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Phytohormones and micronutrient influence on growth dynamics of banana cv. Grand Naine

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Abstract
Banana (*Musa* spp.) is one among the most important world's tropical fruit plants and a member of the Musaceae family. It is the popular fruit grown within the country with high energy, dietary quality, affordability and year-spherical availability instead of other seasonal fruits. An experiment was laid out at COH, Anantharajupeta with different phytohormones (P_1: Methyl Jasmonate @ 1.5 µM, P_2: Methyl Jasmonate @ 1 µM, P_3: Salicylic acid @ 200 ppm, P_4: Salicylic acid @ 100 ppm, P_5: Homobrassinolide @ 3 ppm and P_6: Homobrassinolide @ 2 ppm) and micronutrients (M_1: Zinc sulphate @ 0.5%, M_2: Ferrous sulphate @ 0.2%, M_3: Borax @ 0.3%) to check their effect on growth attributes of tissue culture Banana. Results revealed that the treatment combination Homobrassinolide @ 3 ppm + Ferrous sulphate @ 0.2% (P_5M_2) recorded the highest in leaf length (98.55, 98.15 and 98.354 cm), leaf width (48.15, 48.24 and 48.19 cm), number of leaves (22.77, 22.30 and 22.54) and leaf area (37.96, 37.88 and 37.92m^2) at 90, 150 and 210 days after planting in Banana cv. Grand Naine.

Keywords: Phytohormones, micronutrients, banana cv. grand Naine

Introduction
Banana is one of the most important world's tropical fruit plants and a member of the Musaceae family. It is thought to be one of the top fruit plants cultivated by using people on the dawn of civilization. It is the popular fruit grown within the country with high energy, dietary quality, affordability and year-spherical availability instead of other seasonal fruits.
Among India's fruit vegetation, banana currently ranked first in production and third in area, with 315.04 lakh MT produced yearly from 8.78 lakh hectares. In Andhra Pradesh, major banana growing districts are East Godavari, West Godavari, YSR Kadapa, Guntur, Kurnool, Vizianagaram, Krishna, Anantapuramu and Srikakulam. It is grown in an extent of 0.89lk hectares in Andhra Pradesh, with a production of 50.03 lakh MT annually (Anon, 2020). The banana fruit majorly contains water (75%), carbohydrate (12.60%), protein (1.10%), fat (0.20%) and *viz*., vitamin A (190 IU), Vitamin B (0.05 mg), nicotinic acid (0.70 mg) and ascorbic acid (10 mg). Banana also consists of minerals like potassium (315 mg), phosphorus (26 mg), magnesium (33 mg), calcium (8 mg), iron (0.70 mg), sodium (1 mg), zinc (0.15 mg) and gives energy of 85 Kcal per 100 g of edible portion and possesses many more important health benefiting compounds (Patel, 2016) [9].

Materials and Methods
The tissue culture banana plants of Grand Naine variety were planted at a spacing of 2 x 2 m in Randomized Block Design with Factorial concept using six phytohormone sprays combined with three micronutrient sprays and 18 treatment combinations. Observations were recorded during the years, 2021 to 2023 at different stages like 5th and 7th month of planting for different growth stages. All the plants received same recommended doses of fertilizers and other cultural practices during the course of investigation. Different phytohormones (P_1: Methyl Jasmonate @ 1.5 µM, P_2: Methyl Jasmonate @ 1 µM, P_3: Salicylic acid @ 200 ppm, P_4: Salicylic acid @ 100 ppm, P_5: Homobrassinolide @ 3 ppm and P_6: Homobrassinolide @ 2 ppm) and micronutrients (M_1: Zinc sulphate @ 0.5%, M_2: Ferrous sulphate @ 0.2%, M_3: Borax @ 0.3%) were studied.

Results and Discussion
Number of leaves at 7th month after planting
The data pertaining to number of leaves at 7th month in Banana cv. Grand Naine was presented

in Figure 1. Among different phytohormones studies highest number of leaves were recorded in the phytohormone Homobrassinolide @ 3 ppm (P_5-22.80, 22.51 and 22.65). While lowest number of leaves was recorded in treatment Salicylic acid @ 200 ppm (P_3-16.66, 16.50 and 16.58) during the plant crop, ratoon crop and pooled mean respectively. With regard to micronutrients data revealed that highest number of leaves (M_2-22.34, 22.20 and 22.27) were recorded in treatment Ferrous sulphate @ 0.2%. Lowest was recorded (M_3– 13.68, 13.79 and 13.74) in treatment Borax @ 0.3% at plant crop, ratoon crop and pooled data respectively. Interaction effect revealed that treatment combination showing highest number of leaves (P_5M_2-22.77, 22.30 and 22.54) was recorded in Homobrassinolide @ 3 ppm +Ferrous sulphate @ 0.2%. Whereas lowest was recorded (P_3M_3-16.78, 16.56 and 16.67) in treatment combination Salicylic acid @ 200 ppm + Borax @ 0.3% during the plant crop, ratoon crop and pooled mean respectively.

Leaf length at 210 Days after planting

The data pertaining to leaf length (cm) in Banana cv. Grand Naine as influenced by various treatments has been presented in and Figure 2. Among different phytohormones studied highest leaf length (P_6-100.21, 103.34 and 101.75 cm) in the treatment Homobrassinolide @ 2 ppm was recorded. Lowest leaf length (P_3-86.04, 85.94 and 85.99 cm) was observed in the treatment Salicylic acid @ 200 ppm during plant crop, ratoon crop and pooled mean respectively. The leaf length was noticed to be maximum in (M_2-95.40, 94.36 and 94.88 cm) was recorded in treatment Ferrous sulphate @ 0.2% which was at par with the treatment (M_1-94.15, 94.24 and 94.19 cm) Zinc sulphate @ 0.5% at plant crop, ratoon crop and pooled mean. Lowest leaf length (M_3 - 92.91, 92.85 and 92.88 cm) was observed in the treatment Borax @ 0.3% at plant crop, ratoon crop and pooled mean respectively. With regard to interaction effect data revealed that highest leaf length (P_5M_2-98.55, 98.15 and 98.354 cm) was observed in treatment combination Homobrassinolide @ 3 ppm + Ferrous sulphate @ 0.2% which was statistically at par with treatment combination (P_5M_3-97.22 cm) Homobrassinolide @ 3 ppm+ Borax @ 0.3%, (P_6M_2-96.72 cm) Homobrassinolide @ 2 ppm + Ferrous sulphate @ 0.2%, (P_6M_1-95.95 cm) Homobrassinolide @ 2 ppm + Zinc sulphate @ 0.5% at pooled mean whereas lowest leaf length (P_3M_3-83.66, 84.45 and 84.05 cm) in treatment Salicylic acid @ 200 ppm + Borax @ 0.3% was recorded during the plant crop and ratoon crop and pooled mean respectively.

Above results are in conformity with the research results of Bajguz (2000) [1], Sharma *et al*. (2017) [7]. Highest leaf length which was observed in the treatment Homobrassinolide @ 3 ppm (P_5), might be due to delay in leaf senescence or abscission, which may be a sign of increased chlorophyll content and the cause of lengthening of leaves in plants treated with brassinsteroids spray. Homobrassinolide-treated tomato leaves had much higher chlorophyll pigment content than the reference growth regulators GA and NAA. Brassinosteroids may have stimulated the transcription and translation of enzymes involved in chlorophyll synthesis, which, in combination with a lower level of catabolizing enzymes, may be the primary reason of increased chlorophyll content.

Leaf width at 210 days after planting

The data related to leaf width (cm) of Banana cv. Grand Naine as influenced by various phytohormones and micronutrients was presented in Figure 3. Among phytohormones studies highest leaf width (P_6-48.66, 48.73 and 48.70 cm) was recorded in the treatment Homobrassinolide @ 2 ppm which was in turn-maintained parity with treatment (P_5- 48.53, 48.66 and 48.99 cm) Homobrassinolide @ 3 ppm. Lowest leaf width (P_3 - 40.81, 40.86 and 40.84 cm) was recorded in treatment Salicylic acid @ 200 ppm at plant crop, ratoon crop and pooled mean respectively. With regard to micronutrients highest leaf width was recorded in the treatment Zinc sulphate @ 0.5% (M_1-47.65, 47.74 and 47.70 cm) which was significantly at par with treatment (M_2-46.29, 46.37 and 46.33 cm) Ferrous sulphate @ 0.2%. Lowest was recorded in the treatment Borax @ 0.3% (M_3-44.75 cm, 44.76 cm and 44.75 cm) at plant crop, ratoon crop and pooled mean respectively. The interaction effect has revealed that treatment combination Homobrassinolide @ 3 ppm + Ferrous sulphate @ 0.2% (P_5M_2-48.15, 48.24 and 48.19 cm) recorded the highest leaf width which was significantly at par with the treatment (P_6M_1- 47.95, 48.12 and 48.03 cm) Homobrassinolide @ 2 ppm+Zinc sulphate @ 0.5%. While lowest leaf width was recorded in the treatment combination Salicylic acid @ 200 ppm + Borax @ 0.3% (P_3M_3-41.50, 41.64 and 41.57 cm) during the plant crop, ratoon crop and pooled mean respectively.

Our results obtained are in line with Gudesblat and Russinova (2011) [10] and Wei and Li (2016) [8]. A significant increase in leaf width found at 90, 150 and 210 days after planting. Brassinosteroids would have increased leaf width by promoting cell elongation and division, increasing cell size and number, and ultimately increasing the photosynthetic surface area in plants whereas Fe serves as a component for vital enzymes such as cytochrome of ET.

Leaf area at 210 Days after planting

The data pertaining to leaf area (m^2) of Banana cv. Grand Naine as influenced by various phytohormones and micronutrients was presented on Figure 4. With regard to phytohormones, data revealed that highest leaf area (P_5-39.01, 40.29 and 39.64m^2) in the treatment Homobrassinolide @ 3 ppm was recorded which was statistically at par with treatment (P_6-37.78, 37.50 and 37.64 m^2) Homobrassinolide @ 2 ppm and treatment (P_2- 39.00, 38.98 and 38.988m^2) Methyl jasmonate @ (1 µM) at plant crop, ratoon crop and pooled mean. Lowest leaf area (P_3-28.09, 27.64 and 27.86 m^2) was found in the treatment Salicylic acid @ 200 ppm during the plant crop, ratoon crop and pooled mean respectively. Among different micronutrients, it was evident from the data that highest leaf area (M_2-35.89, 35.99 and 35.94m^2) was recorded in treatment Ferrous sulphate @ 0.2% which was in parity with treatment (M_1-35.33, 35.00 and 35.17m^2). Lowest leaf area (M_3 -33.26, 33.25 and 33.25m^2) was observed in treatment Borax @ 0.3% at plant crop, ratoon crop and pooled mean respectively. With regard to interaction effect that highest leaf area (P_5M_2-37.96, 37.88 and 37.92m^2) was observed in treatment combination Homobrassinolide @ 3 ppm + Ferrous sulphate @ 0.2% which was in parity with treatment combinations (P_6M_1-37.04, 36.70 and 36.87m^2) Homobrassinolide @ 2 ppm + Zinc sulphate @ 0.5%, (P_5M_3-36.59, 35.92 and 36.25m^2) Homobrassinolide @ 3 ppm+ Borax @ 0.3% and (P_6M_1-37.04, 36.70 and 36.87m^2) Homobrassinolide @ 2 ppm + Borax @ 0.3% at plant crop,

ratoon crop and pooled mean whereas lowest leaf area (P_3M_3-27.78, 28.13 and 26.95m^2) in treatment Salicylic acid @ 200 ppm + Borax @ 0.3% was recorded during the plant crop and ratoon crop and pooled mean respectively.

According to Sakurai and Fujiok (1993) [6], brassinosteroids had a positive effect on leaf area because of their connection with phytochrome, Ramraj *et al*. (1997) [5] which facilitated growth regulation and also stimulated cell expansion. and Prakash *et al*. (2008) [4] found similar results in sesame. External application of micronutrients at a higher level considerably boosted the nutritional status of Fe and Zn nutrients in banana leaves cv. Grand Naine. Ghanta and Mitra (1993) [2] and Jeyabaskaran and Pandey (2008) [3] found similar results in banana.

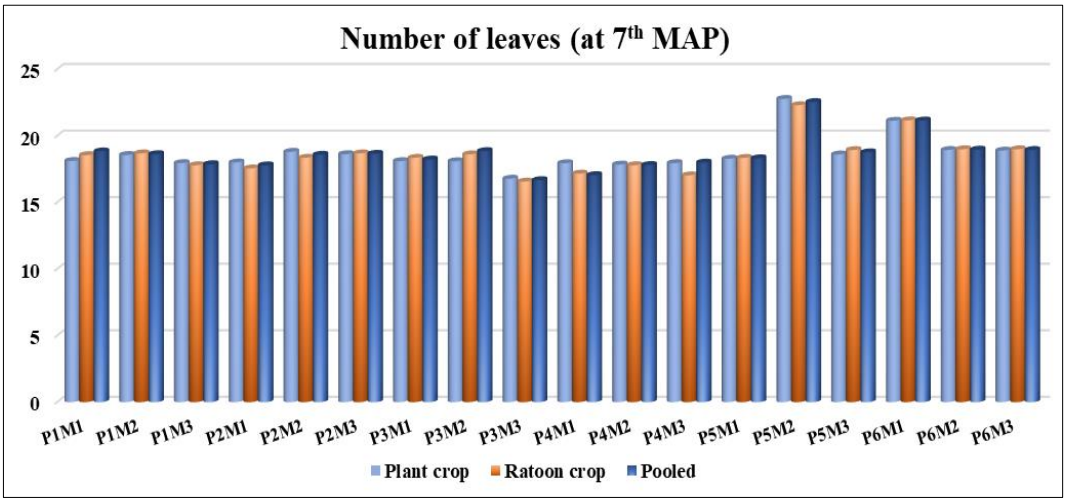

Fig 1: Effect of phytohormones and micronutrients on number of leaves at 7th month in banana cv. Grand Naine

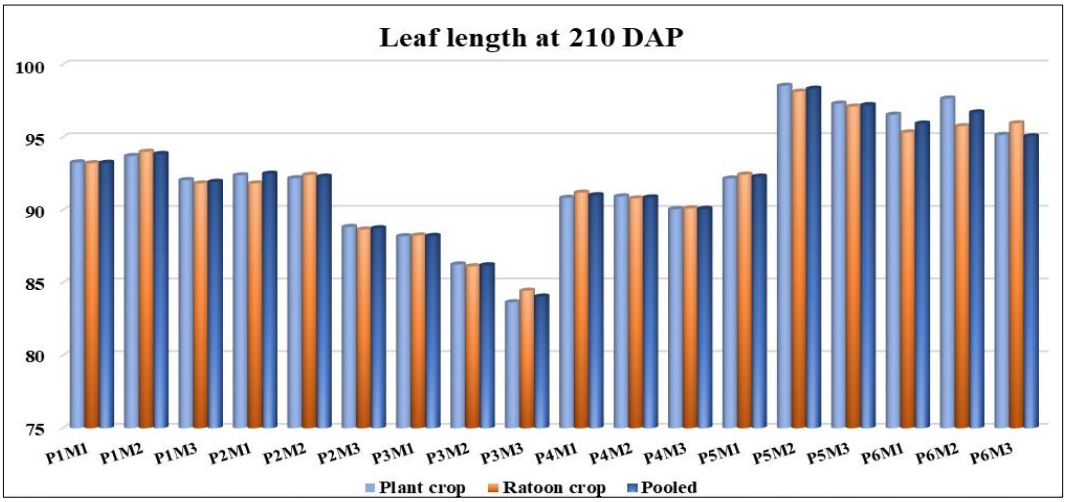

Fig 2: Effect of phytohormones and micronutrients on leaf length at 210 DAP of banana cv. Grand Naine

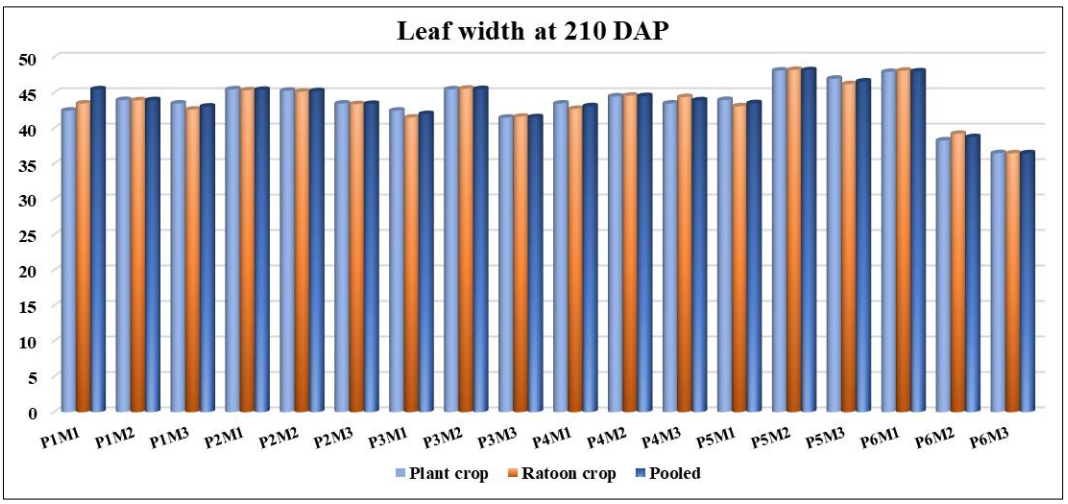

Fig 3: Effect of phytohormones and micronutrients on width at 210 DAP of banana cv. Grand Naine

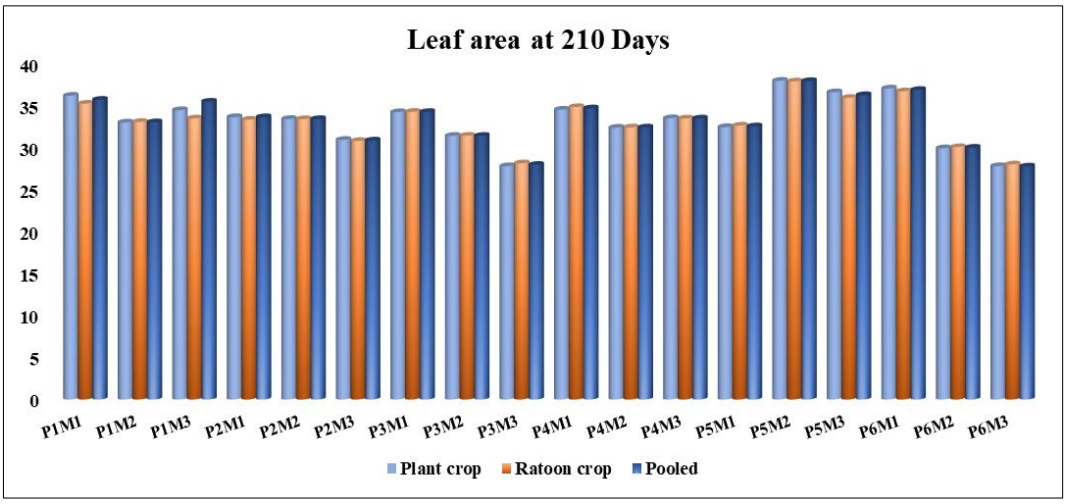

Fig 4: Effect of phytohormones and micronutrients on leaf area at 210 DAP of banana cv. Grand Naine

Conclusion

Among different phytohormones and micronutrients studies for number of leaves, leaf length, leaf width and leaf area revealed that significantly recorded the highest in phytohormone Homobrassinolide @ 3 ppm (P_5) and micronutrient Ferrous sulphate @ 0.2% (M_2) and in the interaction effect Homobrassinolide @ 3 ppm + Ferrous sulphate @ 0.2% (P_5M_2) was shown highest and less superior among all treatments was found in Salicylic acid @ 200 ppm **(**P_3) during plant crop, ratoon crop and pooled mean respectively.

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