

Effect of different nitrogen levels and plant growth regulators on Total chlorophyll content and chlorophyll stability index of banana cv. Ney Poovan

Abstract

The present study highlights the Effect of different nitrogen levels and plant growth regulators on Total chlorophyll content and chlorophyll stability index of banana cv. Ney Poovan. 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. A field experiment in banana cv. Ney Poovan was conducted with various levels of nitrogen and plant growth regulators at Orchard, Tamil Nadu Agricultural University, Coimbatore. Both chlorophyll a and b, and total chlorophyll were increased with the increased levels of nitrogen, and the effect of foliar spray of urea had pronounced influence. High nitrogen level appeared to have more impact on chlorophyll b than on chlorophyll a.

Keywords: plant growth regulators, chlorophyll a, chemical manipulation, physiological efficiency

Introduction

Banana is one of the important fruit crops of tropical and subtropical countries. 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). At harvest, banana retains a part of the assimilates and nutrients in pseudostem and leaves and so, the crop is relatively less efficient in translocation of assimilation to sink. (Simmonds, 1966). To overcome this malady, use of a suitable growth regulator may be advantageous.

Materials and methods

A field experiment in banana cv. Ney Poovan was conducted with various levels of nitrogen and plant growth regulators at Orchard, Tamil Nadu Agricultural University, Coimbatore. The

experiment was conducted in split plot design with three replications. In the main plot treatment the levels of nitrogen are as follows, M₁ (Control): 150 g plant⁻¹ (45g + 75g +30g N plant⁻¹ at 3,5 and 7 MAP, respectively), M₂: M₁ + Urea 2% foliar spray, M₃: 200 g N plant⁻¹ (60g + 100g + 40g N plant⁻¹ at 3,5 and 7 MAP respectively), M₄: M₃ + Urea 2% foliar spary. In sub plot different plant growth regulators were sprayed viz., S₁: Control (water spray), S₂: Mepiquat chloride (MC) 500 ppm, S₃: Chlormequat chloride (CCC) 100 ppm, S₄: Ethrel 500 ppm, S₅: Salicylic acid (SA) 100 ppm, S₆: Nitrobenzene 100 ppm, S₇: Benzyl adenine (BA) 20 ppm, S₈: 2,4- Dichlorophenoxy acetic acid (2, 4-D) 25 ppm. 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 I-1 for effective absorption of chemicals. Foliar spray of urea in main plots and foliar spray of bioregulators in subplots were imposed at third, fifth and seventh months after planting separately.

Physiological parameters such as, total chlorophyll content, chlorophyll stability index (CSI), chlorophyll fluorescence and soluble protein content were recorded. The content of chlorophyll *a*, *b* and total chlorophyll were estimated by adopting the procedure of Yoshida et al. (1972) and the contents were expressed as mg g⁻¹ of fresh weight. CSI was assessed following the method of Murty and Majumder (1962) and expressed as percentage. The fluorescence measurement was done by using Plant Efficiency Analyzer (PEA) (Hansatech, UK), that uses a fast analyzing system capable of recording in 10 s was used to assess the chlorophyll fluorescence. Soluble protein content of leaf was estimated by following the procedure of Lowry *et al.* (1951), by using folin ciocalteau reagent and expressed in mg g⁻¹ of fresh weight.

Result and discussion

a. Effect of different nitrogen levels and plant growth regulators on chlorophyll content

Both **chlorophyll a** and **b**, and **total chlorophyll** were increased with the increased levels of nitrogen, and the effect of foliar spray of urea had pronounced influence. High nitrogen level appeared to have more impact on chlorophyll b than on chlorophyll a. Being a constituent of chlorophyll, increased nitrogen supply might have accelerated the synthesis of more chlorophyll pigments (Kohli *et al.*, 1984). Mahadevan (1988) also observed higher chlorophyll content in cv. Nendren with foliar application of urea. Among the growth regulators, salicylic acid and benzyl adenine were more efficient in increasing the contents of chlorophyll a and b. The effects of these treatments were obviously high on chlorophyll a. Increase in chlorophyll content by salicylic acid spray was reported by many early workers in different crops (Setia *et al.*, 1995; Kalpana, 1997;

Sivakumar, 2000). The reason adduced for enhanced chlorophyll biosynthesis by phenolic substances was that the phenolics inhibited chlorophyllase enzyme which led to higher accumulation of chlorophyll (Paricha *et al.*, 1977). Duguma et al. (2014) claimed that banana fruits treated with GA3 delay the change of green skin color due to the retarding effect of the hormone on the synthesis of ethylene and, hence, reduced the respiration rate of the fruits in concentration dependent manner. Retardation in skin color development in Berangan banana could possibly be associated with the activities of ACS and ACO enzymes that are closely related to the production of ethylene (Wan Zaliha et al. 2014). (Table 1a and 1b).

b. Effect of different nitrogen levels and plant growth regulators on chlorophyll stability index

Chlorophyll stability index has been considered as an useful parameter for resisting the degradation of chlorophyll pigments under different stresses (Koleyoreas, 1958; Murty and Majumder, 1962; Sanandachary, 1978). Compared to the effects of growth regulating chemicals, nitrogen levels had low response on chlorophyll stability index. Salicylic acid appeared to effect greater stability to chlorophyll pigments than others, which recorded 21.6 per cent increased chlorophyll stability over untreated plant. (Table 2a and 2b)

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Table 1a. Effect of different levels of nitrogen and plant growth regulators on total chlorophyll (mg g⁻¹) content at different growth stages of banana cv.Ney Poovan (Main effect).

Treatments	3 MAP		5 MAP		7 MAP		Harvest		Mean
Main Plot									
M₁	1.04	(0.0)	1.27	(0.0)	1.37	(0.0)	1.25	(0.0)	1.23
M₂	1.06	(1.9)	1.35	(6.3)	1.36	(-0.7)	1.27	(1.6)	1.26
M₃	1.10	(5.8)	1.37	(7.9)	1.42	(3.6)	1.29	(3.2)	1.30
M₄	1.12	(7.7)	1.38	(8.7)	1.48	(8.1)	1.31	(4.8)	1.32
Mean	1.08		1.34		1.41		1.28		1.28
CD (p=0.05)	NS		0.007		0.008		0.005		
Sub Plot									
S₁	0.98	(0.0)	1.25	(0.0)	1.41	(0.0)	1.21	(0.0)	1.21
S₂	1.10	(12.2)	1.31	(4.8)	1.37	(-2.8)	1.30	(7.4)	1.27
S₃	1.08	(10.2)	1.32	(5.6)	1.37	(-2.8)	1.31	(8.3)	1.27
S₄	1.05	(7.1)	1.35	(8.0)	1.37	(-2.8)	1.23	(1.7)	1.25
S₅	1.18	(20.4)	1.45	(16.0)	1.48	(5.0)	1.36	(12.4)	1.37
S₆	1.04	(6.1)	1.32	(5.6)	1.38	(-2.1)	1.24	(2.5)	1.24
S₇	1.17	(19.4)	1.43	(14.4)	1.44	(2.1)	1.35	(11.6)	1.35
S₈	1.07	(9.2)	1.33	(6.4)	1.14	(-19.1)	1.26	(4.1)	1.20
Mean	1.08		1.34		1.38		1.28		1.27
CD (p=0.05)	0.009		0.011		0.012		0.011		

[Values in parentheses are per cent changes over respective control (M₁ and S₁)]

Table 1b. Effect of different levels of nitrogen and plant growth regulators on total chlorophyll content (mg g^{-1}) at different growth stages of banana cv.Ney Poovan (Interaction effect)

Treatments	3 MAP	5 MAP	7 MAP	Harvest	Mean
Interaction effect					
M ₁ S ₁	0.94	1.21	1.35	1.20	1.18
M ₁ S ₂	1.06	1.26	1.32	1.26	1.22
M ₁ S ₃	1.03	1.23	1.34	1.28	1.22
M ₁ S ₄	1.02	1.26	1.30	1.21	1.20
M ₁ S ₅	1.15	1.36	1.42	1.32	1.31
M ₁ S ₆	0.96	1.27	1.36	1.21	1.20
M ₁ S ₇	1.12	1.37	1.43	1.31	1.31
M ₁ S ₈	1.05	1.23	1.41	1.22	1.23
M ₂ S ₁	0.98	1.22	1.37	1.21	1.20
M ₂ S ₂	1.08	1.31	1.31	1.29	1.25
M ₂ S ₃	1.05	1.37	1.34	1.31	1.27
M ₂ S ₄	1.03	1.34	1.33	1.21	1.23
M ₂ S ₅	1.17	1.45	1.46	1.34	1.36
M ₂ S ₆	0.98	1.34	1.36	1.22	1.23
M ₂ S ₇	1.16	1.46	1.46	1.33	1.35
M ₂ S ₈	1.06	1.33	1.32	1.22	1.23
M ₃ S ₁	0.99	1.28	1.42	1.21	1.23
M ₃ S ₂	1.11	1.34	1.39	1.31	1.29
M ₃ S ₃	1.10	1.31	1.38	1.32	1.28
M ₃ S ₄	1.07	1.39	1.39	1.24	1.27
M ₃ S ₅	1.20	1.53	1.49	1.39	1.40
M ₃ S ₆	1.10	1.32	1.41	1.23	1.27
M ₃ S ₇	1.19	1.47	1.50	1.36	1.38
M ₃ S ₈	1.08	1.31	1.42	1.28	1.27
M ₄ S ₁	1.00	1.28	1.51	1.22	1.25
M ₄ S ₂	1.15	1.34	1.46	1.32	1.32
M ₄ S ₃	1.14	1.37	1.42	1.32	1.31
M ₄ S ₄	1.09	1.39	1.45	1.27	1.30
M ₄ S ₅	1.20	1.47	1.55	1.40	1.40
M ₄ S ₆	1.12	1.36	1.41	1.29	1.30
M ₄ S ₇	1.20	1.41	1.53	1.39	1.38
M ₄ S ₈	1.09	1.37	1.50	1.30	1.31
Mean	1.08	1.34	1.41	1.28	1.28
CD (p=0.05)					
M at S	0.188	0.023	0.024	0.022	
S at M	0.195	0.023	0.023	0.022	

[Values in parentheses are per cent changes over respective control (M₁ and S₁)]

Table 2a. Effect of different levels of nitrogen and plant growth regulators on chlorophyll stability index at different growth stages of banana cv.Ney Poovan (Main effect).

Treatments	3 MAP		5 MAP		7 MAP		Harvest		Mean
Main Plot									
M ₁	61.99	(0.0)	68.55	(0.0)	79.74	(0.0)	64.42	(0.0)	68.67
M ₂	62.24	(0.4)	69.04	(0.7)	80.02	(0.4)	64.42	(0.0)	68.93
M ₃	62.15	(0.3)	69.27	(1.1)	80.61	(1.1)	64.63	(0.3)	69.16
M ₄	62.48	(0.8)	69.71	(1.7)	80.73	(1.2)	64.73	(0.5)	69.41
Mean	62.22		69.14		80.27		64.55		69.05
CD (p=0.05)	NS		0.550		0.640		0.340		
Sub Plot									
S ₁	60.93	(0.0)	67.34	(0.0)	69.06	(0.0)	60.03	(0.0)	64.34
S ₂	44.54	(5.9)	69.36	(3.0)	81.66	(18.2)	65.20	(8.6)	65.04
S ₃	62.45	(2.5)	69.03	(2.5)	81.54	(18.1)	65.16	(8.5)	69.55
S ₄	61.72	(1.3)	68.41	(1.6)	79.60	(15.3)	64.74	(7.8)	68.62
S ₅	63.63	(4.4)	71.04	(5.5)	83.95	(21.6)	67.14	(11.8)	71.15
S ₆	62.21	(2.1)	68.06	(1.1)	79.55	(15.2)	65.07	(8.4)	68.72
S ₇	63.30	(3.9)	70.83	(5.2)	83.64	(21.1)	66.85	(11.4)	71.44
S ₈	61.63	(1.1)	71.00	(5.4)	82.95	(20.1)	61.61	(2.6)	69.56
Mean	60.20		69.43		80.58		64.55		68.89
CD (p=0.05)	0.520		0.600		0.710		0.560		

[Values in parentheses are per cent changes over respective control (M₁ and S₁)]

Table 2b. Effect of different levels of nitrogen and plant growth regulators on chlorophyll stability index at different growth stages of banana cv. Ney Poovan (Interaction effect).

Treatments	3 MAP	5 MAP	7 MAP	Harvest	Mean
Interaction effect					
M ₁ S ₁	60.70	67.21	68.65	59.75	64.08
M ₁ S ₂	62.66	68.52	81.40	65.12	69.43
M ₁ S ₃	62.15	68.12	81.44	65.02	69.18
M ₁ S ₄	61.21	68.06	79.16	64.56	68.25
M ₁ S ₅	63.02	69.91	83.15	66.78	70.68
M ₁ S ₆	62.13	68.00	79.16	65.00	68.57
M ₁ S ₇	63.15	69.46	83.20	66.92	70.72
M ₁ S ₈	61.27	68.10	80.01	61.68	67.77
M ₂ S ₁	61.01	67.98	68.20	59.97	64.29
M ₂ S ₂	62.72	69.24	81.46	65.24	69.67
M ₂ S ₃	62.66	69.13	81.25	65.21	69.56
M ₂ S ₄	61.82	68.01	79.24	64.72	68.45
M ₂ S ₅	63.11	69.85	83.20	66.83	71.06
M ₂ S ₆	62.23	68.20	79.95	65.07	68.86
M ₂ S ₇	63.64	70.43	83.48	67.15	70.89
M ₂ S ₈	61.42	68.98	81.12	61.46	68.21
M ₃ S ₁	60.98	67.00	69.65	60.15	64.45
M ₃ S ₂	62.58	69.46	82.00	65.36	69.85
M ₃ S ₃	62.47	69.15	81.58	65.32	69.63
M ₃ S ₄	61.75	68.72	79.58	64.68	68.68
M ₃ S ₅	63.22	72.10	84.10	66.94	71.98
M ₃ S ₆	62.12	68.12	79.75	65.13	68.78
M ₃ S ₇	63.75	71.21	84.70	67.25	71.34
M ₃ S ₈	61.33	68.31	81.58	61.75	68.24
M ₄ S ₁	61.11	67.26	69.86	60.23	64.62
M ₄ S ₂	63.00	70.58	82.21	65.47	70.32
M ₄ S ₃	62.88	70.15	82.40	65.41	70.21
M ₄ S ₄	62.07	68.81	80.40	64.92	69.05
M ₄ S ₅	64.07	73.12	84.40	67.45	72.58
M ₄ S ₆	62.89	68.51	80.05	65.19	69.16
M ₄ S ₇	64.56	72.14	85.15	67.11	71.93
M ₄ S ₈	62.58	68.64	82.32	61.88	68.86
Mean	62.34	69.28	80.44	64.61	69.17
CD (p=0.05)					
M at S	1.090	1.260	1.470	1.111	
S at M	1.051	1.212	1.411	1.123	

[Values in parentheses are per cent changes over respective control (M₁ and S₁)]