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Original Research

Effect of Chitosan and Gibberellic Acid on Fruit Yield and Production of Peach (*Prunus persica* L.)

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Abstract

The present study investigated the combined effect of chitosan and gibberellic acid on the fruit yield and production of peach (*Prunus persica* L.). The experiment was conducted to explore sustainable and eco-friendly strategies to enhance peach productivity, reduce chemical inputs, and promote overall plant health. The design was Randomized Complete Block (RCBD) with three replications. The experiment exhibited two factors, application of gibberellic acid (Control, 100, 200, 300 ppm) and chitosan (Control, 50, 100, and 150 ppm) abundant were damaged to take its effect on the performance of peach. An early grand variety of peach was used in this research work. Trees treated with gibberellic acid had resulted in lowest Number of fruits (9.93 kg^{-1}), highest Single Fruit weight (262.01 g), Fruit volume (108.75 cm^3), Fruit yield $tree^{-1}$ (52.3 kg), Fruit firmness (4.29 kg/cm^2), Total soluble solid (TSS) (12.82°Brix), Ascorbic Acid (6.3 $mg/100g^{-1}$), lowest Fruit Drop (8.63%), Chlorophyll content (48.75SPAD), lowest Fruit Juice pH (4.47), were recorded in plants representative with 200 mg L^{-1}

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gibberellic acid concentration, Those tree which not treated with gibberellic acid resulted in highest Number of fruits (13.17 kg^{-1}), minimum Single Fruit weight (181.1 g), Fruit volume (89.5 cm^3), minimum no of Fruit yield $tree^{-1}$ (44.58 kg), Fruit firmness (2.5kg/cm^2), Total soluble solid (TSS) (9.22°Brix), Ascorbic Acid (4.8 mg/100 g^{-1}), maximum no of Fruit Drop (%), minimum Chlorophyll content (35.8 SPAD), maximum Fruit Juice pH (5.3). On the other kind, Tree treated by chitosan concentration at the level of 150 ppm have resulted in minimum Number of fruits (9.96 kg^{-1}), maximum Single Fruit weight (267.1 g), Fruit volume (109.17 cm^3), Fruit yield $tree^{-1}$ (57.2 kg), Fruit firmness (4.55 kg/cm^2), Total soluble solid (TSS) (13.81°Brix), Ascorbic Acid (6.17 mg/100 g^{-1}), minimum Fruit Drop (7.4%), Chlorophyll content (51.33SPAD), minimum Fruit Juice pH (4.49). while trees that were not treated with chitosan concentration is resulted in maximum, Number of fruits (12.38 kg^{-1}), minimum Single Fruit weight (185.6 g), Fruit volume (88.67 cm^3), Fruit yield $tree^{-1}$ (40.81 kg), Fruit firmness (2.8 kg/cm^2), Total soluble solid (TSS) (9.28°Brix), Ascorbic Acid (5.1 mg/100 g^{-1}), maximum Fruit Drop (11.7%), Chlorophyll content (33.8SPAD), maximum Fruit Juice pH (5.38). A recorded plant of control treatment has been clear since the investigate data that collected gibberellic acid and chitosan consideration improved peach quality and yield. It will be concluded to gibberellic acid application at the rate of 200 ppm and chitosan use of 150 ppm widely improved fruit yield and quality feature of peach. Therefore, gibberellic acid and chitosan use (200 ppm and 150 ppm) are recommended for attain to a developed growth and as well as peach production in Peshawar climatic environment.

Keywords: chitosan, gibberellic acid, fruit yield, production, peach

Introduction

Peach (*Prunus Persica* L.) is a popular species in the family Rosaceae, known for its succulent stone fruits. Referred to as the "Queen of fruits," peaches have a delicious flavor and a luscious, vibrant outer layer. Originating in China around 1000 B.C., peaches have been cultivated worldwide, particularly in temperate regions [1]. European nations like France and Italy are significant peach producers, contributing to a global production of about four million tons. Asian countries, with China as a prominent exporter, play a crucial role in the peach industry, accounting for approximately 54% of the world's production, followed by Spain, Italy, and France [2, 3].

Research on peach trees has focused on enhancing fruit quality, yield, and development. Micronutrients applied through foliar sprays have shown promising results in improving the growth, yield, and quality of stone fruits. Pakistan, with its diverse climate and ecological conditions, provides suitable soil for various fruits, including stone fruits like peaches, almonds, apricots, and plums [4, 5]. Despite their nutritional value, stone fruits, including peaches, are susceptible to post-harvest deterioration, impacting their shelf life and marketability [6, 7]. To address these challenges, fumigation and pre-harvest nutrient sprays have been explored to mitigate post-harvest losses [8].

Peaches face various challenges, such as diseases caused by insects like cockroaches and fungal infections, including anthracnose, bacterial stain, and brown rot. Researchers have investigated the use of certain compounds, like chitosan and gibberellic acid (GA3), to reduce post-harvest losses and enhance the quality of horticultural products [9].

Chitosan, with its antimicrobial properties, has been effective in preserving vegetables and fruits, including peaches. It carries a positive charge due to its amino and hydroxyl groups, leading to physiological and biological changes on the surface of fruits [10, 11]. Additionally, gibberellic acid (GA3), a plant growth enhancer, plays a vital role in various plant functions, such as seed germination, flowering, and fruit set [9-12]. Furthermore, iron fertilization has been found to improve the crop yield and quality of peach fruits, with the deficiency of iron adversely affecting various parameters like fruit quantity, size, and taste. The application of chitosan and gibberellic acid to peach production aims to enhance fruit yield and quality while addressing post-harvest challenges. Understanding the effects of these substances on peach trees can lead to significant advancements in peach cultivation and contribute to the thriving fruit industry.

The current research aims, To quantify and compare the influence of chitosan and gibberellic acid treatments on the fruit yield of peach (*Prunus persica* L.) plants. Furthermore, to investigate the effects of chitosan and gibberellic acid on the overall fruit production characteristics of peach, including fruit size, weight, and number of fruits per plant. Also, to determine the physiological and biochemical mechanisms underlying the enhanced fruit yield and production in peach plants treated with chitosan and gibberellic acid, focusing on nutrient uptake, hormonal regulation, and defense responses.

Materials and Methods

The research entitled "Effect of Chitosan and Gibberellic Acid on fruit yield of Peach" was conducted in Horticulture Farm, The Agriculture University of Peshawar during 2020-2023.

Experimental Design and Treatment Combination

The study was planned in Randomized Complete Block Design (RCBD) with 2 factors and replicated three times. In this experiment two factors such as gibberellic acid and chitosan were used. Distances between rows were kept 20 ft. while 10 ft. distance was between plants. Early grand variety of peach was used in this experiment.

Factors

Factor A	Factor B
Chitosan (ppm)	GA3 (ppm)
C0 = 0	GA0 = 0
C1 = 50	GA1 = 100
C2 = 100	GA2 = 200
C3 = 150	GA3 = 300

Total number of treatments: 4×4 = 16
Replications: Three (3)
Total experimental component: 16 × 3 = 48

Statistical Analysis

The data collected from the experiments involving the application of chitosan and gibberellic acid on peach plants will be subjected to appropriate statistical analysis. A suitable statistical software package used to perform tests such as Analysis of Variance (ANOVA) to determine the significance of differences among treatments. The significant difference (LSD) test employed to identify specific pairwise differences between treatments if the ANOVA results are significant.

Results and Discussion

The present study was conducted on the peach plant; we work on different parameter.

1. Number of fruits (kg^{-1})

From the table it is clear that, number of fruits kg^{-1} of peach as affected by different levels of chitosan and Gibberellic acid, in case of gibberellic acid parameter 1 shows a maximum number of fruit (kg^1) (13.01 A) were recorded on control (C_0) while the minimum number of fruits (kg^1) (9.93 D) were recorded on 200 ppm gibberellic acid while in case of chitosan maximum number of fruits(kg^1) (12.38 A) were recorded on control (C_0) while minimum number of fruits (kg^1) (9.96 D) were recorded on 150 ppm chitosan. Our result is linked with [14] they furthermore confirmed that less amount of fruits in one kg were obtained by the use of gibberellic acid within peach stone fruit. Growing chitosan awareness resulted in increase in peach fruit weight and quantity [15].

2. Single fruit weight (g)

Parameter 2 single fruit weight (g) of peach as affected by different chitosan and Gibberellic acid levels, in the case of gibberellic acid the maximum single fruit weight (g) (262.01A) were recorded on 200 ppm gibberellic acid while minimum single fruit weight (g) (181.10 D) were recorded on control (C_0) while in case of chitosan maximum single fruit weight (g) (267.01 A) were recorded on 150 ppm chitosan while minimum single fruit weight (g) (184.69 C) were recorded on control (C_0). The results are similar to those of [16] they reflect enhance of fruit influence by purpose of gibberellic acid in stone fruit. The result is linked among introduce [17] they describe to foliar apply of 0.05% chitosan at 7 days, opening since on 14 days in the wake of transplant) expand ordinary result influence, expected effect measurement, and give in of timer pepper (*Capsicum annum*).

3. Fruit volume (cm^3)

Parameter 3 shows maximum Fruit volume (cm^3) (13.01A) were recorded on 200 ppm gibberellic acid while minimum Fruit volume (cm^3) (9.93 D) were recorded on control (C_0) while in case of chitosan maximum Fruit volume (cm^3) (12.38 A) were recorded on 150 ppm chitosan while minimum Fruit volume (cm^3) (9.96 D) were recorded on control (C_0). Comparable results were reported by [18] who confirmed that gibberellic acid function increases fruit quantity. Chitosan may inspire gibberellin in the ovary of carpal in a means position in the cell length and hence enhance volume and quantity [19].

4. Fruit yield $tree^{-1}$ (kg)

From the table parameter 4 were shows maximum Fruit yield $tree^{-1}$ (kg) (52.30 A) were recorded on 200 ppm gibberellic acid while minimum Fruit yield $tree^{-1}$ (kg) (44.58 D) were recorded on control (C_0) while in case of chitosan maximum Fruit yield $tree^{-1}$ (kg) (57.20 A) were recorded on 150 ppm chitosan while minimum Fruit yield $tree^{-1}$ (kg) (40.87 D) were recorded on control (C_0).The current discovery of the investigate can be in procession by [20] they study the whole level of gibberellic acid considerably greater than before the fruit yield. Foliar function of chitosan is the reason enhance in amount of fruit per plant which eventually enlarge crops and efficiency. The raising up of capitulate in treat trees as balance to whole trees can be enhance the tree altitude, yield manner stalk, inside the chloroplast, decrease in infection occurrence [21].

5. Fruit firmness (kg/cm^2)

Parameter 5 clear from the table to shows that maximum Fruit firmness (kg/cm^2) was (4.29 A) recorded on 200 ppm gibberellic acid while minimum Fruit firmness (kg/cm^2) (2.56 C) were recorded on control (C_0) while in case of chitosan maximum Fruit firmness (kg/cm^2) (4.55 A) were recorded on 150 ppm chitosan while minimum Fruit firmness (kg/cm^2) (2.80 D) were recorded on control (C_0). The stone fruit concluded the capacity and the function of gibberellic acid. The firmness increases by GA3 function. It can be articulated the purpose of (100, 200, 300 ppm) of GA3 near the fruit enhances the peach resolution [22]. Before harvest foliar application of chitosan the cause of preservation of yield inflexibility as the configuration of chitosan layer on the crop shell. Chitosan layer acts as (O2) wall which measured the metabolic actions and oxidativelly fail of glucose which leads to fruit developed procedure [23].

6. Total Soluble Solids (TSS) (°Brix)

From the Parameter 5 it was shown that maximum Total Soluble Solids (TSS) (°Brix) was (12.82 A) were recorded on 200 ppm gibberellic acid while minimum Total Soluble Solids (TSS) (°Brix) (9.22 D) were recorded on control (C_0) while in case of chitosan maximum Total Soluble Solids (TSS) (°Brix) (13.81 A) were recorded on 150 ppm chitosan while minimum Total Soluble Solids (TSS) (°Brix) (9.28 D) were recorded on control (C_0). During a chitosan covered the abundant extra investigate think on announce with the intention of TSS of chitosan-chemicals on apricots and papayas are equal to the unprocessed natural crop [24]. To reduce the TSS power outstanding to the purpose of gibberellic acid before the partial with another factor since macro nutrients, predominantly potassium has to noteworthy outcome on fruit excellence as affirmed by [25].

7. Ascorbic Acid (mg $100g^{-1}$)

It was clear that parameter 7 shows that maximum Ascorbic Acid (mg 100 g^{-1}) was (6.03 A A) were recorded on 200 ppm gibberellic acid while minimum Ascorbic Acid (mg 100 g^{-1}) (4.80 C) were recorded on control (C_0) while in case of chitosan maximum Ascorbic Acid (mg 100 g^{-1}) (6.17 A) were recorded on 150 ppm chitosan while minimum Ascorbic Acid (mg 100 g^{-1}) (5.01 D) were recorded on control (C_0).To enhance in the vitamin C increase group region, fruit quantity as well as fruit influence through GA3 function [26]. The significances are conventionality by [27] they concluded that foliar application of 150 mg chitosan significantly improved Ascorbic Acid substance by 10.03 to 21.02%. Vitamin C is huge significance for every plant tissues the development of cell has continuously originate suitable to vitamin C with oxidation crop by amount of future mechanism.

8. Fruits drop (%)

From Table 1 it was fine that minimum Fruits drop (%) was (8.59 C) were recorded on 200 ppm gibberellic acid while maximum Fruits drop (%) (11.71 A) were recorded on control (C_0) while in case of chitosan minimum Fruits drop (%) (7.40 D) were recorded on 150 ppm chitosan while maximum Fruits drop (%) (12.82 A) were recorded on control (C_0). The outside function of GA3 helped in prevent fruit drop of orange [34]. The increased concentration of radiance and dry climate are significant factors that accelerate fruit drop. Chitosan can protect hormonal factors, potentially serving as a foundation for preventing fruit abscission [28].

9. Chlorophyll content (SPAD)

From Table 1 parameter 9 it was clear that maximum Chlorophyll content (SPAD**)** was (48.75 A) were recorded on 200 ppm gibberellic acid while minimum Chlorophyll content (SPAD**)** (35.08 D) were recorded on control (C_0) while in case of chitosan maximum Chlorophyll content (SPAD**)** (51.33 A) were recorded on 150 ppm chitosan while minimum Chlorophyll content (SPAD**)** (33.08 D) were recorded on control (C_0).Foliar application of gibberellic acid and chitosan combinable effect on plants pigment and chlorophyll content between these [29, 33-35].

10. Fruit Juice pH

From the table it was clear that minimum Fruit Juice pH was (4.47 D) were recorded on 200 ppm gibberellic acid while maximum Fruit Juice pH (5.30 A) were recorded on control (C_0) while in the case of chitosan minimum Fruit Juice pH (4.49 D) were recorded on 150 ppm chitosan while maximum Fruit Juice pH (5.38 A) were recorded on control (C_0).

Table 1. Parameter show that peach fruit as effected by different levels of chitosan and gibberellic acid concentration.

Treatments	Gibberellic acid (ppm)				Chitosan (ppm)			
Parameters	Control	100	200	300	Control	50	100	150
Number of fruit kg^{-1}	13.01^a	11.18^b	9.93^d	10.86^c	12.38^a	11.63^b	11.01^c	9.96^d
Single fruit weight (g)	181.10^d	211.4^c	262.01^a	225.36^b	184.69^c	185.74^c	242.45^b	267.01^a
Fruit volume (cm^3)	9.93^d	11.18^b	13.01^a	10.86^c	9.96^d	11.63^b	11.01^c	12.38^a
Fruit yield $tree^{-1}$ (kg)	44.58^c	47.63^c	52.30^a	50.38^b	40.87^d	45.97^c	50.97^b	57.20^a
Fruit firmness (kg/cm^2)	2.56^c	4.12^b	4.32^a	4.29^a	2.80^d	3.55^c	4.39^b	4.55^a
Total soluble solid (^{0}Brix)	9.22^d	11.31^c	12.82^a	12.35^b	9.28^d	10.39^c	12.22^b	13.81^a
Ascorbic Acid ($mg100g^{-1}$)	4.80^c	5.87^b	6.03^a	5.91^b	5.01^d	5.57^c	5.87^b	6.17^a
Fruit drop (%)	11.71^a	11.53^a	8.59^c	9.63^b	12.82^a	10.85^b	10.39^c	7.40^d
Chlorophyll content (SPAD)	35.08^d	40.66^c	48.75^a	45.41^b	33.08^d	39.33^c	46.16^b	51.33^a
Fruit Juice PH	5.30	4.94^b	4.47^d	4.80^c	5.38^a	4.98^b	4.65^c	4.49^d

LSD test for gibberellic acid and chitosan at 1 % level of significance.

Table 2. Parameters show that peach fruit as effected by different levels of chitosan and gibberellic acid concentration.

Parameters	Values
Number of fruit kg^{-1}	0.28 kg^{-1}
Single fruit weight (g)	6.93 (g)
Fruit volume (cm^3)	2.14 (cm^3)
Fruit yield $tree^{-1}$ (kg)	0.81 (kg)
Fruit firmness (kg/cm^2)	0.15 (kg/cm^2)
Total soluble solid (^{0}Brix)	0.31 (^{0}Brix)
Ascorbic Acid ($mg100g^{-1}$)	0.08 ($mg100g^{-1}$)
Fruit drop (%)	0.43 (%)
Chlorophyll content (SPAD)	0.79 (SPAD)
Fruit Juice PH	0.06 PH

Conclusion

On the basis of the outcomes of the research it was concluded that, different chitosan and gibberellic acid foliar application significantly affected various yield and quality parameters such as number of fruits (kg^{-1}), single fruit weight (g), fruit volume (cm^3), fruit yield tree $^{-1}$ (kg), fruit firmness (kg/cm^2), ascorbic acid (mg/100 g^{-1}), (TSS) (^{o}Brix), fruit drop (%), chlorophyll content (SPAD) and fruit juice pH. Gibberellic concentration of 200 ppm gave the best result in all the studied parameters. Regarding chitosan levels 150 ppm gave the best outcome in all the studied parameters. It was concluded that gibberellic acid and chitosan significantly enhanced fruit development related parameters as compared to control.

Conflict of Interest

All the authors declare having no conflict of interest.

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