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Assessing the impact of foliar brassinolide treatments on fruiting parameters of mango (*Mangifera Indica*) cv. Langra

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Abstract

Mango production often faces challenges in achieving optimal fruit yield and quality due to various factors, including pre-harvest fruit drop and limitations in fruit size (Attia & Shehata, 2023) ^[1]. Brassinosteroids, a class of plant hormones, have shown potential in enhancing growth and productivity in several crops, including mango. With this in view, the present study is aimed to investigate the influence of foliar-brassinolide on the physical attributes of mango cv. Langra. Ten treatments consisted of three different levels of brassinolide concentrations, 0.5 ppm, 1.0 ppm and 1.5 ppm applied at two distinct phenological phases: marble stage and 15 days after marble stage and combination both marble and 15 days after marble stage and control. All these, fruit weight, fruit retention, fruit set, yield per tree, and number of fruits per tree, showed a significant effect through brassinolide, while peel thickness, fruit firmness, and fruit volume were significantly affected compared with the control. This was significantly noted as treatment T₆ consisted of 1.0 ppm of brassinolide application at the marble stage + 15 days after the marble stage. It resulted in the best outcome with a stronger increment of 18% to 22% increase in the assessed physical parameters than the control. These findings agree with some previous studies that had already established that exogenous BR application can enhance the fruit-setting rate, size, and firmness in mango (Attia & Shehata, 2023) ^[1]. The strategic application of brassinolide seems to enhance the physical attributes and total yield of mango cv. Langra as supposed by the present study.

Keywords: Brassinolide, mango cv. Langra, fruit quality, foliar application, physical attributes

Introduction

Mango is one of the widely cultivated fruit crops in tropical and subtropical regions with regard to flavor, taste, and nutritional profile (Jangir *et al.*, 2017) ^[5]. The species name of this fruit crop is *Mangifera indica* L. This fruit crop is a member of the family Anacardiaceae. Mango is one of the widely grown fruit crops in the tropical and subtropical regions for its flavor, taste, and nutritional value. Among such varieties, 'Langra' is commercially valuable mainly because of its special characteristic aroma and flavor, along with excellent keeping quality. However, it suffers several challenges with regard to pre-harvest fruit drop, which naturally limits the acquisition of optimal fruit size and quality, and susceptibility to several pests and diseases according to (Gómez-Maldonado *et al.*, 2020) ^[4]. These may raise yield and market value accordingly, hence making mango cultivation challenging for growers.

But to counter such problems, research scientists and horticulturists have always looked for ways of enhancing mango production while at the same time increasing the fruit quality. A promising avenue applied in this area includes the use of plant growth regulators (Patel *et al.*, 2021) ^[8]. PGRs are plant growth regulators, organic compounds which even in low concentrations highly affect physiological processes in plants; thus, there are growth, flowering, fruiting, and stress responses among the different PGRs. The most attention was recently gained by brassinosteroids, which can accelerate lots of crops' yield and quality (Sharma *et al.*, 2021) ^[11].

BRs are natural plant steroidal hormones present in the environment that have enormous physiological roles like cell division and elongation, vascular development, photosynthesis, and biotic and abiotic stress response (Meena *et al.*, 2018) ^[6] (Baghel *et al.*, 2019) ^[2].

Exogenous BR treatment has been correlated with enhanced fruit setting, increased fruit size, and weight, increased fruit firmness, and delayed fruit senescence in mango (Attia & Shehata, 2023)^[1].

The study is designed to determine the possible effect of a commercially available BR, brassinolide, when applied foliarly to the physical parameters of mango cv. Langra. It was attempted to determine the optimal concentration and timing of the application of brassinolide to enhance fruit yield and improvement in the physical attributes of mango fruits.

Materials and Methods

The present study entitled “Assessing the Impact of Foliar Brassinolide Treatments on Fruiting Parameters of Mango cv. Langra” was conducted during 2023-2024 at the Horticulture Garden, Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments, including a control, and three replications. Thirty uniformly aged and healthy mango (cv. Langra) trees were selected. Brassinolide was applied as a foliar spray at three concentrations (0.5, 1.0, and 1.5 ppm) at different phenological stages: (i) marble stage, (ii) marble stage + 15 days after marble stage, and (iii) 15 days after marble stage. Fresh solutions were prepared on the day of application and sprayed during early morning hours. Fully ripe fruits were harvested and transported to the laboratory in muslin cloth bags. Fruits were sorted for uniformity, and damaged or diseased fruits were discarded. Selected fruits were destalked, washed, and used for further analysis. Parameters Recorded. The following physical and yield parameters were evaluated:

- **Fruit weight (g):** Measured using a digital balance
- **Fruit diameter (mm):** Measured at the equatorial axis using a Vernier caliper
- **Peel thickness (mm):** Determined using a Vernier caliper
- **Fruit firmness (kg/cm²):** Measured using a penetrometer
- **Fruit volume (cm³):** Determined by water displacement method
- **Fruit retention (%):** Recorded as the percentage of fruits retained per panicle
- **Fruit set (%):** Calculated as (number of fruits set/total number of flowers) × 100
- **Yield per tree (kg):** Total fruit weight per tree
- **Number of fruits per tree:** Counted at harvest
- **Pulp:stone ratio:** Calculated as pulp weight divided by stone weight
- **Marketable fruit (%):** Calculated as (number of marketable fruits/total fruits) × 100

Statistical Analysis: Data were analyzed using analysis of variance (ANOVA) with WASP 2.0 software. Treatment means were compared using Duncan's Multiple Range Test (DMRT) at a significance level of $p \leq 0.05$.

Results and Discussion

The foliar application of brassinolide at different concentrations and phenological stages significantly influenced the physio-chemical characteristics, yield, and quality of mango (cv. Langra).

Brassinolide application markedly improved fruit weight, with the highest value (297.10 g) recorded in T₆ (1.0 ppm at marble stage + 15 days after marble stage), which was significantly higher than the control (207.67 g). Treatments T₃ and T₅ also showed significant improvements. The increase in fruit weight may be attributed to the role of brassinosteroids in enhancing cell division and elongation, leading to larger fruit size (Sen *et al.*, 2023; Sharma, 2021)^[10, 11].

A similar trend was observed in fruit diameter and volume, where T₆ recorded the maximum values (74.80 mm and 400.43 cm³, respectively), followed by T₅ and T₇. These findings are in agreement with previous reports (Meena, 2023; Patel *et al.*, 2021)^[6, 8], suggesting that brassinolide promotes cell expansion and fruit growth. The combined application at marble stage and 15 days later appears to provide a synergistic effect, resulting in superior fruit development.

Peel thickness decreased with brassinolide treatments, with the thinnest peel observed in T₆ (2.48 mm) compared to the control (3.59 mm). Although thinner peel may reduce mechanical resistance, brassinolide-treated fruits maintained better overall quality, possibly due to improved physiological balance and delayed senescence.

In contrast, fruit firmness increased significantly in all treated plants, with the highest firmness (8.5 kg/cm²) recorded in T₆. Enhanced firmness may be associated with modifications in cell wall structure and carbohydrate metabolism induced by brassinosteroids, contributing to improved shelf life and reduced post-harvest losses. Similar observations have been reported in mango and other fruit crops (Meena, 2023)^[6].

Brassinolide application also significantly improved fruit set and retention. The highest fruit set (70.08%) and retention (85.23%) were observed in T₆, whereas the control recorded the lowest values (61.04% and 74.81%, respectively). This improvement may be due to the role of brassinolide in enhancing hormonal balance, reducing fruit drop, and improving sink strength, thereby increasing fruit retention. Comparable synergistic effects of brassinosteroids have been reported by Attia and Shehata (2023)^[1].

Consequently, yield per tree and number of fruits per tree were significantly higher in treated plants, with T₆ recording the maximum yield (81 kg/tree) and fruit number (306.44), followed by T₅. The increased yield can be attributed to improved fruit set, retention, and individual fruit size, indicating the overall positive impact of brassinolide on productivity.

The pulp:stone ratio, an important quality parameter, was highest in T₆ (9.22) and lowest in the control (7.08). This suggests that brassinolide not only increases fruit size but also enhances the edible portion, thereby improving fruit quality and consumer preference.

Similarly, the percentage of marketable fruits was significantly higher in treated plants, with T₆ (83.92%) and T₅ (83.36%) outperforming the control (71.78%). The improvement in marketability may be due to reduced physiological disorders, better firmness, and enhanced overall fruit quality.

Overall, the results clearly indicate that brassinolide application, particularly at 1.0 ppm applied at marble stage followed by a second application after 15 days (T₆), exerts a synergistic effect on growth, yield, and quality parameters of mango cv. Langra. These findings corroborate earlier

studies (Sharma, 2021; Meena, 2023; Attia & Shehata, 2023) ^[11, 6, 1] and highlight the importance of optimizing both concentration and timing of application for maximum benefit.

Conclusion

The current research assesses the impact of Brassinolide (BR) applied through foliar spray on fruit quality traits of Mango cv. Langra. BR application led to greater, heavier fruits with higher volume and retention, but thinner peel. These findings are consistent with earlier research indicating the growth-regulating effects of BR on mango and other fruits. The thinner peel, though favorable for consumers, enhanced fruit firmness and damage susceptibility. The largest fruit size, volume, and retention occurred with 1.0 ppm BR treatment at the marble stage as well as 15 days after. Yet a compromise between fruit size and other quality factors like firmness and retention was evident as the concentration of BR increased.

BR application at marble stage plus 15 days after gave greater yields and fruit numbers per tree, suggesting that BR not only enhances fruit set but also increases the growth and development of the retained fruits. High levels of BR also improved the pulp-to-stone ratio and marketable fruit percentage, especially with 1.0 ppm at marble stage plus 15 days after. These results imply that BR application strategy optimization could improve yield as well as fruit quality. BR as a mango production management tool needs to be investigated further.

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