



# Effect of Plant Growth Regulator on Growth, Physiology and Yield of Direct Sown Finger Millet (*Eleusine coracana* L.)

P. Srinithi <sup>a\*</sup>, R. Mohanapriya <sup>a</sup>, K. Sharmili <sup>a</sup>  
and P. Susanpoonguzhali <sup>b</sup>

<sup>a</sup> Division of Agronomy, School of Agricultural Sciences, Karunya Institute of Technology and Sciences, Coimbatore-641 114, India.

<sup>b</sup> Division of Soil Science, School of Agricultural Sciences, Karunya Institute of Technology and Sciences, Coimbatore-641 114, 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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## ABSTRACT

**Aims:** To determine the "Effect of plant growth regulator on growth, physiology and yield of direct sown finger millet".

**Place and Duration of Study:** The field experiment was conducted during rabi 2022 at South Farm, Division of Agronomy, Karunya Institute of Technology and Sciences, Coimbatore. The soil of the experimental field was sandy clay loam in texture, nearly neutral in soil reaction (pH 5.36), level of organic carbon (1.03%), available N (289 kg/ha), P (115 kg/ha) and K (437 kg/ha).

**Study Design:** Completely randomized block design.

**Methodology:** T<sub>1</sub> (RDF + Water spray - Control), T<sub>2</sub> (100% RDF + Foliar spraying of

\*Corresponding author: E-mail: [srinithipunniamoorthii@gmail.com](mailto:srinithipunniamoorthii@gmail.com);

Brassinosteroid @ 0.5 ppm), T<sub>3</sub> (100% RDF + Foliar spraying of Gibberellic acid @10 ppm), T<sub>4</sub> (100% RDF + Foliar spraying of Salicylic acid @100 ppm), T<sub>5</sub> (50% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm), T<sub>6</sub> (50% RDF + Foliar spraying of Gibberellic acid @10 ppm), T<sub>7</sub> (50% RDF + Foliar spraying of Salicylic acid @100 ppm), T<sub>8</sub> (Foliar spraying of Brassinosteroid @ 0.5 ppm), T<sub>9</sub> (Foliar spraying of Gibberellic acid @10 ppm), T<sub>10</sub> (Foliar spraying of Salicylic acid @100 ppm).

**Results:** The experiment was laid out in RBD and showed that 100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm (T<sub>2</sub>) gave highest No. of tillers/hill, Dry matter production, leaf area index, grain yield, straw yield, harvest index, post-harvest NPK uptake of finger millet. when compared control (Farmer practice).

**Conclusion:** From this study, it was concluded that PGR along with nutrients application increases the nutrient uptake and yield.

*Keywords: Finger millet; nutrient uptake; plant growth regulator; yield.*

## 1. INTRODUCTION

Finger millet, scientifically known as *Eleusine coracana* L., is a crucial small millet crop in India. It boasts the highest productivity among all millets. Millets, collectively referred to as small-seeded grains, belong to various varieties of annual grasses. These grains are primarily cultivated as crops on marginal lands in dry areas found in temperate, subtropical, and tropical regions. Millets are regarded as the most important cereals in semi-arid zones worldwide and serve as a staple food for millions of people in Africa and Asia [1].

Millets are recognized as one of the most significant cereal grains and are consumed by over one-third of the global population. They rank as the sixth largest cereal crop in terms of agricultural production worldwide. In India, finger millet is cultivated across a total area of 12.11 lakh hectares, with an average yield of 1401 kg/ha, resulting in a production of 16.96 lakh tonnes (AICRP 2020 - 2021). The nutritional content of all millets is three to five times higher compared to commonly used rice and wheat, making them a highly nutritious food option. The prevalence of malnutrition and undernourishment is a significant challenge faced by the Indian population, prompting the exploration of millets as an alternative source of human food both globally and in India. Millets offer several nutritional advantages. They have higher calcium content compared to other cereals and possess the highest iodine content among all food grains. Ragi, in particular, stands out for its excellent protein quality, containing essential amino acids, vitamin A, vitamin B, and phosphorus (Directorate of Millets Development, 2020-2021).

Plant growth regulators (PGRs) are organic compounds that play a role in modifying various physiological processes in plants, apart from providing essential nutrients. PGRs, also known as bio-stimulants or bio-inhibitors, function within plant cells to stimulate or inhibit specific enzymes or enzyme systems, thereby assisting in the regulation of plant metabolism. These regulators typically exhibit their effects at very low concentrations within plants. Growth regulating chemicals that demonstrate positive impacts on major agronomic crops can hold significant value. However, the ultimate measure of success for PGRs lies in their ability to increase harvested yields or enhance crop quality, thereby ensuring their profitability. In recent years, foliar application of plant growth regulators (PGRs) and nutrients, one of the management options, is being employed increasingly to overcome physiological constraints leading to rapid change in the phenotype of the plant within the season to achieve enhanced production in crops [2]. With this basis, the present investigation was focused on growth, physiological, and yield attributes in finger millet by foliar nutrients and PGRs under irrigated conditions.

## 2. MATERIALS AND METHODS

The experiment was conducted during the rabi season of 2022 at South Farm, Division of Agronomy, Karunya Institute of Technology and Sciences, Coimbatore. The experimental site is geographically located in the western agro-climatic zone of Tamil Nadu at 10° 56'N latitude and 76° 44'E longitude at an elevation of 474 m above mean sea level. The soil of the experimental field was sandy clay loam in texture, nearly neutral in soil reaction (pH 5.36), level of organic carbon (1.03%), available N

(289 kg/ha), P (115 kg/ha) and K (437 kg/ha). Treatments comprised of T<sub>1</sub> (RDF + Water spray - Control), T<sub>2</sub> (100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm), T<sub>3</sub> (100% RDF + Foliar spraying of Gibberellic acid @10 ppm), T<sub>4</sub> (100% RDF + Foliar spraying of Salicylic acid @100 ppm), T<sub>5</sub> (50% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm), T<sub>6</sub> (50% RDF + Foliar spraying of Gibberellic acid @10 ppm), T<sub>7</sub> (50% RDF + Foliar spraying of Salicylic acid @100 ppm), T<sub>8</sub> (Foliar spraying of Brassinosteroid @ 0.5 ppm), T<sub>9</sub> (Foliar spraying of Gibberellic acid @10 ppm), T<sub>10</sub> (Foliar spraying of Salicylic acid @100 ppm). These had been replicated thrice in RBD (Randomized Block Design). The recommended dose of fertilizer at the time of sowing is applied in the form of urea, DAP, and MOP and data were subjected to statistical analysis of variance method [3].

### 3. RESULTS AND DISCUSSION

#### 3.1 No. of Tillers/Hill

The results showed that there is no significant differences at all three stages of observation as shown in Fig. 1. The higher no. of tillers was recorded in T<sub>2</sub> (100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm) at 45, 60 DAS and at harvest of 8.5, 8.6 and 9.0, respectively. Golada and Debbarma [4] reported that the dissimilarity in growth attributes signifies that each rice variety responds uniquely to the applied nutrient in terms of uptake and utilization efficiency. Further, increase in tiller/hill may be due to its application of PGR which controls the growth of the plant as reported by Singh et al. [5]. The lowest value was recorded in control (T<sub>1</sub>) of 4.9, 5.0 and 8.0, respectively.

#### 3.2 Dry Matter Production

The data on the dry matter production of finger millet as influenced by the nutrients and plant growth regulators at various growth stages are presented in Table 1. Among different treatments compared 100% RDF + Brassinosteroid @ 0.5ppm (T<sub>2</sub>) registered the highest dry matter production of 4902 kg ha<sup>-1</sup> and 6021 kg ha<sup>-1</sup> at 60 DAS and at harvest. At 45, 60 DAS and harvest 100% RDF + Brassinosteroid @ 0.5ppm (T<sub>2</sub>) is statistically on par with T<sub>3</sub> (100% RDF + Foliar spraying of Gibberellic acid @10 ppm), T<sub>4</sub> (100% RDF + Foliar spraying of Salicylic acid @100 ppm). Suresh et al. [6] reported that increased nutrient application, particularly NPK, played a

significant role in enhancing dry matter production. The presence of NPK nutrients influenced the efficiency with which sunlight was utilized by promoting increased biomass. It was also noted that any inadequacy of nitrogen adversely affected the efficiency of utilizing sunlight for photosynthesis. Similar, results were also supported by Pradhan et al. [7]. The lowest value was recorded in the control (T<sub>1</sub>) with values of 4902 kg ha<sup>-1</sup> and 6324 kg ha<sup>-1</sup>.

#### 3.3 Leaf Area Index

The effect of plant growth regulator on leaf area index was presented in Table 2. LAI was significantly influenced by the treatments as compared to control. Application of 100% RDF + Brassinosteroid @ 0.5ppm (T<sub>2</sub>) recorded higher LAI at 30 DAS (2.95), 60 DAS (3.23) and at harvest (4.05). It was statistically on par with application of 100% RDF + Foliar spraying of Gibberellic acid @10 ppm (T<sub>3</sub>) and 100% RDF + Foliar spraying of Salicylic acid @100 ppm (T<sub>4</sub>). The observed phenomenon could be attributed to an increase in leaf numbers, leaf length, width, and the presence of tillers. These findings align with a previous study reported by Kumar et al. [8]. Sengupta et al. [9], it was reported that the biomass of the crop increased as the crop aged. Additionally, the application of a growth regulator had a clear and significant impact on the accumulation of dry matter. The lower leaf area index was recorded with values of 1.57, 1.09 and 2.34, respectively.

#### 3.4 Yield

##### 3.4.1 Grain yield

Spraying of foliar nutrients and growth regulators had significant influence on grain yield of finger millet (Table 3). The plant sprayed with plant growth regulators at 100% RDF + Brassinosteroid @ 0.5ppm (T<sub>2</sub>) produced significantly higher grain yield of 4791 kg ha<sup>-1</sup>. This was followed by foliar application of 100% RDF + Foliar spraying of Gibberellic acid @10 ppm (T<sub>3</sub>) and this was on par with 100% RDF + Foliar spraying of Salicylic acid @100 ppm (T<sub>4</sub>) with grain yield of 4450 and 4422 kg ha<sup>-1</sup>, respectively. The observed increase in biomass could be attributed to the enhancement of growth-related characteristics such as leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR), and net assimilation rate (NAR). Dawood et al. [10] was noted that the application of plant growth regulators (PGR)

resulted in an increase in kernel yield and yield components of sunflower. This increase was attributed to the impact of physiological and biochemical processes that improved vegetative growth, active assimilation, and efficient translocation of nutrients from source to sink. Sengupta et al. [9], it was found that brassinolide exerted a significant influence on the growth and seed yield of the crop. The lowest value was recorded in control ( $T_1$ ) of  $3871 \text{ kg ha}^{-1}$ .

### 3.4.2 Staw yield

Application of 100% RDF + Brassinosteroid @ 0.5ppm ( $T_2$ ) recorded a higher straw yield of  $5950 \text{ kg ha}^{-1}$ . It was followed by of 100% RDF + Foliar spraying of Gibberellic acid @10 ppm ( $T_3$ ) which was statistically on par with 100% RDF + Foliar spraying of Salicylic acid @100 ppm ( $T_4$ ). The straw yield enhancement due to the adoption of different treatments might be due to the continuous supply of nutrients which in turn increased the plant height, dry matter production.

This is also attributed due to the higher nutrient uptake throughout the crop growth period. The results of the present study were in confirmation with the finding of Esther and Gautam [11]. The lowest straw yield ( $4468 \text{ kg ha}^{-1}$ ) was recorded with control ( $T_1$ ).

### 3.4.3 Harvest index

The harvest index is the best measure of the source and sink relationship indicating efficient uptake and utilization of nutrients to biological and economic yield. In this investigation, the foliar application of 100% RDF + Brassinosteroid @ 0.5 ppm ( $T_2$ ) recorded a higher harvest index. This might be due to the increased mobilization of metabolites to reproductive sinks. Azizi Kh et al. [12] reported that foliar spray of gibberellic acid increased the harvest index in soybean. The effect of growth regulator enhances the physiological and biochemical process that to increase the yield and yield attributes reported by Ashwini et al. (2021).

**Table 1. Effect of plant growth regulators on dry matter production ( $\text{kg ha}^{-1}$ ) of direct sown finger millet**

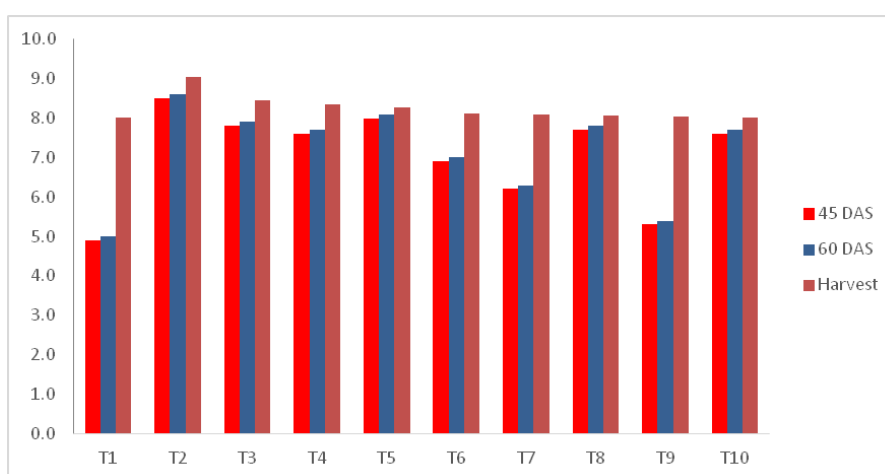
Treatment	DMP ( $\text{Kg ha}^{-1}$ )		
	45 DAS	60 DAS	Harvest
$T_1$ - RDF + Water spray	182	2806	3072
$T_2$ - 100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	442	4902	6324
$T_3$ - 100% RDF + Foliar spraying of Gibberellic acid @10 ppm	406	4575	6021
$T_4$ - 100% RDF + Foliar spraying of Salicylic acid @100 ppm	398	4455	6002
$T_5$ - 50% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	328	4006	5548
$T_6$ - 50% RDF + Foliar spraying of Gibberellic acid @10 ppm	308	3870	5363
$T_7$ - 50% RDF + Foliar spraying of Salicylic acid @100 ppm	302	3798	5258
$T_8$ - Foliar spraying of Brassinosteroid @0.5 ppm	238	3377	4304
$T_9$ - Foliar spraying of Gibberellic acid @10 ppm	232	3285	4090
$T_{10}$ - Foliar spraying of Salicylic acid @100 ppm	214	3208	3977
<b>SEd</b>	29.03	52.67	72
<b>C.D(P= 0.05%)</b>	61.45	111.502	153

**Table 2. Effect of plant growth regulators on leaf area index of direct sown finger millet**

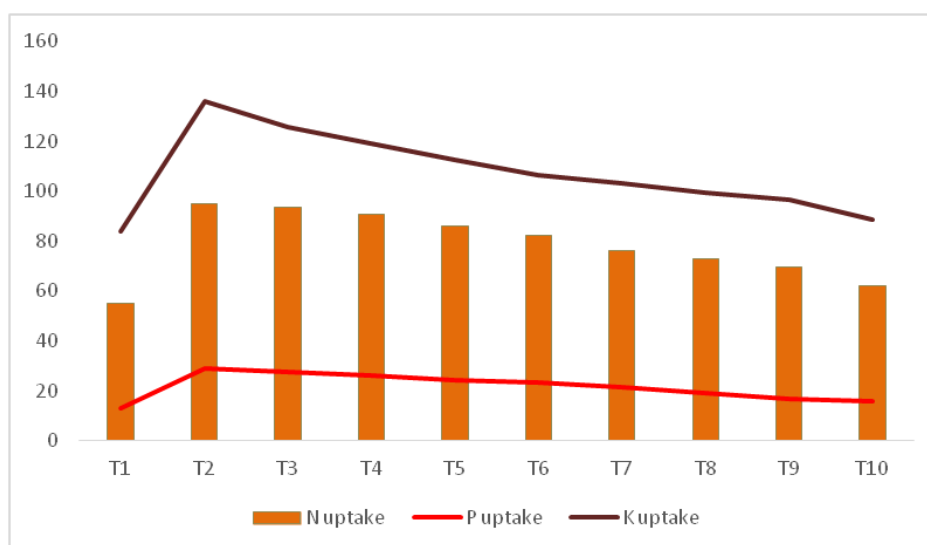
Treatment	LAI		
	45DAS	60DAS	Harvest
$T_1$ - RDF + Water spray	1.63	2.09	2.54
$T_2$ - 100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	2.95	3.23	4.05
$T_3$ - 100% RDF + Foliar spraying of Gibberellic acid @10 ppm	2.76	2.95	3.74
$T_4$ - 100% RDF + Foliar spraying of Salicylic acid @100 ppm	2.61	2.75	3.62
$T_5$ - 50% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	2.33	2.53	3.43
$T_6$ - 50% RDF + Foliar spraying of Gibberellic acid @10 ppm	2.14	2.26	3.21
$T_7$ - 50% RDF + Foliar spraying of Salicylic acid @100 ppm	2.03	2.13	3.08
$T_8$ - Foliar spraying of Brassinosteroid @0.5 ppm	1.97	2.09	2.98
$T_9$ - Foliar spraying of Gibberellic acid @10 ppm	1.82	1.98	2.82
$T_{10}$ - Foliar spraying of Salicylic acid @100 ppm	1.74	1.84	2.66
<b>SEd</b>	0.085	0.081	0.086
<b>CD (P=0.05%)</b>	0.179	0.171	0.181

**Table 3. Effect of plant growth regulators on grain yield (kg ha<sup>-1</sup>), straw yield (kg ha<sup>-1</sup>) and harvest index of direct sown finger millet**

Treatment	Grain Yield	Straw Yield	HI
T <sub>1</sub> - RDF + Water spray	3871	4568	0.46
T <sub>2</sub> - 100% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	4491	5840	0.43
T <sub>3</sub> - 100% RDF + Foliar spraying of Gibberellic acid @10 ppm	4450	5768	0.44
T <sub>4</sub> - 100% RDF + Foliar spraying of Salicylic acid @100 ppm	4422	5712	0.44
T <sub>5</sub> - 50% RDF + Foliar spraying of Brassinosteroid @ 0.5 ppm	4298	5473	0.44
T <sub>6</sub> - 50% RDF + Foliar spraying of Gibberellic acid @10 ppm	4273	5264	0.45
T <sub>7</sub> - 50% RDF + Foliar spraying of Salicylic acid @100 ppm	4243	5101	0.45
T <sub>8</sub> - Foliar spraying of Brassinosteroid @0.5 ppm	3991	4844	0.45
T <sub>9</sub> - Foliar spraying of Gibberellic acid @10 ppm	3974	4798	0.45
T <sub>10</sub> - Foliar spraying of Salicylic acid @100 ppm	3945	4662	0.46
<b>SEd</b>	80.28	82.99	
<b>CD(P=0.05%)</b>	169.9	175.7	



**Fig. 1. Effect of plant growth regulator on no. of tillers hill-1 of direct sown finger millet**



**Fig. 2. Effect of plant growth regulator on NPK uptake of direct sown finger millet**



Map 1. Study area

### 3.5 Post-harvest NPK Uptake

The higher nutrient uptake of NPK at harvest was recorded in 100% RDF + Brassinosteriod @ 0.5 ppm ( $T_2$ ) with values of 95.1 kg ha<sup>-1</sup>, 28.7 kg ha<sup>-1</sup> and 107.1 kg ha<sup>-1</sup> (Figure). It was followed by 100% RDF + Foliar spraying of Gibberellic acid @10 ppm ( $T_3$ ) which was statistically on par with 100% RDF + Foliar spraying of Salicylic acid @100 ppm ( $T_4$ ). Higher nutrient content in the produce and higher biomass production of finger millet might be the pertinent reason for higher uptake of nutrients. These findings were in close agreement with the results reported Sujatha et al. [13] and Singh et al. [14]. The lowest NPK uptake was recorded 55.2, 13.1 and 70.6 kg ha<sup>-1</sup> at all the stages of harvest in control ( $T_1$ ).

### 4. CONCLUSION

Based on above findings it can be concluded that combination of 100% RDF + Brassinosteriod @ 0.5 ppm ( $T_2$ ) has performed better in growth parameters and yield attributes of finger millet and has also proven profitable.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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