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# Effect of Foliar Application of Nutrients and Growth Regulators on Physiological Traits under Water stress in Finger Millet (*Eleusine coracana* L. Gaertn)

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## ABSTRACT

In an attempt to study the influence of nutrients and growth regulators on physiological traits under water stress in finger millet (*Eleusine coracana* L. Gaertn), a field study was carried out at Agricultural College Farm, Bapatla in Randomized Block Design (RBD) with three replications during *rabi,* 2022-23. The experiment consisted of eight treatments *viz*., Control (No stress: Irrigation as and when required) ($T_1$), stress imposed at flowering for 8 days ($T_2$), $T_2$ + $KNO_3$ @0.2% ($T_3$), $T_2$ + 19:19:19 NPK @2% ($T_4$), $T_2$ + Brassinosteroid (Double 0.04% a.i.) (0.5 ppm) ($T_5$), $T_2$ + Salicylic Acid (100 ppm) ($T_6$), $T_2$ +Mepiquat chloride (Chamatkar-5% @ 200 ppm) ($T_7$), and Consortia ($T_2$ + 19:19:19 NPK @ 2% + Brassinosteroid (Double 0.04% a.i.) (0.5 ppm) + Salicylic Acid (100 ppm)) ($T_8$). The foliar sprays were applied at post flowering stage. Studies revealed that the apparent values of physiological characters in finger millet differed significantly. Physiological parameters such as Crop Growth Rate (CGR), Leaf Area Index (LAI) at 15 days interval from 45 DAS, Relative Water Content (RWC) and SPAD Chlorophyll Meter Readings (SCMR) at post flowering were recorded. Amongst the different foliar treatments given to water stressed plants, Consortia ($T_2$ + 19:19:19 NPK @ 2% + Brassinosteroid (Double 0.04% a.i.) (0.5 ppm) + Salicylic Acid (100 ppm)) ($T_8$) had recorded significantly highest values which was at par with Irrigated control ($T_1$). Hence, it was concluded that the foliar spray of 19:19:19 NPK @ 2%, Brassinosteroid (0.5 ppm) and Salicylic Acid (100 ppm) was found to be effective in improving the physiological aspects which correlated with the better yield under water stress condition in finger millet.

**Keywords:** *Foliar application, consortia, nutrients and growth regulators.*

Finger millet is one of the important nutrient rich crop mostly grown in rainfed areas, where water stress can be experienced by the crop in one stage or the other. Water stress can be defined as the absence of adequate moisture necessary for normal plants to grow and complete their life cycle (Zhu, 2002). Water stress is one of major environmental constraints which can decrease crop productivity drastically as compared to the other factors and 2/3$^{rd}$ of the potential yield of major crop lost due to stress conditions (Chaves *et al*., 2009). Water stress is an increasing trend in the present-day scenario of climate change in the arid and semi-arid regions of the world. Stress during the reproductive phase in finger millet is more important and decreases the grain yield and the yield attributes to the extent of 18.9 per cent.

Under moisture stress conditions, crop plants are prone to nutrient deficit also, either due to limited supply of nutrients or due to the non-conducive soil conditions to nutrient absorption, when foliar application is the best preferable option as suggested by Salisbury and Ross (1985). Foliar spray allows the nutrients to reach the site of food synthesis directly, resulting in no waste and a rapid delivery of food, as well as a reduction in fertilizer usage. Though it is not a substitute to soil application, it certainly can be considered as supplement to soil application (Upadhyay *et al*., 1992). Foliar nutrition penetrates the leaf cuticle or stomata and enters the cell, allowing for easy and rapid nutrient utilization (Latha and Nadanassababady, 2003). In recent years, foliar application of nutrients and plant growth regulators

(PGRs) under water stress has become one of the management options to overcome physiological constraints leading to enhanced production in crops particularly in millets (Esmaeil and Abed, 2012). In this view, the present investigation was taken up to study the influence of foliar application of nutrients and plant growth regulators on the physiological traits of finger millet under water stress conditions.

## MATERIAL AND METHODS

A field experiment was conducted at the Orchard Block, Agricultural College Farm, Bapatla, Acharya N.G. Ranga Agricultural University during *rabi,* 2022-23 with the finger millet variety VR 1099 (*Gostani*) in Randomized Block Design (RBD) with three replications and eight treatments *viz*, Control (Irrigation as and when required) ($T_1$), Stress imposed at flowering for 8 days ($T_2$), stress + $KNO_3$ @0.2% ($T_3$), stress + 19:19:19 NPK @2% ($T_4$), stress + Brassinosteroid (Double 0.04% a.i.) (0.5 ppm) ($T_5$), stress + Salicylic Acid (100 ppm) ($T_6$), stress +Mepiquat chloride (Chamatkar-5% @ 200 ppm) ($T_7$), and Consortia $T_4 + T_5 + T_6$ ($T_8$). All the treatments except control were subjected to water stress by withdrawing irrigation for 8 days from flowering. Foliar treatments were imposed to the crop after stress at post flowering stage.

The observations were taken from five tagged plants per each plot. The observations for physiological traits such as Crop Growth Rate (CGR), Leaf Area Index (LAI) were noted at 15 days interval from 45 DAS. Relative Water Content (RWC) and SPAD Chlorophyll Meter Readings (SCMR) were recorded at the post flowering stage. SCMR was recorded using SPAD chlorophyll meter (SPAD 502) and Relative water content (RWC) was assessed according to Barrs and Weatherly (1962) method and expressed as percent. The collected data were analyzed statistically using ANOVA technique suggested by Panse and Sukhathme (1978).

## RESULTS AND DISCUSSION

### Crop Growth Rate (g $m^{-2}$ $d^{-1}$)

The data presented in Table 1 revealed that the CGR in finger millet varied significantly due to different foliar treatments at all the stages of crop growth. Significantly higher CGR was recorded under irrigated control ($T_1$) during 45, 60, 75 and 90 DAS, respectively and was on par with plants subjected to water stress + foliar spray with Consortia ($T_8$). The increase in growth might be due to a better nutritional environment in the plant system. The nourishment of nutrients and PGRs might have compensated the stress in terms of CGR at different stages of crop growth and the results are in accordance with the findings of Nagaraju (2014) who stated that combined spray of brassinolide @ 1 ppm at 23 DAS, salicylic acid @ 20 ppm at 35 DAS in chickpea increased crop growth rate.

### Leaf Area Index

Foliar application had a significant effect on the leaf area index in finger millet. The data pertaining to variation in LAI due to different nutrients and growth regulators were presented in Table 2. In the present study, LAI gradually increased from 45 DAS to 75 DAS and thereafter decreased in all treatments. No significant difference was observed among the treatments at 45 DAS as treatments were not imposed till that point of crop period. Significantly highest LAI was observed in irrigated control - no stress and no foliar application ($T_1$) and was on par with water stressed plants applied with Consortia ($T_8$) while lowest was observed in water stressed plants without spray ($T_2$). The present study indicated that all the foliar applied chemicals had increased the leaf area index. This could be due to increase in the accumulation and translocation of assimilates that resulted in prolonged vegetative phase and greater photosynthetic ability of the plant producing higher leaf area. The results are in conformity with the findings of Chetan Babu *et al*.(2020) in black gram.

### Relative Leaf Water Content (%)

Significant reduction was noticed in Relative water content (RWC) under water stressed conditions (Table 3). The leaf RWC in control plants (unstressed) was found 25.65% higher than water stressed plants ($T_2$). It was found to be improved under water stress by foliar application of nutrients and growth regulators, with PGR Consortia ($T_8$) showing values on par with control ($T_1$). This might be due to the action of plant growth regulators *i.e*; SA regulates the stomatal openings and reduces transpirational water loss enabling the plants to maintain turgor and photosynthesis under water deficit conditions and the application of Brassinosteroid reduces the water loss and ameliorate the water deficit stress. The results were also in accordance with the findings of Mohanabharathi *et al*. (2019) in finger millet.

**Table 1: Effect of nutrients and plant growth regulators on Crop Growth Rate in finger millet under water stress conditions**

| S. No. | Treatments | Crop Growth Rate (g $m^{-2}$ $d^{-1}$) | | |
|---|---|---|---|---|
| | | 45-60 DAS | 60-75 DAS | 75-90 DAS |
| 1 | $T_1$: Control | 8.47 | 6.66 | 4.93 |
| 2 | $T_2$: Water deficit stress at flowering | 6.41 | 4.42 | 2.01 |
| 3 | $T_3$: $T_2$ + $KNO_3$ @ 0.2% | 7.02 | 5.47 | 3.43 |
| 4 | $T_4$: $T_2$ + 19:19:19 NPK @2% | 7.14 | 5.54 | 3.52 |
| 5 | $T_5$: $T_2$ + Brassinosteroid @ 0.5 PPM | 7.39 | 5.69 | 3.76 |
| 6 | $T_6$: $T_2$ + Salicylic acid @100PPM | 7.52 | 5.76 | 3.9 |
| 7 | $T_7$: $T_2$+ Mepiquat chloride @ 200 PPM | 6.29 | 5.1 | 2.9 |
| 8 | $T_8$: Consortia ($T_4$ +$T_5$ +$T_6$) | 8.06 | 6.38 | 4.47 |
| | SEm± | 0.28 | 0.26 | 0.21 |
| | CD (P=0.05) | 0.86 | 0.79 | 0.64 |
| | CV (%) | 6.71 | 8.03 | 10.06 |

**Table 2: Effect of nutrients and plant growth regulators on Leaf Area Index in finger millet under water stress conditions**

| S. No. | Treatments | Leaf Area Index | | | |
|---|---|---|---|---|---|
| | | 45 DAS | 60 DAS | 75 DAS | 90 DAS |
| 1 | $T_1$: Control | 1.14 | 3.01 | 4.06 | 3.42 |
| 2 | $T_2$: Water deficit stress at flowering | 1.01 | 1.53 | 2.49 | 1.81 |
| 3 | $T_3$: $T_2$ + $KNO_3$ @ 0.2% | 1.03 | 2.41 | 3.39 | 2.56 |
| 4 | $T_4$: $T_2$ + 19:19:19 NPK @2% | 1.07 | 2.57 | 3.47 | 2.72 |
| 5 | $T_5$: $T_2$ + Brassinosteroid @ 0.5 PPM | 1.02 | 2.72 | 3.52 | 2.81 |
| 6 | $T_6$: $T_2$ + Salicylic acid @100PPM | 1.06 | 2.73 | 3.6 | 2.93 |
| 7 | $T_7$: $T_2$ + Mepiquat chloride @ 200 PPM | 1.05 | 2.14 | 2.64 | 2.17 |
| 8 | $T_8$: Consortia ($T_4$ +$T_5$ +$T_6$) | 1.08 | 2.86 | 3.82 | 3.23 |
| | SEm± | 0.04 | 0.09 | 0.12 | 0.11 |
| | CD (P=0.05) | NS | 0.26 | 0.36 | 0.35 |
| | CV (%) | 6.32 | 6.05 | 6.13 | 7.33 |

**SPAD Chlorophyll Meter Reading (SCMR)**

The SPAD value was found to be highest in Irrigated control ($T_1$) which was on par with those of water stressed plants treated with nutrients and PGR Consortia ($T_8$) with a remarkable increase of 37.19% over water stressed plants with no foliar application ($T_2$) at post flowering stage (Table 3). The increase in chlorophyll might be due to the combined effect of major nutrients and specific plant growth regulators. This might be due to the effect of salicylic acid, brassinosteroids and nutrients in activating the enzymes for synthesis of pigments, cell division and morphogenesis, protecting the chlorophyllase enzyme and also direct absorption of nutrients as constituents of chlorophylls. Also, nitrogen supply might have increased chlorophyll formation since chlorophyll

contains nitrogen as one of its constituents (Fageria *et al*., 2011) and that might have prevented chlorophyll degradation and leaf senescence under stress. This is in conformity with the findings of Prabha *et al*. (2016) and Mohanabharathi *et al*. (2019) in finger millet.

The growth and development of finger millet gets affected with the duration and intensity of water stress, especially at flowering stage. In the present study, nutrients and plant growth regulators were used through foliar spray and the physiological parameters under water stress condition were studied. Among the treatments, foliar spray 19:19:19 NPK @ 2% + Brassinosteroid (Double 0.04% a.i.) (0.5 ppm) + Salicylic Acid (100 ppm) showed better performance through improved LAI, CGR, RWC and SCMR which might have contributed for higher yield in finger millet under water stress. Hence, the foliar application of 19:19:19 NPK, Brassinosteroid and Salicylic Acid can be recommended at post flowering stage to improve the yield of finger millet under water stress conditions.

**Table 3. Effect of foliar application of nutrients and growth regulators on RWC and SCMR of finger millet under water stress**

| S. No. | Treatments | Relative Water Content (%) | SPAD chlorophyll meter reading (SCMR) |
|---|---|---|---|
| 1 | $T_1$: Control | 94.58 | 38.53 |
| 2 | $T_2$: Water deficit stress at flowering | 75.27 | 25.97 |
| 3 | $T_3$: $T_2$ + $KNO_3$ @0.2% | 80.82 | 29.83 |
| 4 | $T_4$: $T_2$ + 19:19:19 NPK @ 2% | 82.2 | 30.5 |
| 5 | $T_5$: $T_2$ + Brassinosteroid @ 0.5 PPM | 83.78 | 31.93 |
| 6 | $T_6$: $T_2$ + Salicylic acid @100PPM | 84.35 | 32.63 |
| 7 | $T_7$: $T_2$ + Mepiquat chloride @ 200 PPM | 82.31 | 30.87 |
| 8 | $T_8$: Consortia ($T_4$ +$T_5$ +$T_6$) | 92.3 | 35.63 |
| | Sem± | 3.1 | 1.66 |
| | CD (P=0.05) | 9.39 | 5.02 |
| | CV (%) | 6.35 | 8.96 |

## LITERATURE CITED

**Barrs H D and Weatherley P E 1962.** A re-examination of the relative turgidity technique for estimating water deficits in leaves. *Australian journal of biological sciences*. 15 (3): 413-428.

**Chaves M M, Flexas J and Pinheiro C 2009.** Photosynthesis under drought and salt stress:Regulation mechanisms from whole plants to cell. *Annals of Botany*. 103 (4): 551- 560.

**Chetan Babu R T, Narayana S, Mavarkar, Sridhara S, Ganapathi and Nandish M S 2020.** Growth and yield of blackgram as influenced by water soluble fertilizers and plant growth promoting rhizomicrobial consortia under rainfed condition in southern transition zone of Karnataka. *International Journal of chemical studies*. 8 (5): 1339-1342.

**Esmaeil Y and Abed V 2012.** Impact of urea as nitrogen source and Pix as growth regulator on cotton (*Gossypium hirsutum* L.). *International Journal of Biology*. 4:3.

**Fageria N K, Dos S A B and Coelho A M 2011.** Growth, yield and yield components of lowland rice as influenced by ammonium sulfate and urea fertilization. *Journal of Plant Nutrition*. 34 (3): 371-386.

**Latha M R and Nadanassababady T 2003.** Foliar nutrition in crops. *Agricultural Reviews*. 24 (3): 229-234.

**Mohanabharathi M, Sritharan N, Senthil A and Ravikesavan R 2019.** Physiological studies for yield enhancement in finger millet under drought condition. *Journal of Pharmacognosy and Phytochemistry*. 8 (3): 3308-3312.

**Nagaraju S 2014.** Physiological effects of boron, brassinosteroids and salicylic acid on dry matter partitioning and yield of chickpea (*Cicer arietinum* L.). M.Sc. (Agri) *Thesis*. Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad.

**Panse V G and Sukhatme P V 1978.** Statistical methods for Agricultural Workers, ICAR, New Delhi.

**Salisbury F B and Ross C W 1985.** *Plant Physiology*. Belmont. 540.

**Prabha V V, Senthil A, Sritharan N and Boominathan P 2016.** Effect of foliar application of plant growth regulators and nutrients on physiological traits of finger millet (*Eleusine coracana*). *Research on Crops*. 17 (3): 483-488.

**Upadhyay V B, Koshta L D, Bisen C R and Sachidanand B 1992.** Studies on response of arhar (*Cajanus cajan* L. Millsp) to foliar spray of DAP and under rainfed condition. JNKVV Research Journal. 26 (1): 60-61.

**Zhu J K 2002.** Salt and drought stress signal transduction in plants. Annual Reviews of Plant Biology. 53: 247-273.

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