

Effect of plant growth regulators and chemicals on morphological traits and yield of banana cv. Grand Nain

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Abstract: Foliar application of CCC 1000 ppm at 4th and 6th month after planting of banana cv. Grand Nain significantly increased the pseudostem girth, number of leaves, root volume and number of roots. However, the maximum leaf area and leaf area index were recorded in brassinolide treated plants. CCC treatment improved the number of hands, number of fingers, finger size and thereby bunch weight, yielding maximum fruit of 80.38 t ha⁻¹. The quality parameters viz., total soluble solids, ascorbic acid, reducing sugars and total sugars were also influenced significantly by foliar spray of CCC at 1000 ppm concentration.

Key words : Banana, growth regulators, CCC.

Introduction

Banana is one of the important fruit crops of the tropical and subtropical countries. The burgeoning interest in banana research in the last twenty years results from the belated realization that *Musais* an under-exploited genus, not withstanding the fact that bananas are a major exporting commodity second only to citrus in terms of the world fruit trade (Gowen, 1995). In India, banana accounts for higher fruit production among various fruit crops contributing 31 per cent of total fruit production.

To overcome the production constraints, chemical manipulation could be tried to improve the root system, in proportion to shoot growth. Apart from this, any attempt on improving the physiological efficiency of the crop will also have significant impact. One of the biotechnological approaches to overcome these bottlenecks and to make stupendous contributions in increasing productivity is the use of plant growth regulators (PGRs). Very small concentrations of these substances produce

major growth changes. PGRs have witnessed a substantial upsurge in synthesis and utilization in the last decade and have emerged as magic chemicals which could be profitably exploited to overcome physiological constraints leading to enhanced production. The present study with different plant growth regulators might be useful to improve the yield through better dry matter partitioning efficiency, well developed root system and quality attributes.

Materials and Methods

Experiments were conducted during 2002-2003 to assess the influence of plant growth regulators and chemicals on morphophysiological changes and to understand their effects on bunch yield and quality changes in banana cv. Grand Nain. Plants raised in polyethylene bags having six leaves, were planted in the pits at a spacing of 2m x 2m and applied with recommended fertilizer dose of 110:35:330g N: P₂O₅ : K₂O plant⁻¹ in three splits during 3rd, 5th and 7th months after planting (MAP), and the experiment was conducted in Randomized Block Design (RBD) of 8x8

Table. 1 Effect of plant growth regulators and chemicals on morphological traits at shooting stage of banana cv. Grand Nain

Treatments	Number of levels plant ⁻¹	Leaf Area (m ² plant ⁻¹)	Leaf Area Index	Number of roots	Root (cc)
T ₁	12.69	15.06	3.77	183.50	0.92
T ₂	13.15	16.60	4.15	225.46	1.28
T ₃	13.05	16.75	4.19	215.12	1.56
T ₄	13.26	16.55	4.14	228.56	1.59
T ₅	15.01	15.22	3.81	248.56	1.62
T ₆	14.82	15.66	3.92	245.99	1.60
T ₇	14.91	15.10	3.78	256.15	1.66
T ₈	14.36	18.45	4.61	231.57	1.45
T ₉	13.34	18.38	4.60	230.15	1.42
T ₁₀	14.77	18.65	4.66	232.55	1.55
T ₁₁	12.95	17.40	4.35	197.23	1.34
T ₁₂	12.93	17.56	4.39	195.15	1.28
T ₁₃	13.01	18.20	4.55	198.22	1.39
T ₁₄	12.85	17.45	4.36	185.45	1.22
T ₁₅	12.76	17.36	4.34	184.36	1.15
T ₁₆	12.87	17.55	4.39	186.90	1.26
S.Ed	2.52	0.27	0.005	2.532	0.026
CD (P=0.05)	NS	0.58	0.009	5.172	0.053

m plot size with two replications. The plant growth regulators namely Brassinolide (BR), Chloromequat chloride (cycocel), Mepiquat chloride (MC) and chemicals such as Nitrophenol (NP) and Salicylic acid (SA) were sprayed at different MAP. The treatment included T₁: control, T₂: MC 500ppm at 4th MAP, T₃: MC 500ppm at 6th MAP, T₄: MC 500ppm at 4th & 6th MAP, T₅: CCC 1000ppm at 4th MAP, T₆: CCC 1000ppm at 6th MAP, T₇: CCC 1000ppm at 4th & 6th MAP, T₈: BR 0.2ppm at 4th MAP, T₉: BR 0.2ppm at 6th MAP, T₁₀: BR 0.2ppm at 4th & 6th MAP, T₁₁: NP 100 ppm at 4th MAP, T₁₂: NP 100 ppm at 6th MAP, T₁₃: NP 100ppm at 4th & 6th MAP, T₁₄: SA 100ppm at 4th MAP, T₁₅: SA 100ppm at 6th MAP, T₁₆: SA 100ppm at 4th & 6th MAP. Respective foliar spray treatments were given in the early morning hours before 8 AM. Teepol was added to the spray fluid as surfactant @ 1.5ml l⁻¹ for effective

absorption of chemicals. First spray was given during 4th MAP and second spray during 6th MAP. Control plants were sprayed with deionized water alone.

Growth characteristics viz., pseudostem height, pseudostem girth, number of leaves, root volume, leaf area and leaf area index (LAI) were recorded at 3rd MAP, 5th MAP, 7th MAP and at harvest stage. The pseudostem height was measured from the base of the trunk to the axil of the youngest leaf where, the pseudostem girth at different stages at 30cm height from the ground level. Number of leaves and number of roots were counted and root volume was measured by water displacement method. Total leaf area was estimated nondestructively by multiplying the product of length and breadth of all leaves by the factor 0.8 (Murray, 1960). LAI was assessed using

Fig.1. Effect of plant growth regulators and chemicals on pseudostem height (cm) at shooting stages of banana cv. Grand Nain

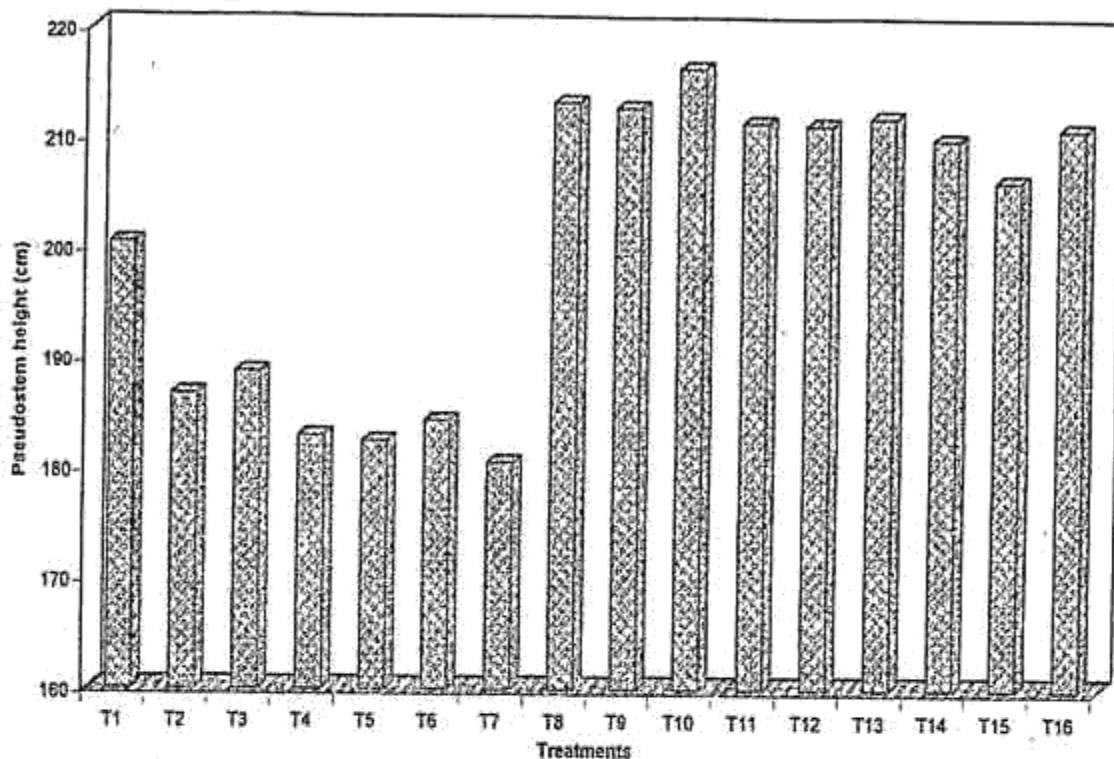


Fig.2. Effect of plant growth regulators and chemicals on pseudostem girth (cm) at shooting stages of banana cv. Grand Nain

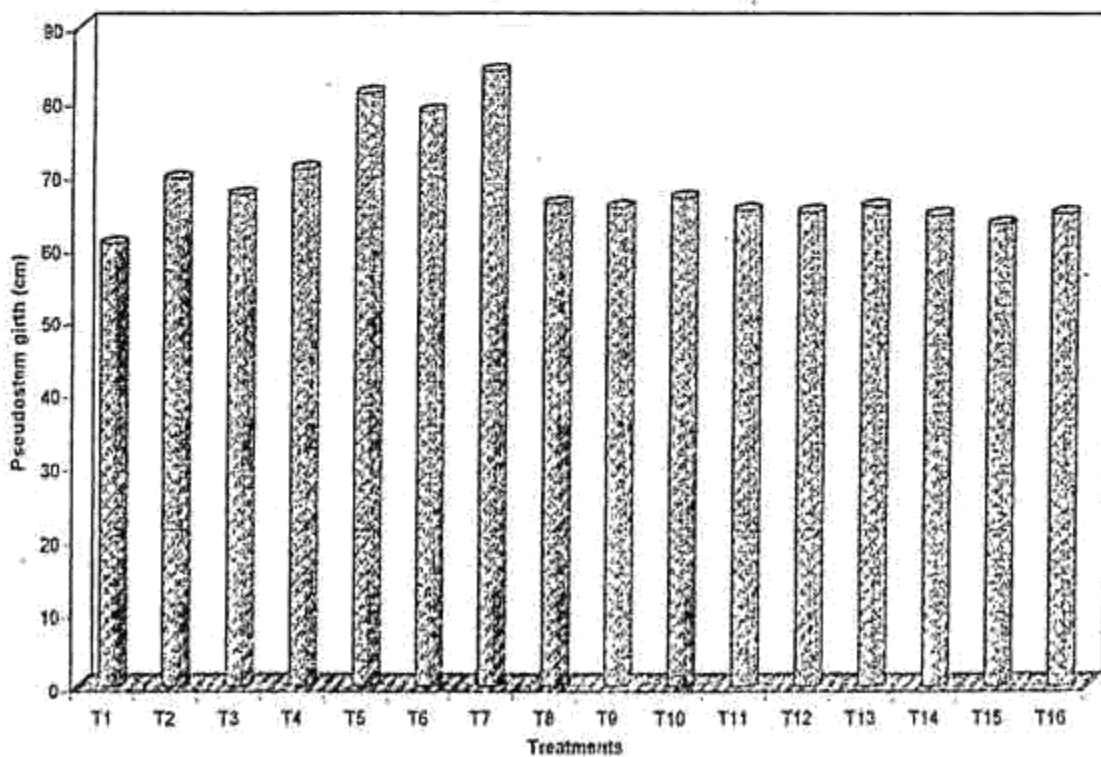
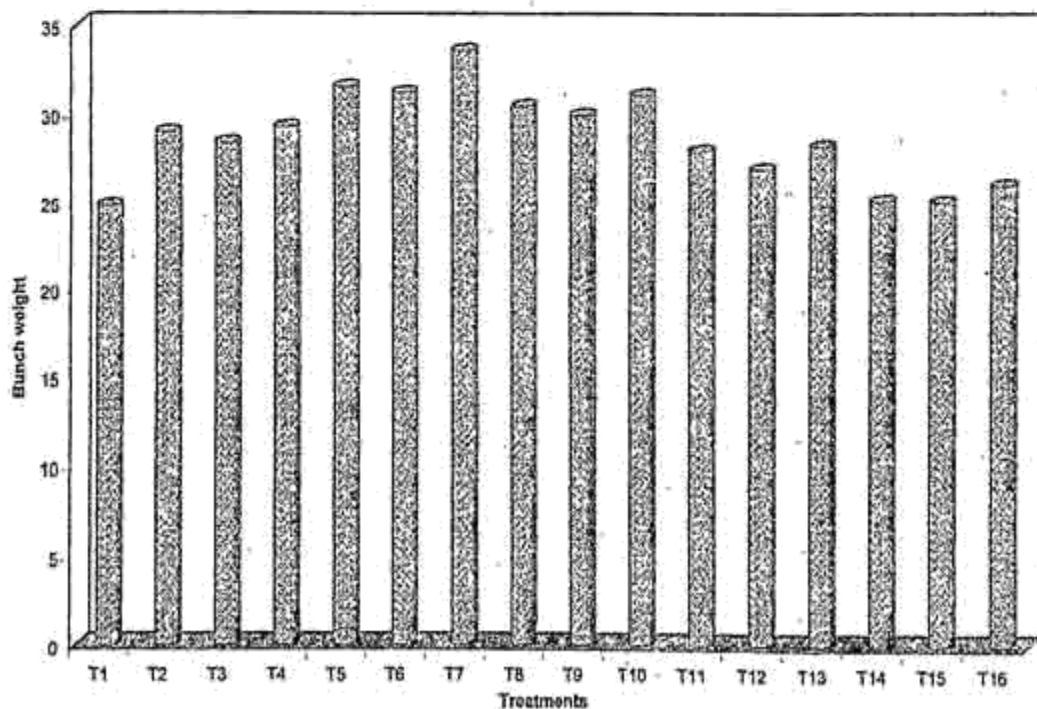


Table. 2. Effect of plant growth regulators and chemicals on bunch characters and fruit quality traits of banana cv. Grand Nain.

Treatments	Number of hands (bunch-1)	Number of fruits (bunch-1)	TSS (%)	Ascorbic acid content (mg 100g-1)	Reducing sugar (%)	Total sugars (%)
T ₁	9.01	160.00	20.00	12.04	13.84	15.20
T ₂	10.14	171.00	21.50	13.62	14.71	16.65
T ₃	10.12	169.30	21.35	13.56	14.65	16.52
T ₄	10.15	179.80	21.55	13.65	14.75	16.84
T ₅	10.60	179.30	23.15	14.21	15.90	17.60
T ₆	10.58	169.00	22.80	14.01	15.22	17.25
T ₇	11.05	180.53	23.60	15.03	16.40	17.98
T ₈	10.55	179.75	22.50	13.90	15.20	16.05
T ₉	10.51	169.30	22.00	13.66	15.03	15.42
T ₁₀	10.55	182.40	22.10	14.00	15.21	16.35
T _n	10.01	171.80	21.26	13.21	14.25	16.25
T ₁₂	10.00	169.50	21.25	12.85	14.22	16.62
T ₁₃	10.05	174.50	21.30	13.54	14.62	16.80
T ₁₄	9.58	176.00	21.05	12.71	14.02	15.25
T ₁₅	9.50	175.05	21.00	12.64	14.01	16.55
T ₁₆	9.85	177.50	21.15	12.75	14.06	16.97
S.Ed	0.10	0.97	0.012	0.010	0.013	0.012
CD (P=0.05)	0.20	1.99	0.025	0.020	0.027	0.025

Fig.3. Effect of plant growth regulators and chemicals on bunch weight of banana cv. Grand Nain



total leaf area and ground area occupied by the plant (William, 1946). Yield parameters comprising number of hands, number of fingers, finger size, and bunch weight were observed. Total soluble solids in fruit was measured by using hand refractometer. Ascorbic acid content was assessed by the method of Freed (1966), while reducing and total sugars by following the procedure of Somogyi (1952). The data were subjected to statistical analysis as per the procedure of Panse and Sukhatme (1961).

Results and Discussion

The plant height showed linear increasing trend from 5th MAP to shooting stages (Fig.1). Foliar application of brassinolide, nitrophenol and salicylic acid recorded the maximum plant height, while cycocel and mepiquat chloride treatments reduced the plant height by 9.0 per cent. The increase in plant height by salicylic acid might be attributed to its synergistic interaction with available endogenous auxin and it could be observed in terms of increased cell wall plasticity and cell elongation as reported in Cheena millet (Datta and Nanda, 1985) and in soybean (Zhao and Lin, 1993). The reduced plant height is due to retardation of transverse cell division particularly in stellar cambium, which is the zone of meristematic activity at the base of the internode.

Plants with more girth are desirable as they reflect on bunch size and other related characters. Besides, they give better anchorage for the plant (Krishnan and Shanmugavelu, 1979). Relatively increased pseudostem girth was observed in cycocel 1000 ppm at 4th and 6th MAP followed by cycocel 1000 ppm at 4th MAP (Fig.2). Caldes and Garcia (1973) reported that Girth of the pseudostem was positively correlated with bunch weight and number of hands per bunch. In banana cv. Karpuravalli, increased pseudostem girth was observed due to the increased cell wall plasticity owing to stimulatory action of

the auxin present in cytozyme (Tagawa and Bonner, 1967). Among the treatments, as per take not suggested sprayed plants were able to produce more number of leaves (Table. 1). Growth retardants are in general capable of reducing the stature of the plant and the photoassimilates accumulated in the stem might have been diverted to the development of more number of leaves. This is in conformity with the results obtained in okra (Arora *et al.* 1990). Higher leaf area in BR treated plants could be due to delay in leaf senescence or abscission (Iwahari *et al.* 1990) which may again be a manifestation of increased chlorophyll content (Shen *et al.*, 1990). The increase in leaf area in brassinolide sprayed plants might be due to its positive effect on cell division and cell elongation and there by enhanced leaf expansion as reported by Sairam (1994). The higher LAI was recorded in brassinolide treated plant (Table. 1). LAI and canopy structure influence photosynthetic etc, which in turn is related to dry matter production and hence crop yield. One of the principle factors influencing the canopy net photosynthesis reported trait LAI is me of the Hansen, (1972). Brassinolide promote leaf area in crop plants accompanied by the increased leaf area and the enhancement of LAI by brassinolide has been reported by Panchal (1991) in groundnut. Root characters such as number of healthy roots and root volume were recorded high in the cycocel and brassinolide treated plants at harvest stages (Table. 1). Generally, tissue cultured bananas are able to produce more roots in the presence of adequate growth regulators resulting in better morphological and other economic traits. Zhao Rui *et al.* (2000) reported that cycocel 25 mg litre promoted root activity in tomato. Application of mepiquat chloride increased root growth in cotton (Urwillar and Oosterhuis, 1986), and tomato (Zhukova *et al.* 1987).

Application of cycocel 1000 ppm on 4th and 6th MAP (T₇) registered more bunch

weight as well as total yield followed by BR (Fig.3). The increase in yield could be attributed to the change in morphological traits such as reduced pseudostem height, increased pseudostem girth, and more number of functional leaves. This is in confirmation with the findings of Shakila (2000) in banana cv. Robusta. The significant increase in number of hands per bunch and number of fingers per bunch were due to rapid differentiation of the meristem into various primordial structures which determine the bunch size (Table.2). The increased bunch weight due to increase in number of hands, number of fingers and finger weight have been reported by Badgujar *et al.* (1999) and Shakila (2000) in banana cv. Robusta. Cycocel at 750 ppm produced the highest seed yield in sponge gourd due to high number of female flowers and fruits and low sex ratio (Patil *et al.* 2001). Application of cycocel 500 ppm significantly increased the yield by 90 per cent without affecting berry size in red raspberries cv. Autumn Bliss (Ghora *et al.*, 1998). Foliar spray of cycocel 1000 ppm at 4th and 6th MAP resulted in higher TSS, ascorbic acid content, reducing sugar and total sugar (Table.2)

Conclusion

A close analysis of the present investigation revealed that foliar application of plant growth regulators and chemicals were able to increase the growth and yield of banana cv. Grand Main. Among the treatments foliar spray for cycocel 1000 ppm at 4th and 6th MAP was found to be more effective in increasing yield.

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