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Shweta Hiremath

Department of Fruit Science,
Kittur Rani Channamma College of
Horticulture Arabhavi, Belagavi,
Karnataka, India

Nanditha GC

AICRP on Fruits, Kittur Rani
Channamma College of
Horticulture Arabhavi, Belagavi,
Karnataka, India

Kashinath Patil

Department of Fruit Science,
Kittur Rani Channamma College of
Horticulture Arabhavi, Belagavi,
Karnataka, India

Yegireddy Ashok

Department of Floriculture,
Medicinal and Aromatic Plants,
Faculty of Horticulture, Uttar
Banga Krishi Viswavidyalaya,
West Bengal, India

Jyoti Uppar

Department of PSMA, Kittur Rani
Channamma College of
Horticulture Arabhavi, Belagavi,
Karnataka, India

Corresponding Author:

Shweta Hiremath

Department of Fruit Science,
Kittur Rani Channamma College of
Horticulture Arabhavi, Belagavi,
Karnataka, India

Optimizing growth of Ratoon II Banana (*Musa* spp. cv. Grand Naine) using diatomaceous earth

Shweta Hiremath, Nanditha GC, Kashinath Patil, Yegireddy Ashok and Jyoti Uppar

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Abstract

A field investigation was carried out during 2015-16 (June-November) to assess the influence of diatomaceous earth (DE) on the growth and physiological attributes of Ratoon II banana (*Musa* spp. cv. Grand Naine). The findings indicated significant differences among treatments, with integrated application of RDF and DE performing better than their individual use. The treatment RDF + DE @ 750 kg ha⁻¹ exhibited maximum pseudostem height and girth, number of functional leaves and leaf area, demonstrating enhanced vegetative growth. Likewise, higher chlorophyll a and chlorophyll b content were observed under this treatment, suggesting improved photosynthetic activity. These improvements could be associated with enhanced nutrient availability, improved soil conditions, and the role of silicon from DE in facilitating nutrient absorption and stress resistance. In comparison, the application of DE alone resulted in relatively lower values, emphasizing the importance of combining it with fertilizers. Overall, the study highlights that the integration of DE with RDF, particularly at higher application rates, is an effective strategy to improve growth and physiological performance of Ratoon II banana under field conditions.

Keywords: Banana, grand naine, diatomaceous earth, silicon

Introduction

Banana (*Musa* spp.) is one of the most important fruit crops cultivated in India, ranging from tropical to subtropical climates and serving as a major source of income to the farmers. Among the different cultivars, Grand Naine (AAA group) is commercially grown due to its high yield potentiality, uniform fruit quality and adaptability to diverse agroclimatic conditions (Mahmoud, 2013) [2]. In Banana cultivation, ratooning- the practice of allowing subsequent crops from the suckers of previous plants, in order to enhance productivity with cost effectiveness. In general, the first ratoon performs comparative to plant crop, while, the second ratoon shows declined performance due to nutrient depletion, soil fatigue and reduced physiological efficacy of the mother corm (Naik *et al.*, 2016) [5]. Therefore, improving the growth performance of Ratoon-II is necessary for sustained production with economic viability.

In recent years, the use of soil amendments has been significantly increased to enhance the soil fertility, nutrient use efficiency thereby the plant growth. Diatomaceous earth (DE), a naturally occurring siliceous sedimentary material composed of amorphous silica derived from fossilized diatoms, has emerged as a promising input in sustainable agriculture (Reka *et al.*, 2021) [7]. It has physicochemical properties like – high porosity, larger surface area and silica content, that enables the soil aeration, water retention and nutrient availability. Moreover, silicon, though not classified as an essential nutrient, but known to enhance structural strength, improved photosynthetic efficiency and tolerance to biotic and abiotic stresses (Gokavi *et al.*, 2021) [1]. In many of the horticultural crops, silicon supplementation has been reported to influence the growth. Hence, the application of diatomaceous earth may play a vital role in mitigations associated with ratoon cropping by enhancing the root activity, nutrient uptake and improved physiological efficiency.

Despite its benefits in the other crops, limited information is available on the application of diatomaceous earth in banana, particularly in the context of ratoon crop management. This study aims to evaluate the role of diatomaceous earth along with different levels of Recommended Dose of Fertilizers (RDF) in optimizing growth parameters of Ratoon II banana, with a focus on improving plant vigour and sustaining productivity under ratoon cropping systems.

Materials and Methods

The study was conducted during 2015-16 (June-November) at the Farm of Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak taluka, Belagavi district, Karnataka. The experiment was laid in Randomized Block Design (RBD) with ten treatments (T₁– Absolute control, T₂– Recommended dose of fertilizers, T₃ – Half of recommended fertilizers, T₄ – Diatomaceous Earth (DE) alone (500 kg/ha), T₅ – Half of RDF + 250 kg/ha DE, T₆ – Half of RDF + 500 kg/ha DE, T₇ – Half of RDF + 750 kg/ha DE, T₈– RDF + 250 kg/ha DE, T₉ – RDF + 500 kg/ha DE, T₁₀ – RDF + 750 kg/ha DE), replicated thrice with 48 plants per treatment, having spacing of 1.8 m × 1.8 m. The RDF followed was 400:200:400 g NPK plant⁻¹ year⁻¹ according to Maneesha *et al.*, (2025) [3].

Results and Discussion

Application of Diatomaceous earth along with RDF had significantly influenced the growth of Ratoon II of Banana cv. Grand Naine. Among the different treatments, RDF + DE @ 750

kg/ha had greatly influenced the growth of Ratoon crop II and the poor performance was observed in control plants. The treatments, Half of RDF+ DE @ 750 kg/ha, RDF+ DE @ 250 kg/ha and RDF+ DE @ 500 kg/ha showed at par performance, but the best was noticed in RDF + DE @ 750 kg/ha. The highest pseudostem height (198.22 cm) was recorded in RDF + DE @ 750 kg ha⁻¹, which was significantly superior to the control (164.28 cm). Pseudostem diameter also followed a similar trend, with T₁₀ recording the maximum value (15.05 cm), followed by T₉ (14.25 cm) and T₂ (14.19 cm), all significantly higher than the control (12.36 cm). The number of functional leaves per plant was highest in T₁₀ (15.00), followed by T₉ (14.78) and T₂ (14.67). Leaf area showed a marked increase with integrated nutrient treatments, with the highest value observed in T₁₀ (12.24 m²), followed by T₉ (11.41 m²) and T₈ (11.05 m²). Among physiological parameters, chlorophyll *a* and chlorophyll *b* content was maximum in T₁₀ (1.60 mg g⁻¹ and 0.73 mg g⁻¹ respectively) and the least was observed in control plants (0.78 mg g⁻¹ and 0.26 mg g⁻¹ respectively).

Table 1: Influence of Diatomaceous Earth and RDF on growth parameters

Treatments	Pseudostem height (cm)	Pseudostem diameter (cm)	Number of functional leaves per plant	Leaf area (m ²)	Chlorophyll a	Chlorophyll b
T ₁ – Absolute control	164.28	12.36	12.93	07.56	0.78	0.26
T ₂ – Recommended dose of fertilizers	189.22	14.19	14.67	10.93	1.40	0.38
T ₃ – Half of RDF	184.50	13.94	13.00	10.13	1.18	0.32
T ₄ – DE alone	146.50	11.48	11.55	05.72	0.79	0.26
T ₅ – Half of RDF+DE @ 250 kg/ha	184.06	13.84	13.42	10.07	1.27	0.34
T ₆ – Half of RDF+ DE @ 500 kg/ha	176.11	13.82	13.25	09.50	1.30	0.36
T ₇ – Half of RDF+ DE @ 750 kg/ha	179.72	13.68	13.83	08.51	1.44	0.39
T ₈ – RDF+ DE @ 250 kg/ha	187.00	13.84	14.33	11.05	1.54	0.57
T ₉ – RDF+ DE @ 500 kg/ha	185.50	14.25	14.78	11.41	1.59	0.72
T ₁₀ – RDF+ DE @ 750 kg/ha	198.22	15.05	15.00	12.24	1.60	0.73
S.Em±	05.88	0.43	0.34	0.65	0.04	0.02
C.D at 5%	17.46	1.27	1.00	1.94	0.11	0.06

The superiority of RDF + DE @ 750 kg ha⁻¹ on growth may be attributed to synergistic effect of balanced nutrient supply and soil conditioning effects of diatomaceous earth (Silva *et al.*, 2020) [8]. The height and diameter of the pseudostem might be increased due to enhanced cell division, elongation and assimilate accumulation, which could be due to improved nutrient availability and uptake (Mills-Ibibofori *et al.*, 2019) [4]. The silicon in DE likely contributed to strengthening cell walls and improving plants integrity with increased plant vigour. The increment in the functional leaves and other leaf related parameters might be due to improved photosynthetic capacity and delayed leaf senescence. Silicon is known to enhance water-use efficiency and reduce transpiration losses, which may have contributed to better leaf retention and expansion (Tavares *et al.*, 2016) [9]. The enhanced chlorophyll *a* and *b* contents in treatments receiving RDF along with DE further support the improvement in photosynthetic efficiency. This could be due to the role of silicon in stabilizing chloroplast membranes, reducing oxidative stress and enhancing nitrogen metabolism, which is directly associated with chlorophyll synthesis (Oliveira *et al.*, 2023) [6]. The comparatively lower performance of DE alone, highlights that although DE improves soil physical properties such as aeration and moisture retention, it cannot substitute for essential nutrients required for optimal plant growth. However, treatments with half RDF combined with DE (T₅–T₇) showed improvement over half RDF alone (T₃), indicating that DE enhances nutrient use efficiency and partially compensates for reduced fertilizer input. Overall, the findings suggest that the combined application of

RDF and diatomaceous earth, particularly at higher levels, plays a crucial role in improving growth attributes and physiological efficiency of Ratoon II banana. This integrated approach not only enhances plant vigour, but also supports sustainable nutrient management in banana cultivation systems.

Conclusion

The study concludes that the combined application of recommended dose of fertilizers (RDF) with diatomaceous earth (DE) significantly enhances the growth and physiological performance of Ratoon II banana (*Musa* spp. cv. Grand Naine), with RDF + DE @ 750 kg ha⁻¹ emerging as the most effective treatment. This combination resulted in superior pseudostem height, girth, leaf production, leaf area, and chlorophyll content, indicating improved vegetative vigour and photosynthetic efficiency. While DE alone was less effective, its integration with RDF proved beneficial, suggesting its potential as a sustainable soil amendment for optimizing ratoon crop performance and improving nutrient use efficiency in banana cultivation.

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