activity, and metabolite synthesis. Understanding these pathways is important for developing more effective seed priming techniques and for improving crop performance under stressful conditions.

Pre-sowing priming induces a particular physiological status in seeds and has emerged as a promising strategy to improve plant behavior in the field. Seed priming helps in various physiological, biochemical and molecular mechanisms which results in enhanced crop yield [5]. There is a strong interest for farmers and seed companies to find suitable cheap priming treatments but also to precisely identify the agronomical properties improved as a result of priming in cultivated species. Foliar spraying is beneficial because it gives fast result than application of chemical fertilizers to the soil. Foliar treatment is economical and less wasteful as compared to direct use where it absorb by soil particle and that is why less available to root system. Foliar nutrition can minimize lag time between application and uptake by the crop. Moreover, nutrition solution is absorbed by trichomes or through rupture in cuticle which can able to reach at the target site.

Boron is one of the key micronutrients required by the plant for its growth and development. It has known that peanut need for boron is a bit higher than other legumes crops. Boron has the ability to increase photosynthetic and enzymatic activity in the peanut plant. It also involves in protein and nucleic acid metabolism. Boron maintains the structural integrity of the plant and protects the plasma membrane from external damage [6]. It also helps in sugar transport, division and elongation of a cell, involve in the transport of auxin and metabolism in roots and improve ATPase activity [7]. Boron deficiency causes pollen grain germination. Pollen tube growth and viability of pollen grains are also affected due to boron deficiency [8]. Boron is the only element which is available in soil solution and plant can easily take up from the soil as a non-ionized molecule at a suitable pH range [9].

Molybdenum involves in nitrogenase - an enzyme that is responsible for the nitrogen fixation process by bacteria symbiotically with legumes crops. It also plays a key role in nitrogen metabolism, protein synthesis, and Sulphur metabolism. Molybdenum is required in pollen formation so Mo deficient plant will cause effect in their fruits and pollen grains formation. It is also important for the absorption and translocation of iron in the plants [10].

In India, Micronutrient application to crop plants is done mainly as a basal application in soil or through foliar sprays. Here in this research, application of B and Mo through seed priming, foliar spray, soil application as well as their combined effect is assed and their result on growth parameters are shown here.

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2. METHODOLOGY

2.1 Experimental Site and Layout

The present investigation was conducted during Rabi 2019 season at the central farm, Regional Research and Technology Transfer Station, Coastal Zone, OUAT, Bhubaneswar. The farm is situated at N 20°15.885’ and E 85°48.024’ with an accuracy of ± 9 feet as recorded in GARMIN GPSmap 76CSx device. The fresh seeds of groundnut variety Devi (ICGV - 91114) were used as sowing material. The details of the experiment site is as shown in table 1.

Table 1. Details of the experiment site

Location	Central Research Station, OUAT
Elevation	25.9 meter
Land form	Medium land
Slope	0.1 N-S
Parent material	Laterite
Ground water table	1.5 m
Erosion	el
Surface drainage	Well-drained

The field was laid out in randomized block design with twelve treatments and three replications with groundnut. The treatments were T_1 (Seed priming with Borax solution @ 0.01%), T_2 (Seed priming with Borax solution @ 0.05%), T_3 (Seed priming with Borax solution @ 0.10%), T_4 (Foliar application of Borax @ 100 ppm), T_5 (Soil application of Borax @ 10 kg/ha), T_6 (Seed priming with Sodium Molybdate @ 0.25 g/l for 2 hours), T_7 (Seed priming with Sodium Molybdate @ 0.50 g/l for 2 hours), T_8 (Seed priming with Sodium Molybdate @ 0.75 g/l for 2 hours), T_9 (Foliar application of Sodium Molybdate @ 50 ppm), T_{10} (Soil application of Sodium Molybdate @ 1.5 kg/ha), T_{11} (T_2 + T_7) and T_{12} (Control).

2.2 Climatic Conditions

Climate is humid throughout the season. Values of relative humidity are about 80% to 87% in the morning and 3% to 85% in the afternoon during the southwest monsoon season. Mean Maximum Temperature of Coldest month (Dec.) was 28.9 ^{0}C. Mean minimum temperature of coldest month (Dec.) was15.4 ^{0}C. In the summer and post monsoon seasons, there were moderate clouds. Sky was clear or lightly clouded in the winter. Thunderstorms were observed throughout the year except December. Fog occured during winter season.

Max. precipitation – 21 mm (26 April, 2020)
Max. RH – 90.39 (3 Jan, 2020)
Max. Temp – >38.1 °C (End of March and April)
Min. Temp – 9.6 (29 December, 2019
Max. wind speed – 6.0 m/s

2.3 Measurement and Analysis

Various morpho-physiological parameters at various growth stages were recorded. Five plants were selected randomly from each plot and their height was measured from ground level to the tip of the plant. Observation was recorded at 30, 60 and 90 days after sowing (DAS) of the seeds. The average height of the 5 plants were considered out for the final record. The number of branches per plant was counted from five plants from each plot at 30, 60 and 90 DAS, respectively. While, Number of leaves was calculated only at 30 DAS. Five trifoliate leaves from each treatment were collected from sample plants and leaf area was measured by leaf area meter and the average was calculated in square centimeter. ~~Leaf area was measured with use of leaf area meter~~. Leaf area was recorded at 60 and 90 DAS, respectively. This leaf area values were worked out to calculate the leaf area index (LAI) using the formula written in the table 2. LAI is defined as the one-sided green leaf area per unit ground surface area. LAI was calculated by dividing leaf area per plant by the land area occupied by a single plant ~~samples~~. Dry matter contents were recorded at 30, 60 and 90 DAS by uprooting five plants were ~~uprooted at~~ randomly ~~in~~ from each treatment. These samples were oven dried at 60 °C till a constant

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weight was recorded. After attaining constant weight, dried samples were weighed and expressed on per plant basis. Crop growth rate (CGR) is defined as the rate of dry matter production per unit land area per unit time. The observations were recorded at different intervals of 60 and 90 days after sowing. Relative growth rate (RGR) is growth rate relative to size. It is also called as the exponential growth rate or the continuous growth rate. The observations were recorded at different intervals of 60 and 90 days after sowing. Net assimilation rate (NAR) is a value that relates plant productivity to plant size. It is obtained by dividing the rate of increase in dry weight by leaf size (usually leaf area).

Table 2. Formulas used to assess the morpho-physio growth parameters in the experiment

Sr. No.	Growth parameters	Formula used	References
1	Leaf area index **unit?**	LAI = $\frac{\text{Leaf area}}{Ground\ area}$	Sestak et al., 1971 [11]
2	Crop Growth Rate **unit?**	CGR = $\frac{W_2 - W_1}{t_2 - t_1} \times \frac{1}{A}$??	Watson, 1952 [12]
3	Relative Growth Rate **unit?**	RGR = $\frac{\ln W_2 - \ln W_1}{t_2 - t_1}$	Blackman, 1919 [13]
4	Net Assimilation Rate **unit?**	NAR = $\frac{W_2 - W_1}{A_2 - A_1} \times \frac{log\ A_2 - \log A_1}{t_2 - t_1}$	Radford, 1967 [14]

Where,

W_1= Dry matter production plant^{-1}(g) at time t_1
W_2 = Dry matter production plant^{-1}(g) at time t_2
A = Ground area covered by the plant (dm^{-2})
A_1= Ground area covered by the plant (dm^{-2}) at time t_1
A_2= Ground area covered by the plant (dm^{-2}) at time t_2
ln = natural logarithm
log A_2 – log A_1= natural log difference leaf area

3. RESULTS AND DISCUSSION

3.1 Plant Height

The investigation on the impact of seed priming, basal and foliar application of micronutrients was studied for the plant. The plant height of five randomly selected plants in each plot were measured at 30 DAS, 60 DAS, and 90 DAS and the mean values have been presented in table 3. Plant height reported non-significant at 30 DAS. It was observed that treatment T_{11} (T_2 + T_7) has shown the significant higher plant height of 33.0 cm, and 42.60 cm at 60 DAS and 90 DAS, respectively. Among all the treatments, T_{11} was observed 21.32 %, and 16.85 % higher than the control at 60 DAS and 90 DAS, respectively. The next significantly higher was observed by treatment T_5 having a value of 32.50 cm and 42.60 cm at 60 and 90 DAS, respectively. It was observed that treatment T_5 shown the second-highest percent increase which was 19.49 % and 17.68 % as compared to control at all three intervals of 60 and 90 DAS, respectively. The lowest plant height was recorded in the untreated control.* not compared critically, see table values???

Plant height is one of the important characters of the plant which indicates the vegetative growth and the changes in this character may brought by different seed priming, basal and foliar application practices which definitely influence this growth parameter. The height of plant was more in T_{11} treatment due to the application of additional Boron and Molybdenum through seed priming treatments.

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Similar results of increase in plant height with combined application of boron and molybdenum were reported by Dugger (1973) [8], Duyinggiong et al. (2002) [15] and Nayak et al. (2009) [16].

Table 3. : Effect of micronutrients on plant height at 30, 60 and 90 DAS **font size?**

Treatments	30 DAS (cm)	60 DAS (cm)	90 DAS (cm)
T_1 - Seed priming with B @ 0.01 %	7.87	28.90	38.10
T_2 - Seed priming with B @ 0.05%	7.90	29.40	39.43
T_3 - Seed priming with B @ 0.10%	8.10	30.00	40.70
T_4 - Foliar app. of B @ 100 ppm (20 DAS and 30 DAS)	8.20	31.60*	41.70*
T_5 - Soil application of Borax @ 10 kg/ha	8.37	32.50*	42.60*
T_6 - Seed priming with Mo @ 0.25 g/l for 2 hrs	7.70	28.30	36.70
T_7 - Seed priming with Mo @ 0.50 g/l for 2 hrs	7.83	29.20	36.80
T_8 - Seed priming with Mo @ 0.75 g/l for 2 hrs	7.80	29.80	38.30
T_9 - Foliar app. of Mo 50 ppm (20 DAS and 30 DAS)	7.70	30.00	39.17
T_{10} - Soil app. of Mo @ 1.5 kg/ha	7.80	30.50*	39.60
T_{11} - T_2 + T_7	8.63	33.00*	42.30*
T_{12} – CONTROL	7.60	27.20	36.20
SE.m (±)	0.433	1.1112	1.455
C.D. (0.05)	NS	3.2592	4.2676
C.V.	9.42	6.41	6.41

3.2 Number of Branches

The investigation on the impact of seed priming, basal, and foliar application of micronutrients was studied for the plant. The number of branches of 10 randomly selected plants in each plot was counted at 30, 60, and 90 DAS and the mean values have been presented in table 4. It was observed that treatment T_{11} (T_2 + T_7) has shown significantly higher number of branches *viz.* 6.20 and 9.17 at 30 DAS and 90 DAS, respectively. The number of branches recorded significantly higher under treatment T_5 at 60 DAS. The lowest number of branches was counted in untreated control (T_{12}) at 30 DAS and 90 DAS. At 60 DAS, treatment T_1 recorded the lowest number of branches. It was observed from table 4 that treatment T_{11} (T_2 + T_7) has reported significantly higher number of branches. Sahu (1998) [17] also observed similar results when treated with combined application of Zn, B and Mo.

Table 4. Effect of micronutrients on number of branches at 30, 60 and 90 DAS

Treatments	30 DAS	60 DAS	90 DAS
T_1 - Seed priming with B @ 0.01 %	5.30	7.40	7.68
T_2 - Seed priming with B @ 0.05%	5.40	7.60	7.80
T_3 - Seed priming with B @ 0.10%	5.50	7.90	8.20
T_4 - Foliar app. of B @ 100 ppm (20 DAS and 30 DAS)	5.50	8.10	8.30
T_5 - Soil application of Borax @ 10 kg/ha	5.80	8.30	8.40
T_6 - Seed priming with Mo @ 0.25 g/l for 2 hrs	5.20	7.60	7.80
T_7 - Seed priming with Mo @ 0.50 g/l for 2 hrs	5.23	7.70	7.90
T_8 - Seed priming with Mo @ 0.75 g/l for 2 hrs	5.40	7.80	8.00
T_9 - Foliar app. of Mo 50 ppm (20 DAS and 30 DAS)	5.60	7.80	8.10
T_{10} - Soil app. of Mo @ 1.5 kg/ha	5.70	7.90	8.10
T_{11} - T_2 + T_7	6.20	8.20	9.17
T_{12} – CONTROL	5.20	7.70	7.57
SE.m (±)	0.1673	0.1751	0.2608
C.D. (0.05)	0.4907	0.5136	0.7649
C.V.	5.27	3.87	5.59

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3.3 Leaf Area and Number of Leaves

Plant leaf area was calculated at different growth stages (60 DAS and 90 DAS) and presented in table 5. It was observed that significantly higher mean value of leaf area shown by treatment T_{11} (T_2 + T_7) of 1350.0 cm^2 $plant^{-1}$ and 1500.0 cm^2 $plant^{-1}$ at 60 DAS and 90 DAS, respectively. The lowest leaf area was observed in untreated control (T_{12}) at 60 DAS and 90 DAS. The investigation on the impact of seed priming, basal and foliar application of micronutrients was made for number of leaves per plant at 30 DAS and the observations have been depicted in table 5. The result showed that the significantly higher mean value regarding number of leaves were recorded at 30 DAS in the treatment T_{11} (T_2 + T_7) of 10.48 leaves per plant. The lowest number of leaves was recorded in untreated control (T_{12}) at 30 DAS.

Leaves are responsible for the productivity of the plant. It is easy to measure leaf area, and they are also the parts of the plant most responsive to nutrients and micronutrients availability and application. Besides, Leaf area helped in observing and comparing growth of the plant and also determining leaf area index. The data on leaf area of groundnut observed at interval of 60 DAS and 90 DAS that presented in table 5 as influenced by different levels and method of boron and molybdenum application. This increment in leaf area is also supported by the finding of Geethanjali et al. (2015) [18] and Sharma et al. (2017) [19]. The more the number of the leaves, more photosynthesis will occur and more productivity of the plant. The data on number of leaves are presented in table 5. The result showed that the significantly higher number of leaves were recorded at 30 DAS in the treatment T_{11} (T_2 + T_7) of 10.48 numbers per plant. This result of the combined seed priming of boron and molybdenum are agreed with Sharma et al. (2017) [19].

Table 5. Effect of micronutrients on leaf area at 30, and 60 DAS and number of leaves at 30 DAS

Treatments	Leaf area (cm^2 $plant^{-1}$)		Number of leaves
	30 DAS	60 DAS	30 DAS
T_1 - Seed priming with B @ 0.01 %	1134.00	1421.00	9.41
T_2 - Seed priming with B @ 0.05%	1182.67	1456.00	9.62
T_3 - Seed priming with B @ 0.10%	1236.00	1461.00	9.84
T_4 - Foliar app. of B @ 100 ppm (20 DAS and 30 DAS)	1261.00	1484.00	10.26
T_5 - Soil application of Borax @ 10 kg/ha	1311.00	1498.00	10.18
T_6 - Seed priming with Mo @ 0.25 g/l for 2 hrs	1211.67	1346.00	9.43
T_7 - Seed priming with Mo @ 0.50 g/l for 2 hrs	1261.00	1351.00	9.82
T_8 - Seed priming with Mo @ 0.75 g/l for 2 hrs	1273.00	1394.00	10.11
T_9 - Foliar app. of Mo 50 ppm (20 DAS and 30 DAS)	1281.00	1477.00	10.37
T_{10} - Soil app. of Mo @ 1.5 kg/ha	1290.00	1468.00	10.09
T_{11} - T_2 + T_7	1350.00	1500.00	10.48
T_{12} – CONTROL	1090.00	1320.00	9.41
SE.m (±)	49.5424	42.2116	0.2553
C.D. (0.05)	145.3118	123.81	0.7488
C.V.	6.92	5.11	4.46

3.4 Leaf Area Index

Leaf area index (LAI) was calculated at different growth stages of crop are presented in table 6. LAI was calculated at 60 and 90 DAS growth stage. The significantly higher LAI was obtained under treatment T_{11} which was 4.5 (60 DAS) and 5.0 (90 DAS). The lowest mean value of LAI was observed in untreated control (T_{12}) that is 3.63 (60 DAS) and 4.40 (90 DAS).

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Leaf area index is a measure of leafiness per unit ground area and relates to the photosynthetic efficiency level. It is a significant variable for growth and yield as it is an important determinant of light interception and transpiration. In table 6, the LAI data determined at various growth phases were provided. Results revealed that T_{11} shows significantly increased value compared to control in both intervals. This corroborates with the results of Geethanjali et al. (2015) [18] and Sharma et al. (2017) [19].

Table 6. Effect of micronutrients on leaf area index at 60 and 90 DAS

Treatments	Leaf area index	
	60 DAS	90 DAS
T_1 - Seed priming with B @ 0.01 %	3.78	4.74
T_2 - Seed priming with B @ 0.05%	3.94	4.85
T_3 - Seed priming with B @ 0.10%	4.12	4.87
T_4 - Foliar app. of B @ 100 ppm (20 DAS and 30 DAS)	4.20	4.95
T_5 - Soil application of Borax @ 10 kg/ha	4.37	4.99
T_6 - Seed priming with Mo @ 0.25 g/l for 2 hrs	4.04	4.49
T_7 - Seed priming with Mo @ 0.50 g/l for 2 hrs	4.20	4.50
T_8 - Seed priming with Mo @ 0.75 g/l for 2 hrs	4.24	4.65
T_9 - Foliar app. of Mo 50 ppm (20 DAS and 30 DAS)	4.27	4.92
T_{10} - Soil app. of Mo @ 1.5 kg/ha	4.30	4.89
T_{11} - T_2 + T_7	4.50	5.00
T_{12} – CONTROL	3.63	4.40
SE.m (±)	0.1651	0.1407
C.D. (0.05)	0.4843	0.4127
C.V.	6.92	5.11

3.5 Dry Weight

The dry weight of the plant of each treatment was estimated and their mean values were presented in table 7. From the results, it was found that the treatment T_{11} (T_2 + T_7) shows the significantly higher values of the dry weight of the plant at all intervals (30, 60, and 90 DAS) which was 2.51, 18.67, and 26.41 g plant^{-1}, respectively. The treatment T_{11} reported 31.59 %, 15.84 %, and 22.04 % increment as compared to untreated control. The lowest mean dry weight of the plant was reported by untreated control (T_{12}) that is 1.91, 16.12, and 21.64 g plant^{-1} at 30, 60, and 90 DAS, respectively.

Since plants have a high composition of water and the level of water in a plant will depend on the amount of water in its environment, using dry weight as a measure of plant growth tends to be more reliable. Data related to dry weight at different growth interval are presented in table 7. Boron is known as helpful in sugar transport, division and elongation of cell, involve in transport of auxin and metabolism in roots and improve ATPase activity (Gupta, 2007) [7]. Overall boron application helps in enhancing growth of the plant. Application of molybdenum also leads to increase in dry weight and growth of the plant. This statement is in tune with reports of Singh et al. (2007) [20].

Table 7. Effect of micronutrients on dry weight at 30, 60 and 90 DAS

Treatments	Dry weight (g plant^{-1})		
	30 DAS	60 DAS	90 DAS
T_1 - Seed priming with B @ 0.01 %	1.98	16.28	22.02
T_2 - Seed priming with B @ 0.05%	2.15	16.49	22.86
T_3 - Seed priming with B @ 0.10%	2.23	17.07	23.67
T_4 - Foliar app. of B @ 100 ppm (20 DAS and 30 DAS)	2.12	16.57	24.46
T_5 - Soil application of Borax @ 10 kg/ha	2.45	17.92	25.64
T_6 - Seed priming with Mo @ 0.25 g/l for 2 hrs	1.96	16.98	22.50
T_7 - Seed priming with Mo @ 0.50 g/l for 2 hrs	2.05	16.44	22.01
T_8 - Seed priming with Mo @ 0.75 g/l for 2 hrs	2.15	16.52	22.81
T_9 - Foliar app. of Mo 50 ppm (20 DAS and 30 DAS)	2.17	16.78	23.98

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T_{10} - Soil app. of Mo @ 1.5 kg/ha	2.07	17.84	25.57
T_{11} - T_2 + T_7	2.51	18.67	26.41
T_{12} – CONTROL	1.91	16.12	21.64
SE.m (±)	0.1216	0.5142	1.0593
C.D. (0.05)	0.3567	1.5082	3.107
C.V.	9.81	5.25	7.76

3.6 Crop Growth Rate

The crop growth rate (CGR) was calculated for 60 DAS to 90 DAS growth period and shown in the form of a bar chart in figure 1 for the easy comparison of the data. Treatment T_{11} (T_2 + T_7) was observed as a maximum crop growth rate among all the treatments. Treatment T_{11} calculated 0.3023 g dm^{-2} day^{-1} as compared to 0.1841 g dm^2 day^{-1} in control T_{12}. The lowest value of crop growth rate was recorded by untreated control T_{12}.

The crop growth rate and relative growth rate (RGR) was calculated for 60 DAS to 90 DAS growth period and shown in the form of a bar chart in figure 1 and 2 that reveals that Treatment T_{11} as a maximum growth rate. It may be due to that priming with micronutrients enable seeds to uptake water at a faster rate and encourages it for different metabolic processes and Boron is already reported that it activate key enzymes such as phosphorylase, α-amylase etc. which might stimulate cell elongation, meristematic growth and increase chlorophyll content leading to overall growth. Geethanjali et al. (2015) [18] found similar results on the relative growth rate of groundnut.

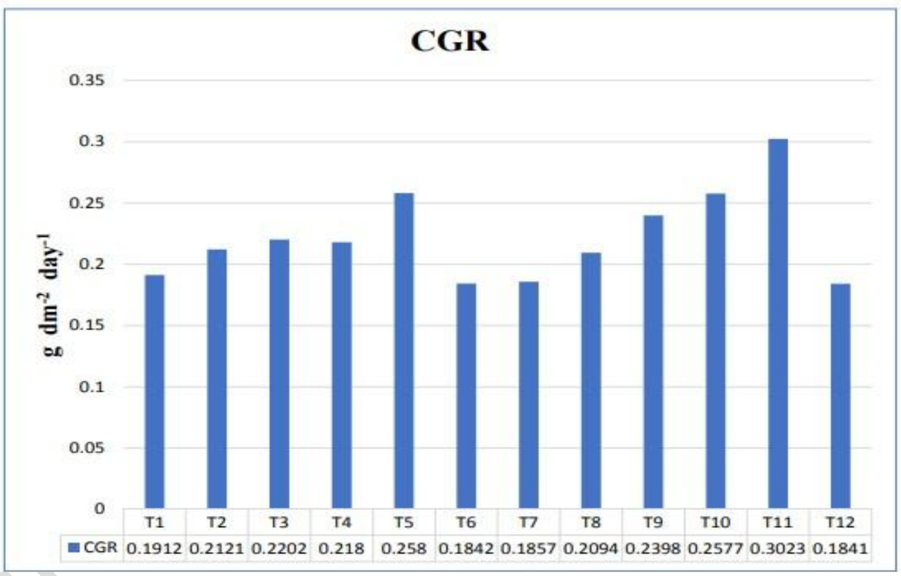

Fig. 1. Crop growth rate as influenced by the different levels and methods of borax and sodium molybdate applications **Check the unit of CGR??**

3.7 Relative Growth Rate

Treatment T_{11} (T_2 + T_7) was observed as a maximum relative growth rate among all the treatments. Treatment T_{11} calculated 14.52 mg g^{-1} day^{-1} as compared to 9.823 mg g^{-1} day^{-1} in control T_{12}. The lowest value of relative growth rate was recorded by untreated control T_{12}.

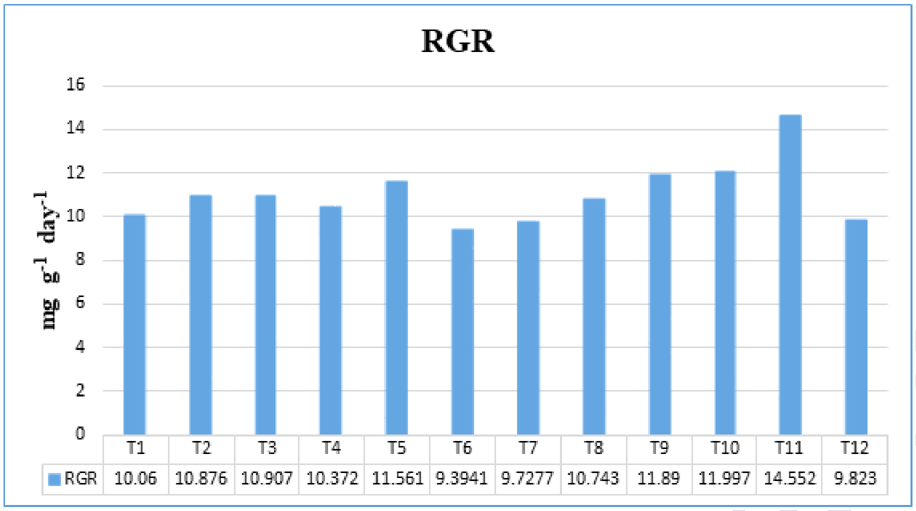

Fig. 2. Relative growth rate as influenced by the different levels and methods of borax and sodium molybdate applications

3.8 Net Assimilation Rate

Treatment T_{11} (T_2 + T_7) found as maximum net assimilation rate among all the treatments. Treatment T_{11} calculated 2.2351 g m^{-2} day^{-1} as compared to 1.9876 g m^{-2} day^{-1} in control T_{12}. The lowest value of net assimilation rate of 1.9207 g m^{-2} day^{-1} was recorded by treatment T_1.

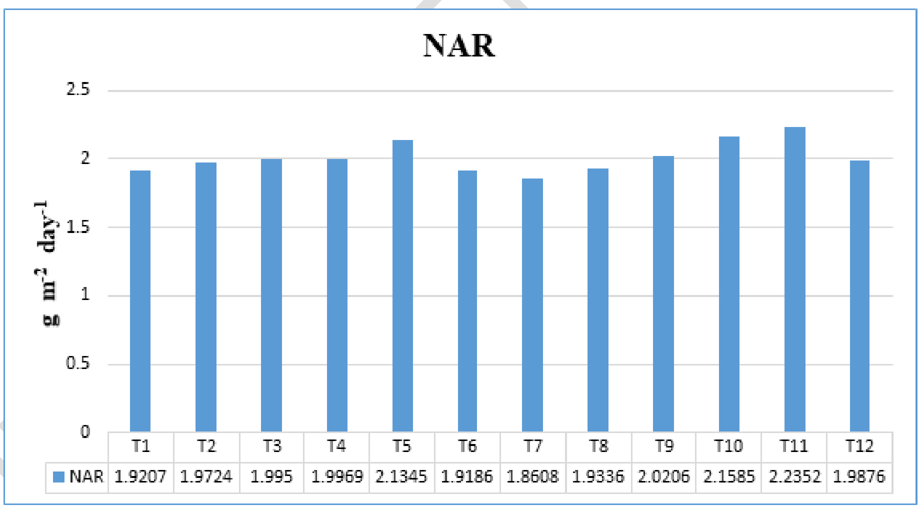

Fig. 3. Net assimilation rate as influenced by the different levels and methods of borax and sodium molybdate applications

4. CONCLUSION

Micronutrient application in groundnut crop is highly essential. Among various micronutrients, Boron and Molybdenum have important roles to play in the plant growth and physiology of the crop. From the results of the present investigation, it can be concluded that seed priming with micronutrients, such as Borax (0.05%) + Sodium Molybdate (0.50 g/l) for 2 hours and drying to original moisture content, followed by sowing was effective in micronutrient delivery to crops for enhancing crop growth.

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