



Effect of Foliar Spraying with the Growth Inhibitor Paclobutrazol on the Quality of Chandler Strawberry (*Fragaria ananassa*) under Punjab Subtropics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment conducted during the Rabi season of 2022 aimed to investigate the impact of foliar spray with the growth retardant paclobutrazol at various timings on the strawberry cultivar Chandler (*Fragaria ananassa* Duch). The experimental design employed a Randomized Block

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Design (RBD) with eight treatments, each replicated three times. Paclobutrazol was administered at different intervals, specifically at 110, 115, 120, 125, 130, 135, and 140 days after planting, along with a control group receiving no spray. The results demonstrated a significant influence of Paclobutrazol spray timing on the quality parameters. Among the different treatments with the plant growth retardant, Treatment 4 (PBZ 250 ppm at 125 days after planting) exhibited the highest values for fruit length (31.40 mm), fruit width (25.70 mm), fruit thickness (1.79 mm), fruit weight (12.03 g), Total Soluble Solids (TSS) (9.50°Brix), Firmness (1.92 N) and Titrable Acidity (2.56%) whereas lowest values observed in the control.

Keywords: Growth retardant; paclobutrazol; fragaria ananassa; chandler; fruit quality.

1. INTRODUCTION

Strawberry (*Fragaria ananassa* Duch) is one of the most widely consumed and well-liked berry fruits. It has a pleasant taste, a delicate flavor, and a pleasing appearance, all of which contribute to its popularity. Strawberries, in addition to their delightful and sensory qualities, can be categorized as a functional fruit due to their high concentration of important nutrients and phytochemicals. These elements not only enhance the taste of the fruit, but also play an important role in supporting human health and overall well-being [1]. Strawberry fruit quality as well as customer acceptance is determined by the fruit's size which comprises of length and breadth, with, color development, taste, texture, and flavor. The fruit ingredients responsible for the overall strawberry flavor are sugar, organic acid since their balance defines the fruit's charm and pleasant taste [2]. Strawberry farming is a global agricultural technique that takes place in a variety of climates and places around the world. This tasty and nutritious fruit, famed for its sweet and tangy flavor, grows best in well-drained soil and temperate to cool temperatures. Major strawberry-producing countries include the United States, where states like California play a critical role, and China, where provinces like Shandong produce a substantial amount. Spain, Mexico, Egypt, and South Korea are all significant contributors to the global strawberry market. Strawberry farming necessitates meticulous attention to details such as irrigation, fertilization, and pest control. The fruit is cultivated on fields, but in some areas, new approaches like as high tunnels or greenhouse farming are used to lengthen the growing season. Strawberries are recognized not just for their exquisite taste but also for their nutritious content, making them a sought-after crop in international markets.

Paclobutrazol (triazole derivative), a growth inhibitor, is commonly used to regulate growth

and development by altering associated biochemical and physiological processes. By suppressing gibberellin manufacture at the kaurene stage, it has been successfully used to induce and regulate flowering, fruiting, and plant vigor in numerous fruit crops, resulting in reduced vegetative growth, promising early and copious flowering, and improved quality. When applied before flowering, it promotes strawberry growth, yield, and quality. Its use increases the number of blooms per plant, the number of runners and plantlets per runner, the number of berries set and the berries yielded [3]. Keeping in view the that timing of application of paclobutrazol will effect quality of strawberry, the current study was carried out to investigate the viability of applying Paclobutrazol at various spray timings on the quality of strawberry crops in Punjab subtropics.

2. MATERIALS AND METHODS

The study was conducted outdoors within the premises of the Department of Agriculture's Research Farm at Sant Baba Bhag Singh University in Jalandhar during the 2022-2023 period. Its objective was to investigate the impact of varying the timing of foliar spray with Paclobutrazol on the overall quality of strawberries (*Fragaria ananassa* Duch) of the Chandler cultivar. The location of the site is specified by the coordinates 31.4220 North and 75.8087 East. Raised beds, characterized by a finely cultivated soil texture and devoid of weeds and grasses, were meticulously prepared and covered with black polythene sheeting for mulching. Robust runners of the Chandler cultivar were acquired from the RHRSS research station in Bhaderwah, Jammu and Kashmir and were planted during the fortnight of October with a 45 cm recommended spacing. Across all experimental treatments, a uniform application of the recommended dosage of manures and fertilizers, coupled with consistent practices of irrigation, weeding, and hoeing, was maintained.

The experimental layout followed a randomized block design (RBD) with three replications. Each plot measured 4 x 3 meters.

The treatment groups were as follows: T0 - control (no spray), T1 - PBZ @ 250 ppm 110 days after planting, T2 - PBZ @ 250 ppm 115 days after planting, T3 - PBZ @ 250 ppm 120 days after planting, T4 - PBZ @ 250 ppm 125 days after planting, T5 - PBZ @ 250 ppm 130 days after planting, T6 - PBZ @ 250 ppm 135 days after planting, and T7 - PBZ @ 250 ppm 140 days after planting. Foliar spraying of Paclobutrazol 250 ppm recommended was initiated in early February and continued until the beginning of March. Observations were recorded at harvesting stage on different quality parameters (these are all studied the quality parameters of strawberry crop because the

length, width and thickness decide the physical appearance of the fruit and TSS and Acidity decide the taste and flavour of the fruit) like fruit length (mm), fruit width (mm) and fruit thickness (mm) were calculated with the help of Vernier calipers. Fruit weight (g) was measured by using weighing machine. TSS ($^{\circ}$ Brix) was calculated by using a digital refractometer. AOAC's suggested approach was used to determine the Titrable acidity (%). Firmness (N) was measured with the help of digital penetrometer. According to the statistical process for Agricultural Research, the mean values of the data will be subjected to analysis of variance. Randomized Block Design. Utilising a method and algorithms, various statistical parameters were computed. The mean of the qualities was compared using ANNOVA (Analysis of Variance) [4].



Plate 1. Raising of seed beds



Plate 2. Manuring



Plate 3. Application of fertilizers



Plate 4. Mulching



Plate 5. Plantation



Plate 6. Irrigation



Plate 7. Flowering Stage



Plate 8. Fruiting Stage

3. RESULTS AND DISCUSSION

3.1 Influence of Paclobutrazol on Physical Quality Parameters of strawberry Plant

The data recorded from 2022, shown in Tables 1 and 2 indicate that the time of application of paclobutrazol significantly affected the physical quality parameters viz. fruit length, fruit width, fruit thickness, fruit weight and firmness of the strawberry (*Fragaria ananassa* Duch) cv. Chandler.

It was found that spraying paclobutrazol at varied intervals had a significant influence on fruit length, fruit width, fruit weight and firmness. All these parameters showed an increasing trend from treatment T0 (Control) to treatment T4 (PBZ

250 ppm 125 days after planting. T4 (PBZ 250 ppm 125 days after planting) recorded the maximum fruit length (31.40 mm), fruit width (25.70 mm) and fruit weight (12.03 g) while for treatments T5 to T7 (PBZ 250 ppm application after 130 to 145 days after planting) there was decrease in these parameters whereas T0 (control) yielded the shortest fruit length, fruit width, fruit weight. Data also showed that all treatments where paclobutrazol was applied outperformed better than the control. However fruit thickness and firmness does not have significant effect of spraying paclobutrazol at various intervals although slight increase in thickness and firmness as compared in the control has been recorded. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the thickest fruit (1.79 mm) with highest firmness (1.92 N) while minimum was recorded in T0 (control) yielded the smallest fruit thickness and

firmness. The increase in fruit length and width also have been noted by kumra et al. [5]. The identical values of fruit thickness and fruit weight were also obtained by Al-Raisy et al. [6]. The same results were also observed by Gine bordonaba & Terry [7].

As it is known fact that paclobutrazol stops vegetative growth in plants and promotes reproductive growth, due to vegetative growth retardation photo assimilates are diverted towards reproductive parts resulting in increase in cell growth and meatbolities. Also maximum increase in length, width and weight of the fruit of strawberry at 125 days after planting may be attributed due to the optimum balance between vegetative shoot and reproductive growth at which maximum photassimilates would have been available to the plant for increase in physical parameters.

3.2 Influence of Paclobutrazol on Chemical Quality Parameters of Strawberry Plant

It was found that spraying paclobutrazol at varied intervals had a significant influence on total soluble solids. This parameter showed an

increasing trend from treatment T0 (Control) to treatment T4 (PBZ 250 ppm 125 days after planting). T4 (PBZ 250 ppm 125 days after planting) recorded the maximum tss (9.50 °Brix) while for treatments T5 to T7 (PBZ 250 ppm application after 130 to 145 days after planting) there was decrease in tss whereas T0 (control) yielded the shortest TSS. Data also showed that all treatments where paclobutrazol was applied outperformed better than the control. The same results were also obtained by Abolfazl et al. [8]. Using phenolphthalein as an indicator, ten millilitres of filtered juice was titrated against N\10 NaOH solution. The arrival of the pink colour signalled the finish line. One ml of N\10 NaOH, which is equal to 0.0064 g of anhydrous citric acid, was used to compute the total titrable acidity in terms of citric acid. However titrable acidity does not have significant effect of spraying paclobutrazol at various intervals although slight increase in acidity as compared in the control has been recorded. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the highest level of acidity (2.56%) while minimum was recorded in T0 (Control). There was no discernible impact discovered. The same outcomes were also seen by Gine Bordonaba & Terry [7].

Table 1. Effect of application of growth retardant (paclobutrazol) at different timings on physical quality parameters of strawberry cv. Chandler under Punjab conditions

Treatments	Fruit length (mm)	Fruit width (mm)	Fruit thickness (mm)	Fruit weight (g)	Firmness (N)
T0	17.20	16.10	1.49	7.36	1.62
T1	20.40	19.20	1.55	8.90	1.74
T2	24.50	20.50	1.62	9.50	1.76
T3	27.70	23.90	1.71	10.60	1.79
T4	31.40	25.70	1.79	12.03	1.92
T5	29.30	23.50	1.75	11.20	1.89
T6	29.40	23.20	1.72	10.60	1.84
T7	28.20	22.10	1.69	10.03	1.80
CD (0.5%)	1.56	0.91	N/A	1.05	N/A

Table 2. Effect of application of growth retardant (paclobutrazol) at different timings on chemical quality parameters of strawberry cv. Chandler under punjab conditions

Treatments	TSS (°Brix)	Titrable Acidity (%)
T0	6.60	2.20
T1	7.50	2.39
T2	7.60	2.45
T3	8.00	2.51
T4	9.50	2.56
T5	8.90	2.48
T6	8.83	2.46
T7	8.50	2.44
CD (0.5%)	1.43	N/A

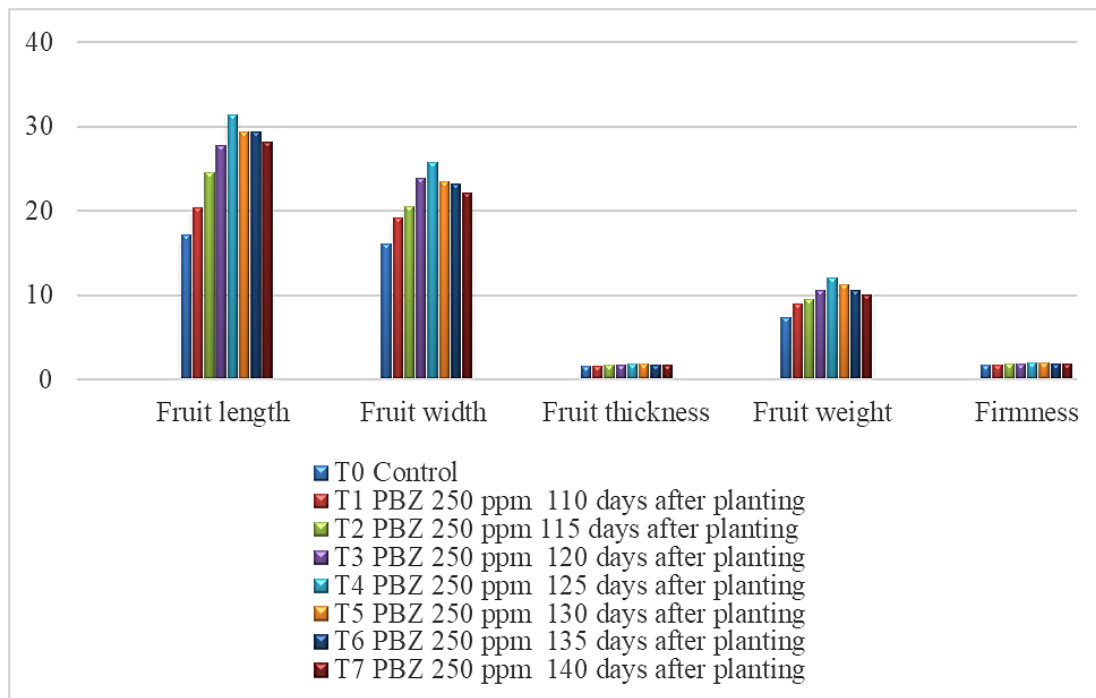


Fig. 1. Fruit length (mm), fruit width (mm), fruit thickness (mm), fruit weight (g) and firmness (N).

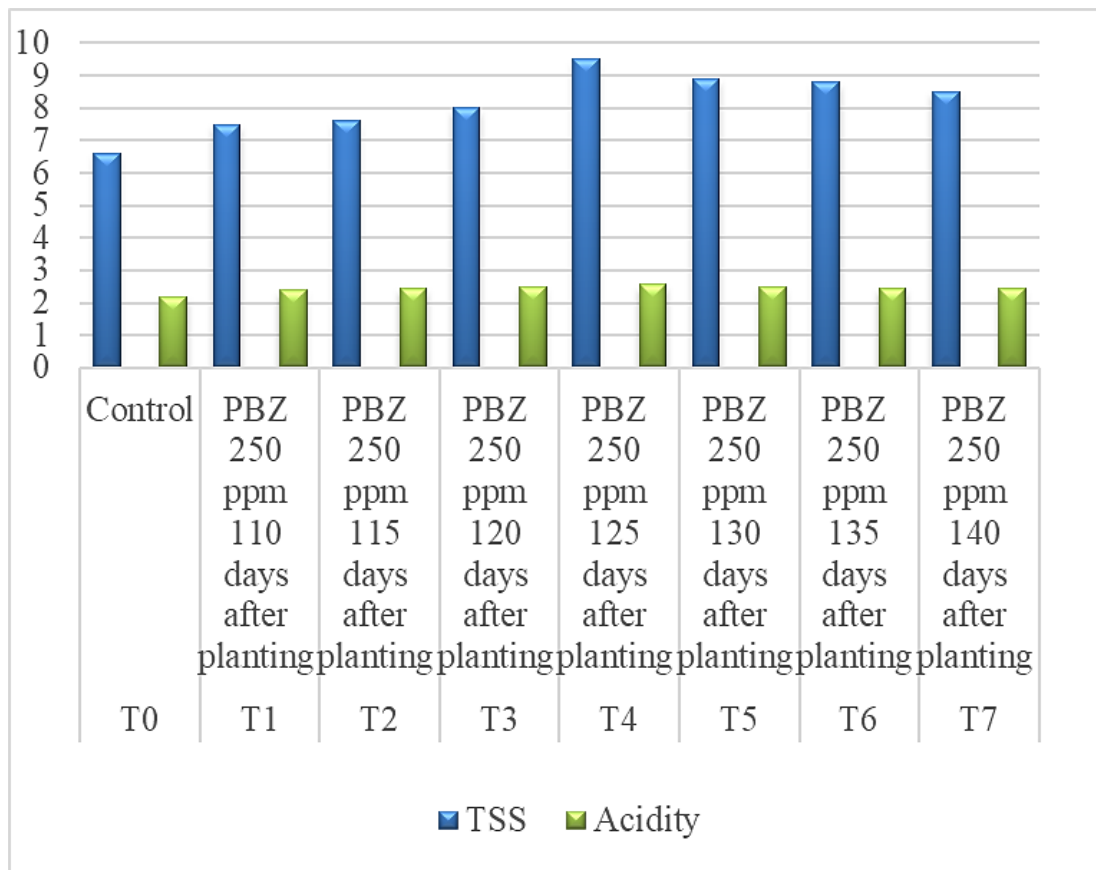


Fig. 2. TSS (% brix) and Titration acidity (%)

4. CONCLUSION

According to the preceding explanation, growth inhibitors have a typical impact on plant architecture in terms of yield and quality contributing characteristics when taken at the appropriate time and dose. So, for the subtropical condition of punjab, farmers are advised that the ideal time to apply the plant growth inhibitor paclobutrazol @ 250 ppm among the various spray timings is 125 days after planting because it produces better fruit quality and high yield, which will further help in improving farmers' profitability.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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