

The impact of applying the growth retardant paclobutrazol at various timings on the quality of the strawberry cultivar Chandler (*Fragaria ananassa*) was investigated under Punjab conditions.

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Effect of foliar spraying with the growth inhibitor paclobutrazol on the quality of Chandler strawberry (*Fragaria ananassa*) under Punjab subtropics

**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 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%) with lowest values observed in the control group.

**Keywords:** Cultivar, Chandler, Growth retardant, *Fragaria ananassa*, Paclobutrazol and treatments.

**Comment [p2]:** Modify the key words according to the abstract..

**Introduction:** Strawberry (*Fragaria ananassa* Duch) is one of the most widely consumed and well-liked berry fruits. It has a pleasant taste, a delicate flavour, and a pleasing appearance, all of which contribute to its popularity. Strawberries, in addition to its delightful flavour 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 flavour of the fruit, but they also play an important role in supporting human health and overall well-being [1]. Strawberry fruit quality is determined by the fruit's size and colour development, but customer acceptance is determined by taste, texture, and flavour. The key fruit ingredients responsible for the overall strawberry flavour are sugars and organic acids, since their balance defines the fruit's sweetness 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 flavour, 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

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**Comment [p4]:** Modify in all text: flavor

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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.

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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 to 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 above mentioned facts in mind, the current study was carried out to investigate the viability of applying Paclobutrazol at various spray timings on the quality of strawberry crop in Punjab subtropics.

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**Material 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 RH RSS research station in Bhadarwah, Jammu and Kashmir and were planted at 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 4x3 meters.

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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 was initiated in early February and continued until the beginning of March. Observations were recorded on different quality parameters like fruit length (mm), fruit width (mm), fruit thickness (mm), fruit weight (g), TSS (°Brix), acidity (%) and firmness (N). The pooled data from one year was statistically evaluated according to Gomez, K. A., and Gomez, A. A. (1984) [4]. The mean of the qualities was compared using a paired 't' test, and the least significant difference was set at 5%.

**Comment [p22]:** The indicators studied are not all quality indicators of the fruit, so other quality indicators must be added.

**Comment [p23]:** Write how different quality indicators were estimated, and document the sources adopted.

**Comment [p24]:** Write the type, and version of the statistical analysis program used.

### DEMONSTRATION

	
<p><b>Plate 1 Raising of seed beds</b></p>	<p><b>Plate 2 Manuring</b></p>
	
<p><b>Plate 3 Application of fertilizers</b></p>	<p><b>Plate 4 Mulching</b></p>



**Plate5**Plantation



**Plate6**Irrigation



**Plate7**FloweringStage



**Plate8**FruitingStage

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## Results and Discussion

**Comment [p25]:** Interpret the results scientifically.

### A): Influence of Paclobutrazol on quality parameters of strawberry plant.

A): The assembled results from 2022, shown in Table 1 and 2 indicate that Paclobutrazol significantly affected the quality parameters of the strawberry (*Fragaria ananassa* Duch) cv. Chandler.

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

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

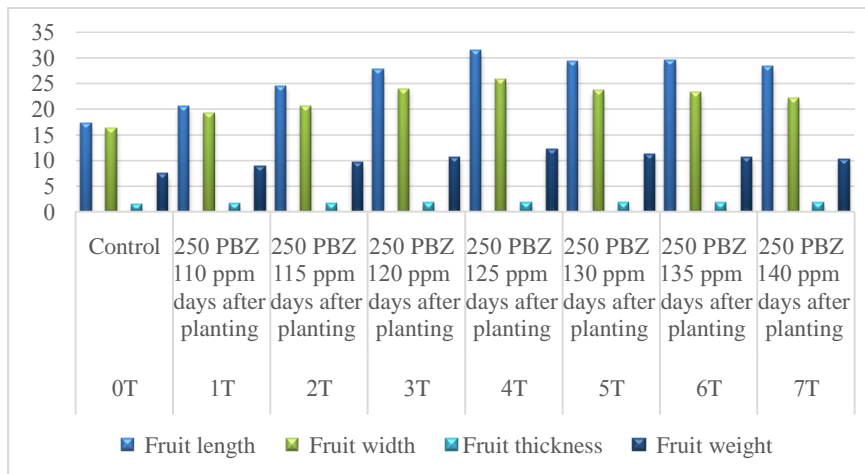


Fig1–Fruit length(mm),Fruitwidth(mm),Fruitthickness(mm)andFruitweight(g)

**I) Fruit Length:** According to the data, spraying paclobutrazol at varied intervals has a substantial influence on fruit length. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the longest fruit (31.40 mm). T0 (control) yielded the shortest fruit length. Data also showed that all treatments were much better than the control. The findings match with the previous observations of (Kumra et al., 2018) [5]

**II) Fruit Width:** The results show that spraying paclobutrazol at different intervals has a significant influence on fruit width. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the largest fruit (25.70 mm). T0 (control) yielded the smallest fruit width. The data also showed that all treatments outperformed the control. The findings corroborate prior observations of (Kumra et al., 2018) [5].

**III) Fruit Thickness:** The findings demonstrate that spraying paclobutrazol at various intervals has a significant influence on fruit thickness. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the thickest fruit (1.79 mm). T0 (control) yielded the smallest fruit thickness. Furthermore, data revealed that all treatments outperformed the control. There was no meaningful effect discovered. The identical values were obtained by (Al-Raisy et al., 2010) [6].

**IV) Fruit Weight:** The results indicate that spraying paclobutrazol at different intervals has a significant influence on fruit weight. The treatment T4 (PBZ 250 ppm 125 days after planting) produced the most fruit (12.03g). T0 (control) produced the smallest fruit weight.

**Comment [p26]:** What are the results of the reference studies that were relied upon in discussing the results?

Furthermore, data showed that all treatments outperformed the control. The findings match with the previous observations of (Al-Raisy *et al.*, 2010) [6].

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

Treatments	TSS (°Brix)	Firmness (N)	Titrateable Acidity (%)
T0	6.60	1.62	2.20
T1	7.50	1.74	2.39
T2	7.60	1.76	2.45
T3	8.00	1.79	2.51
<b>T4</b>	<b>9.50</b>	<b>1.92</b>	<b>2.56</b>
T5	8.90	1.89	2.48
T6	8.83	1.84	2.46
T7	8.50	1.80	2.44
CD (0.5%)	1.43	N/A	N/A

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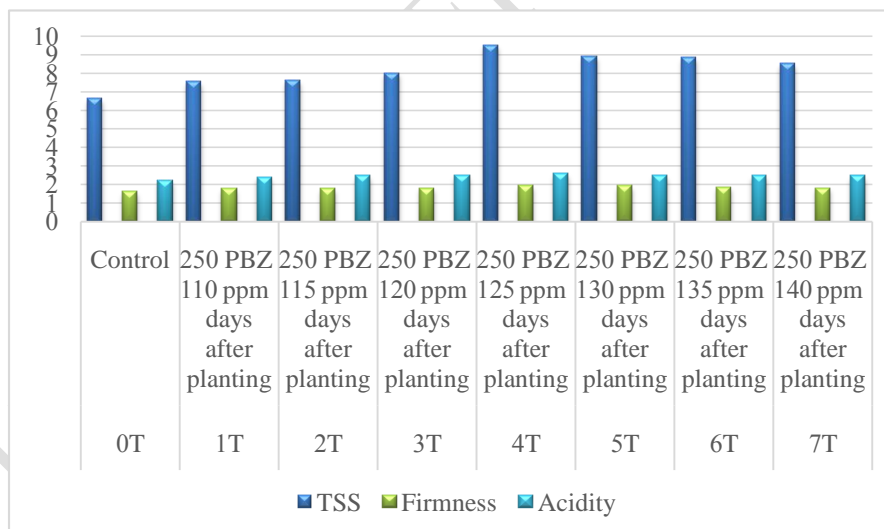


Fig2–TSS (°Brix), Firmness (N) and Titrateable acidity (%).

**V) Total Soluble Solids:** The findings show that paclobutrazol spraying at various intervals significantly affects the TSS. The treatment T4 (PBZ 250 ppm) was used 125 days after

planting to achieve the highest TSS (9.50 °Brix). However, from T0 (control), the lowest TSS was seen. Statistics also shown that all treatments outperformed the control. Similar outcomes were seen by (Abolfazletal., 2012) [7].

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**VI) Firmness:** The findings demonstrate that spraying paclobutrazol at different intervals has a significant influence on firmness. T4 (PBZ 250 ppm 125 days after planting) produced the highest firmness (1.92 N), whereas T0 (control) produced the lowest firmness. Statistics also revealed that all treatments outperformed the control. There was no meaningful effect discovered. The same results were obtained by (GinéBordonaba and Terry, 2009) [8].

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**VII) Titrable Acidity:** The results show a substantial effect of paclobutrazol spraying at different intervals on titrable acidity. The treatment T4 (PBZ 250 ppm, 125 days after planting) showed the highest level of acidity (2.56%). The acidity of T0 (the control) was, however, the least. All therapies outperformed the control, according to data. There was no discernible impact, it was discovered. The same outcomes were seen by (GinéBordonaba and Terry, 2009) [8].

## 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 produced better fruit quality and high yield, which will further help in improving farmers' profitability.

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## References

**Comment [p33]:** Most of the references used are old, so more recent references must be documented.  
Write Doi for all references.  
Write references in a uniform manner.

1. D.Urso,G.,dAquino,L.,Pizza,C.,&Montoro,P.(2015).Integratedmassspectrometricandmultivariate data analysis approaches for the discrimination of organic and conventional strawberry (*Fragaria ananassa* Duch) crops. *Food Research International*, 77, 264-272.
2. Domingues, A.R.; Vidal, T.C.M.; Hata, F.T.; Ventura, M.U.; Gonçalves, L.S.A.; Silva, J.B. 2018. Postharvest quality, antioxidant activity and acceptability of strawberries grown in conventional and organic systems. *Brazilian Journal of Food Technology*. 21, e2017154.
3. Pandey, A. K., Pathak, S., Barman, P., & Dwivedi, S.K. (2020). Influence of Nutrients and Plant Growth Regulators on Growth, Flowering and Yield Characteristics of Strawberry cv. Chandler. *International Journal of Current Microbiology and Applied Sciences*, 9 (11), 143-151.
4. Gomez, K.A., & Gomez, A.A. (1984). Statistical procedures for agricultural research. John Wiley & Sons.
5. Kumra, R., Saravanan, R. S., Bakshi, P., Kumar, A., Singh, M., & Kumar, V. (2018). Influence of plant growth regulators on strawberry: A review. *International Journal of Chemical Studies*, 6(1), 1236-1239.
6. Al-Raisy, F. S., Al-Said, F. A., Al-Rawahi, M.S., Khan, I.A., Al-Makhmari, S.M., & Khan, M.M. (2010). Effects of column sizes and media on yield and fruit quality of strawberry under hydroponic vertical system. *European Journal of Scientific Research*, 43(1) 48-60.
7. Abolfazl, L., Mohammad, A.R., Mojtaba, K.R., and Behzad, K. (2012). Effect of paclobutrazol and sulfate zinc on vegetative growth, yield and fruit quality of strawberry (*Fragaria ananassa* Duch. cv. Camarosa). *Annals of Biological Research*. 3(10) 4657-4662.
8. Giné Bordonaba, J., & Terry, L. A. (2009). Development of a glucose biosensor for rapid assessment of strawberry quality: relationship between biosensor response and fruit composition. *Journal of Agricultural and Food Chemistry*. 57(18) 8220-8226.

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