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# Investigating Foliar Nutrients on Total Chlorophyll and Some Chemical Constituents of Groundnut under Drought

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**ABSTRACT**

*A field experiment was conducted at Dryland Farm of S.V.Agricultural College, Regional Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Tirupati during rabi season, 2014-15. The study aimed to enhance drought tolerance and yield through foliar nutrition in groundnut crop under moisture stress conditions. In the present study, treatments include ten foliar application of nutrients and two without foliar applications (one control irrigated and one control stress).* The results revealed that, *significant variations for morphological, physiological and yield parameters were observed. The foliar spray treatment $KNO_3$ @ 0.5% recorded significantly 55 per cent high total chlorophyll content compared to control stress treatment followed by other treatments NPK- 19:19:19 @ 0.5% and KCl @ 1% with 54 and 50 per cent high total chlorophyll content respectively. Among the treatments, there significance treatmental differences were not found. Treatments showed 0.153 - 0.159 g $g^{-1}$ range in total carbohydrates, 25 per cent - 26.53 per cent range in protein content and also treatments showed oil content ranges from 46.87 per cent - 48.57 per cent.*

***Key words*:** *Groundnut, Moisture stress, Nutrients, Foliar application*

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is considered one of the most important oilseed crops in the world. It contains about 50% oil, 25-30% protein, 20% carbohydrate and 5% fiber and ash which make a substantial contribution to human nutrition. The high-energy value, protein content, and minerals make groundnut a rich source of nutrition at a comparatively low price. About two thirds of world production is crushed for oil and remaining one third is consumed as food, because its high price in the international commodity market. Most of the cultivated area in India using high rates of NPK chemical fertilizers, especially nitrogen fertilizer however, one of the most important factors for crop growth and high yield with good quality. Shortage of nitrogen will restrain chlorophyll synthesis. Nitrogen is major component of chlorophyll content in plant. Foliar spraying of nitrogen at moisture deficit can sustain the chlorophyll content of plants under moisture stress.

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Dwivedi *et al*[5]., stated that in groundnut, total oil and total protein content was not affected by mid-season drought, but end-of-season drought increased protein content. This increase was progressive, corresponding to the intensity of water deficit. Differences in protein content became significant even at relatively low levels of moisture deficit. Therefore, the objective of the present study was to investigate the effect of foliar application of chemical fertilizers on total chlorophyll and some chemical constituents of groundnut.

## MATERIAL AND METHODS

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati campus of Acharya N.G. Ranga Agricultural University, during *rabi* season, 2014-15 which is geographically situated at 13.5°N latitude and 79.5°E longitude, with an altitude of 182.9 m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. Groundnut variety 'Dharani' was selected for the study whose duration was 110 days. The experiment was laid out in a Randomized block design with 12 treatments replicated thrice. The following treatments were foliar applied at 60 days after sowing (15 days after imposition of moisture stress). Treatments consists of $T_1$ - Control (Irrigated), $T_2$ - Control (Stress), $T_3$- Water spray, $T_4$- 2 % Urea, $T_5$- 2 % Di Ammonium Phosphate (DAP), $T_6$ - 1 % KCl, $T_7$ - 0.5 % $ZnSO_4$, $T_8$- 0.5 % $FeSO_4$, $T_9$ - 1 % Urea + 0.5 % Zn $SO_4$ + 0.5 % $FeSO_4$ , $T_{10}$- NPK 19:19:19 @ 0.5 % (water soluble fertilizers), $T_{11}$- NPK 17:17:17 @ 0.5 % (water soluble fertilizers) and $T_{12}$ - Potassium Nitrate @ 0.5 %.

The experiment was conducted in a sandy loam soil with a plot size of 3 x 3 m. The crop was sown on 18th December, 2014 with a spacing of 22.5 X 10 cm. Nitrogen was applied as basal dose @ 20 kg N $ha^{-1}$ in the form of urea. Phosphorus and potash were given @ 40 kg $P_2O_5$ and 50 kg $K_2O$ per ha basally. Gypsum was applied at 35 DAS @ 500 kg $ha^{-1}$. Hand weeding and hoeing was done twice at 20 days interval after sowing. Prophylactic measures were taken up to protect the crop from all insect pest and diseases throughout the crop growth period. Need based irrigations were given, however, the crop was irrigated to field capacity at 40 DAS and then there was no irrigation provided between 45-75 DAS. Treatments were foliar applied on 60th day after sowing *i.e*. 15 days after imposition of moisture stress.

Chlorophyll content and quality parameters of groundnut variety Dharani influenced by foliar spray treatments for drought mitigation were recorded at four stages at 45, 60, 75 and 90 DAS.

**Chlorophyll content (mg $g^{-1}$):**

Chlorophyll content was estimated by soaking 0.1gm of fresh leaf sample in 10 ml Dimethyl sulfoxide for 24 hours in dark. Then light absorbance values were recorded at 645 nm and 663 nm using UV 2450 visible spectrophotometer. The chlorophyll content was calculated by using the formula given by Arnon[1].

Chlorophyll a (mg $g^{-1}$) = $12.7 (D\ 663) - 2.69 (D\ 645) \times \frac{V}{1000 \times W}$

Chlorophyll b (mg $g^{-1}$) = $22.9 (D\ 645) - 4.68 (D\ 663) \times \frac{V}{1000 \times W}$

Total Chlorophyll (mg $g^{-1}$) = $20.2 (D\ 645) + 8.02 (D\ 663) \times \frac{V}{1000 \times W}$

Where,

V = Volume made up

W = Weight of leaf sample

**Total Carbohydrates (g $g^{-1}$):**

Total carbohydrates were estimated by Anthrone method given by Sadasivam and Manickam[8]. Carbohydrates are first hydrolyzed into simple sugars using dilute hydrochloric acid. In hot acidic medium, glucose is dehydrated to hydroxymethyl furfural. This compound forms with anthrone, a green colored product with an absorption maximum at 630nm.

**Protein Content (%):**

The protein content of the kernel was estimated by Infratec ™ 1241 Grain analyzer and expressed as percentage.

**Oil Percentage (%):**

The oil content of the kernel was estimated by Infratec ™ 1241 Grain analyzer and expressed as percentage.

## RESULTS AND DISCUSSION

The results of present investigation revealed existence of sufficient treatment variability among the treatments tested for chlorophyll content and Quality Parameters (Table 1 & 2).

The data indicated that, there was no significant difference found among treatments at 45 DAS. Significant differences were found among the treatments for chl a, chl b, and total chlorophyll content at 60, 75 DAS and 90 DAS (Table 1). Total Chlorophyll content decreased from flowering to pod development stage. Total chlorophyll content was decreased at 60 DAS under moisture stress conditions. At 75 DAS, control stress treatment recorded 55 per cent decreased total chlorophyll content value compared to control irrigated treatment. At 90 DAS, control stress treatment recorded 35 per cent decreased total chlorophyll content value compared to control irrigated treatment. Maiti *et al*[7]., reported that in groundnut, decrease in chlorophyll content in leaves of plants is due to high rate of chlorophyll degradation more than its biosynthesis under water stress conditions.

Among the foliar spray treatments to mitigate moisture stress, significant difference was found at 75-90 DAS of crop growth period. At 75 DAS, after imposition of foliar sprays increase in total chlorophyll content observed except control stress treatment. The foliar spray treatment $KNO_3$ @ 0.5% recorded significantly 55 per cent high total chlorophyll content compared to control stress treatment followed by other treatments NPK- 19:19:19 @ 0.5% and KCl @ 1% with 54 and 50 per cent high total chlorophyll content respectively. At 90 DAS, the foliar spray treatments $KNO_3$ @ 0.5% and NPK- 19:19:19 @ 0.5% recorded 32 per cent higher total chlorophyll content followed by KCl @ 1 % with 30 per cent higher total chlorophyll content compared to control stress treatment. Other foliar spray treatments showed moderate total chlorophyll content values ranged from 2.23 to 2.86 mg $g^{-1}$.

Choudhary and Yadav[4] reported that in cowpea, foliar application of 2 per cent DAP significantly increased the chlorophyll content (2.29 mg $g^{-1}$) of cowpea as compared to control. Bahram[2] concluded about the increase in chlorophyll content of soybean with nitrogen spray under water deficit conditions is due to, nitrogen delay the beginning of leaf senescence.

**Quality Traits**

**Total carbohydrates (g $g^{-1}$)**

Total carbohydrates, oil and protein content in groundnut kernels at harvest as influenced by foliar spray treatments are presented in Table 2.

From the present data, among the treatments, there significance treat mental differences were not found. Treatments showed 0.153 - 0.159 g $g^{-1}$ range in total carbohydrates. Chakraborty *et al*[3]., reported that in groundnut, moisture deficit stress alter the carbohydrate composition of the seeds which play crucial role in osmotic adjustment.

**Protein content (%)**

Dwivedi *et al*[5]., stated that total oil and total protein content was not affected by mid-season drought, but end-of-season drought increased protein content. This increase was progressive, corresponding to the intensity of water deficit. Differences in protein content became significant even at relatively low levels of moisture deficit.

From the present data among the treatments, significance treatmental differences were not found in protein content. Treatments showed protein content ranges from 25 per cent - 26.53 per cent.

**Oil percentage (%)**

Quality parameters like protein and oil content of seed were significantly improved by foliar application of $K_2SO_4$ in groundnut. This is probably due to the positive effect of sulphate in enhancing the protein and oil content in crops[9]. The impact of foliar application of KCl 0.5 per cent and NAA 40 ppm also increased the oil content significantly in soybean[10].

From the present data among the treatments, significance treatmental differences were not found in oil content. Treatments showed oil content ranges from 46.87 per cent - 48.57 per cent.

El-Habbasha *et al*[6]., stated that in groundnut, application of zinc as foliar spray at seed filling stage has increased oil content. This was due to enhanced nitrogen uptake by plant due to foliar spray of zinc. When nitrogen content increases in the seed, directly it increases the protein and oil content of seed.

**Table 1: Effect of foliar application of nutrients on chlorophyll content (mg $g^{-1}$) of groundnut (var. Dharani) under moisture stress conditions**

| S. No. | Treatments | 45 DAS | | | 60 DAS | | | 75 DAS | | | 90 DAS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Chl a | Chl b | Tot chl | Chl a | Chl b | Tot chl | Chl a | Chl b | Tot chl | Chl a | Chl b | Tot chl |
| 1. | Control(Irrigated) | 2.77 | 0.27 | 3.05 | 2.84 | 0.17 | 3.00 | 2.17 | 0.33 | 2.50 | 2.65 | 0.43 | 3.07 |
| 2. | Control (Stress) | 2.56 | 0.45 | 3.01 | 0.99 | 0.22 | 1.01 | 0.87 | 0.25 | 1.12 | 1.70 | 0.31 | 2.01 |
| 3. | Water spray | 2.52 | 0.53 | 3.05 | 0.88 | 0.24 | 1.12 | 1.16 | 0.29 | 1.45 | 1.87 | 0.36 | 2.23 |
| 4. | 2% Urea | 2.73 | 0.37 | 3.10 | 0.84 | 0.27 | 1.11 | 1.26 | 0.30 | 1.56 | 2.02 | 0.41 | 2.42 |
| 5. | 2% DAP | 2.66 | 0.45 | 3.11 | 0.89 | 0.22 | 1.11 | 1.97 | 0.29 | 1.58 | 1.88 | 0.38 | 2.26 |
| 6. | 1 % KCl | 2.72 | 0.46 | 3.18 | 1.00 | 0.21 | 1.25 | 1.99 | 0.40 | 2.39 | 2.40 | 0.51 | 2.90 |
| 7. | 0.2% $ZnSO_4$ | 2.65 | 0.35 | 3.00 | 0.89 | 0.19 | 1.08 | 2.03 | 0.32 | 2.35 | 2.10 | 0.42 | 2.52 |
| 8. | 0.5% $FeSO_4$ | 2.70 | 0.38 | 3.08 | 0.85 | 0.31 | 1.16 | 1.73 | 0.28 | 2.01 | 1.91 | 0.38 | 2.29 |
| 9. | 1% Urea+0.2% $ZnSO_4$+ 0.5% $FeSO_4$ | 2.83 | 0.35 | 3.02 | 0.94 | 0.21 | 1.15 | 1.61 | 0.34 | 1.95 | 2.06 | 0.44 | 2.49 |
| 10. | N:P:K- 19:19:19 @0.5% | 2.65 | 0.47 | 3.12 | 0.99 | 0.22 | 1.21 | 2.08 | 0.34 | 2.42 | 2.45 | 0.53 | 2.98 |
| 11. | N:P:K- 17:17:17 @ 0.5% | 2.63 | 0.47 | 3.10 | 0.97 | 0.24 | 1.21 | 1.80 | 0.45 | 2.25 | 2.36 | 0.50 | 2.86 |
| 12. | 0.5% $KNO_3$ | 2.77 | 0.44 | 3.15 | 0.73 | 0.32 | 1.05 | 2.06 | 0.42 | 2.48 | 2.46 | 0.52 | 2.96 |
| | **MEAN** | **2.68** | **0.41** | **3.08** | **1.07** | **0.24** | **1.29** | **1.73** | **0.33** | **2.50** | **2.16** | **0.43** | **2.58** |
| | **CD (P=0.05)** | **NS** | **NS** | **NS** | **0.084** | **0.132** | **0.105** | **0.12** | **0.116** | **0.25** | **0.133** | **0.097** | **0.125** |
| | **SEm ±** | **0.032** | **0.067** | **0.066** | **0.028** | **0.045** | **0.036** | **0.083** | **0.039** | **0.086** | **0.045** | **0.033** | **0.043** |

**Table 2: Effect of foliar application of nutrients on quality parameters of groundnut (var. Dharani) under moisture stress conditions**

| S. No. | Treatments | Total Carbohydrates (g $g^{-1}$) | Oil Content (%) | Protein Content (%) |
|---|---|---|---|---|
| 1. | Control (Irrigated) | 0.158 | 47.13 | 26.93 |
| 2. | Control (Stress) | 0.154 | 46.87 | 26.33 |
| 3. | Water spray | 0.157 | 47.77 | 26.60 |
| 4. | 2% Urea | 0.154 | 47.40 | 25.87 |
| 5. | 2% DAP | 0.152 | 46.93 | 26.40 |
| 6. | 1 % KCl | 0.159 | 47.97 | 26.47 |
| 7. | 0.2% $ZnSO_4$ | 0.153 | 48.57 | 25.27 |
| 8. | 0.5% $FeSO_4$ | 0.156 | 48.03 | 26.53 |
| 9. | 1% Urea+0.2% $ZnSO_4$+0.5% $FeSO_4$ | 0.158 | 47.87 | 26.57 |
| 10. | N:P:K- 19:19:19 @ 0.5% | 0.156 | 48.57 | 25.00 |
| 11. | N:P:K- 17:17:17 @ 0.5% | 0.154 | 47.70 | 26.37 |
| 12. | 0.5% $KNO_3$ | 0.153 | 47.60 | 26.23 |
| | **MEAN** | **0.155** | **47.70** | **26.21** |
| | **CD (P=0.05)** | **NS** | **NS** | **NS** |
| | **SEm ±** | **0.011** | **1.233** | **0.23** |

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