Advances in Bioresearch
Adv. Biores., Vol 16 (6) November 2025: 79-92

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.16.6.7992

Advances in Bioresearch

ORIGINAL ARTICLE

Effect of Foliar Feeding of NAA and IBA on Physico-Chemical Attributes of Strawberry (*Fragaria × Ananassa* Duch.) Grown Under Open Ventilated Polyhouse

Suneeta Singh, Abhay Kumar* and Sandeep Chauhan
Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun- 248 001, Uttarakhand, INDIA
*Corresponding Author: Abhay Kumar
Email: abhay3112002@gmail.com

ABSTRACT
An experiment was conducted during 2023-24 at the Horticulture Research Block, School of Agriculture Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India to study the "Effect of Foliar Feeding of NAA and IBA on Physico-chemical attributes of Strawberry (Fragaria × ananassa Duch.) grown under open ventilated Polyhouse". The experiment was laid out in a completely randomized design, consisting of three replications and ten treatments. These treatments featured different levels of plant growth regulators at varying concentrations viz. T_0 (control), T_1 (IBA @25ppm), T_2 (IBA @ 50ppm), T_3 (IBA @75ppm), T_4 (NAA @25ppm), T_5 (NAA @50ppm), T_6 (NAA @75ppm), T_7 (IBA @25ppm + NAA @25ppm), T_8 (IBA @50ppm + NAA @50ppm) and T_9 (IBA @75ppm + NAA @75ppm). The various observations related to Physico-chemical attributes were recorded at different harvest intervals. Results revealed that among the different treatments, T_9 (IBA @75ppm + NAA @75ppm) was recorded maximum fruit length (41.48 mm), fresh weight of fruits (16.60 gg), dry weight of fruits (1.26 g), fruit volume (11.51 ml), specific gravity (1.52), fruit shape index (1.57), total soluble solids (8.19 ^{0}Brix), titratable acidity (0.99 %), juice content (12.20 ml), Juice percentage (73.48 %) and moisture content (91.67 %). However, fruit diameter (28.33 mm) and fruit firmness (8.53 kg/cm^2) was maximum recorded in T_8 with IBA @ 50 ppm + NAA @ 50 ppm and minimum was found in T_0(control).
Keywords: *Strawberry, NAA, IBA, fruit length, total soluble solids, titratable acidity*

Received 20.08.2025 Revised 21.10.2025 Accepted 28.11.2025

How to cite this article:
Suneeta Singh, Abhay Kumar and Sandeep Chauhan. Effect of Foliar Feeding Of NAA And IBA On Physico-Chemical Attributes of Strawberry (*Fragaria × Ananassa* Duch.) Grown Under Open Ventilated Polyhouse. Adv. Biores. Vol 16 [6] November 2025. 79-92

INTRODUCTION

The strawberry (*Fragaria x ananassa* Duch.) is esteemed as one of the most visually appealing fruits on a global scale. It is categorized as a temperate crop and falls under the Kingdom Plantae, clade Angiosperms, order Rosales, and family Rosaceae, being identified as a man-made hybrid. The strawberry cultivated for commercial purposes is an octoploid species, characterized by a chromosome number of 2n=8x=56 (15). The cultivated strawberry, scientifically known as (*Fragaria x ananassa*), is a hybrid resulting from the crossbreeding of two Native American species (*F. chiloensis* and *F. virginiana*) (4). The plant is identified as a short-day, herbaceous, monoecious, low perennial species, with its fruit being an Etaerio of achenes that is highly perishable and non-climacteric. It thrives in various climates, although it flourishes best in temperate regions. Propagation occurs through runners, and the plant exhibits a red hue due to the presence of anthocyanin, pelargonidin, 3-monoglucoside, and trace amounts of cyanide. Its remarkable nutritional profile is abundant in vitamins A and C, as well as minerals such as iron and potassium. The high pectin content in strawberries renders them ideal for consumption in their fresh form, as well as for the production of jams and jellies (10). It has good source of Water (90.95g), Energy (32kcal), Protein (0.67g), Carbohydrate (7.68g), Sugars (4.89g), Calcium (16mg), Iron (0.41mg), Phosphorus (24mg), Magnesium (13mg), Potassium (153mg), Sodium (1g), Zinc (0.14g), Vitamin B_1

(0.024mg), Vitamin B_2 (0.022mg), Vitamin B_3 (0.386mg), Vitamin B_6 (0.047mg), Vitamin C (58.8mg), Vitamin E (0.29mg) and Vitamin K (2.2 µg) (USDA) [1-3]. China stands as the foremost producer of strawberries, responsible for around 30 percent of worldwide production. In India, this fruit enjoys popularity within the soft fruit segment, being cultivated in both plains and hilly regions, at elevations up to 3000 meters, in both humid and dry environments (15). Strawberry cultivation in India commenced in the hilly regions of Himachal Pradesh and Uttar Pradesh during the 1960s and has since proliferated to other states, including Uttarakhand specifically Nainital and Dehradun, the Kashmir Valley, Mizoram, Meghalaya, Uttar Pradesh, and Maharashtra, particularly in Pune, Nashik, Mahabaleshwar and Sangali. Furthermore, this crop has also been adopted in West Bengal (Kalimpong), Haryana, Punjab, Karnataka and Rajasthan [4]. According to the Directorate of Horticulture and Food Processing [5], Uttarakhand's total area for fruit cultivation is 81,692.58 ha with a production of 369,447.30 MT and productivity of 4.52 MT/ha per hectare. The National Horticulture Board (2022) reports that the total area for fruit cultivation in India is 7064 '000Ha with production 107507'000MT. Haryana is the leading producer of strawberries, contributing 4.26 thousand tonnes, followed by Maharashtra with 3.26 thousand tonnes. For optimal growth and development, strawberries require specific temperature conditions. A daytime temperature of 22°C is necessary, while nighttime temperatures should ideally fall between 7°C and 13°C. Renowned for their high productivity, strawberries are categorized as a heavy conveyor crop, yielding a considerable amount of fruit (17). The practice of seed propagation is prevalent, requiring seeds to undergo stratification at 0°C for 90 days to enhance their viability. Additionally, one-year-old runners are utilized for commercial propagation (3). The application of plant growth regulators has led to significant advancements in various fruit crops regarding their growth, yield, and quality. NAA facilitates several physiological processes (7). IBA plays a crucial role in determining the sites of root hair development and in promoting their elongation (5). Furthermore, the auxin derived from IBA contributes to the lateral root cap, and the conversion of IBA to IAA in the lateral root primordia likely aids in the formation of lateral roots. Adventitious roots, similar to lateral roots, emerge from aerial tissues such as stems or leaves and are often induced by stress, exhibiting regulatory mechanisms that share similarities with, yet differ from, those of lateral roots (1).

MATERIAL AND METHODS

The current study entitled "Effect of Foliar Feeding of NAA and IBA on Physico-chemical attributes of Strawberry (Fragaria × ananassa Duch.) grown under open ventilated Polyhouse" was carried out at the Horticulture Research Block, School of Agricultural Sciences, Shri Guru Ram Rai University, located in Pathri Bagh, Dehradun, Uttarakhand, India, during the rabi season from November 2023 to April 2024. The climate of this area is categorized as humid subtropical. In January 2024, the highest and lowest temperatures recorded during the crop growing season were 20.3ºC and 6.4ºC, respectively. The cultivar 'Chandler' was selected for this experiment. The study utilized a Completely Randomized Design, which incorporated three replications. Each replication consisted of ten treatments involving Plant Growth Regulators, with all treatments being randomized independently in each replication. The treatments included T_0 (Control), T_1 (IBA @25ppm), T_2 (IBA @50ppm), T_3 (IBA @75ppm), T_4 (NAA @25ppm), T_5 (NAA @50ppm). T_6 (NAA @75ppm), T_7 (IBA @25ppm + NAA @25ppm), T_8 (IBA @50ppm + NAA @50ppm), T_9 (IBA @75ppm + NAA @75ppm). Variance refers to the degree of variability found within a dataset, which is calculated by averaging the squares of the differences from the mean. The analysis of variance was performed utilizing the methodologies introduced by Panse and Sukhatme [9].

Table 1: Treatment combinations with their concentrations

Treatments	Treatment combinations	Concentration
T_0	Control	Water 100%
T_1	IBA	25 ppm
T_2	IBA	50 ppm
T_3	IBA	75 ppm
T_4	NAA	25 ppm
T_5	NAA	50 ppm
T_6	NAA	75 ppm
T_7	IBA + NAA	25 ppm + 25 ppm
T_8	IBA + NAA	50 ppm + 50 ppm
T_9	IBA + NAA	75 ppm + 75 ppm

RESULTS AND DISCUSSION

The research indicated that different levels of indole 3-butryic acid and naphthalene acetic acid had significant impact on physico-chemical attributes of strawberry cv. 'Chandler' when compared to the control. Tables 2, 3 & 4 and Fig. 1-13 illustrated the notable enhancements achieved with various combinations of these plant growth regulators versus the control. A detailed discussion and analysis of these findings are presented in the following sections.

Physical attributes

Fruit length (mm)

The results showed in table 2 and figure 1 depicted that there were non-significant differences in fruit length among the different treatments. The maximum (41.48 mm) and minimum (34.46 mm) fruit length were recorded in treatment T_9 with IBA @ 75 ppm + NAA @ 75 ppm and T_0 (control), respectively. However, fruit length in T_1 (36.23 mm), T_2 (36.56 mm) and T_3 (36.66 mm) were at par with each other. Also, the fruit length in T_4 (37.13 mm) and T_7 (37.38 mm) were at par with each other. The increase in fruit length might be due to the enhanced mobilization of water and the movement of nutrients from their production areas to storage organs, influenced by the application of NAA. Similar findings were reinforced by the results of Sevan et al., [12]; Yadav et al., [16] in strawberry.

Fruit diameter (mm)

The results showed in table 2 and figure 2 reported that there were non-significant differences in fruit diameter among the different treatments. The maximum fruit diameter (28.33 mm) was recorded in T_8 (IBA @ 50 ppm + NAA @ 50 ppm) and minimum fruit diameter (24.66 mm) was recorded in T_0 (control) which were at par with T_5 (24.66 mm) and T_6 (24.76 mm). Fruit diameter in T_1 (25.66 mm) and T_2 (25.66 mm) were at par with each other. Likewise, the fruit diameter in T_4 (27.00 mm) and T_7 (27.66 mm) were also at par with each other. However, there were non-significant observed among the treatments at final harvest. The increase in fruit diameter might be attributed to the more effective mobilization of water and nutrient flow from their production sites to storage organs, influenced by NAA [13].

Fresh weight of fruits (g)

The results displayed in table 2 and figure 3 revealed that there were significant differences in fresh weight of fruits among the different plant growth regulators treatment. The maximum fresh weight of fruit (16.60 g) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum fresh weight of fruit (10.85 g) was recorded in T_0 (control) which were at par with T_1 (10.91 g). Fresh weight of fruit in T_6 (15.65 g), T_7 (15.30 g) and T_8 (15.74 g) were also at par with each other. Likewise, the fresh weight of fruit in T_2 (11.89 g) and T_3 (12.42 g) were at par with each other. However, significant difference was observed in T_4 (13.38 g) and T_7 (15.74 g). The increase in fresh weight of fruits likely accelerated by the synthesis of metabolites, especially carbohydrates and their transport to the fruits, which in turn increased the pulp content. These results match the conclusions drawn by Tiwari et al., [14] in his study of aonla.

Dry weight of fruits (g)

The results reported in table 2 and figure 4 revealed that there were significant differences in dry weight of fruits among the different plant growth regulators treatments. The maximum dry weight of fruits (2.86 g) was recorded in T_4 with NAA @ 25 ppm and minimum dry weight of fruits (1.26 g) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm. Dry weight of fruits in T_2 (2.63 g) and T_3 (2.50 g) were at par with each other. Likewise, the dry weight of fruits in T_6 (2.13 g) and T_7 (2.23 g) were also at par with each other. However, significant difference was observed in T_2 (2.63 g) and T_8 (1.50). IBA enhances root growth, improving nutrient and water uptake, which indirectly affects fruit dry weight. Similar finding was also reported by Tiwari et al., [14].

Fruit volume (ml)

The results depicted in table 3 and figure 5 revealed that there were significant differences in fruit volume among the different plant growth regulators treatments. The maximum fruit volume (11.51 ml) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm which were at par with T_8 (11.20 ml) and minimum fruit volume (6.57 ml) was recorded in T_0 (control). Fruit volume in T_3 (9.20 ml) and T_5 (9.23 ml) were at par with each other. Likewise, the fruit volume in T_6 (10.88 ml) and T_7 (10.75 ml) were also at par with each other. However, significant difference was observed in T_4 (8.33 ml) and T_8 (11.20 ml). This might be due to a more efficient supply of nutrients and photosynthates in NAA-treated plants. This treatment likely boosted the synthesis of metabolites, particularly carbohydrates, and enhanced their transport to the fruits, which led to a higher pulp content. These results are consistent with the conclusions drawn by Tiwari et al., [14] in aonla.

Specific gravity

The results displayed in table 3 and figure 6 revealed that there were significant differences in specific gravity of fruits among the different plant growth regulators treatments. The maximum specific gravity (1.52) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum (1.12) was recorded in T_4 (NAA @ 25 ppm) which were at par with T_1 (1.19). Specific gravity in T_0 (1.34) and T_3 (1.39) were at par with each other. Likewise, the specific gravity of in T_2 (1.27), T_6 (2.27) and T_7 (1.23) were also at par with each other. However, significant difference was observed in T_1 (1.19) and T_8 (1.44). This might be due to when the sink strength and total solid content go up, the specific gravity tends to increase as well. The findings are in agreement with Khunte et al., [6] in strawberry.

Fruit shape index

The results shown in table 3 and figure 7 reported that there were significant differences in fruit shape index among the different plant growth regulators treatment. The maximum fruit shape index (1.57) was recorded in T_9 (IBA @ 75 ppm + NAA @ 75 ppm) and T_6 (NAA@75 ppm). Whereas, the minimum fruit shape index (1.34) was recorded in T_7 (NAA @ 25 ppm + IBA @ 25ppm). Fruit shape index in T_1 (1.41) and T_2 (1.42) were at par with each other. Likewise, the fruit shape index in T_4 (1.37) and T_7 (1.34) were also at par with each other. However, significant difference was observed in T_0 (1.39) and T_5 (1.52). NAA application at different growth stages may result in variations in fruit shape by influencing **polar transport of auxins,** affecting the longitudinal and transverse growth of the fruit. The findings are in agreement with Khunte et al., [6] in strawberry.

Fruit firmness (kg/cm^2)

The results shown in table 3 and figure 8 revealed that there were significant differences in fruit firmness among the different plant growth regulators treatment. The maximum fruit firmness (8.53 Kg/cm^2) was recorded in T_8 with IBA @ 50 ppm + NAA @ 50 ppm which was at par with T_6 (8.36 Kg/cm^2) and minimum fruit firmness (5.66 Kg/cm^2) was recorded in T_0 (control). The fruit firmness in T_1 (6.43 Kg/cm^2) and T_2 (6.93 Kg/cm^2) were at par with each other. Likewise, the fruit firmness in T_5 (7.90 Kg/cm^2), T_7 (7.76 Kg/cm^2) and T_9 (7.93 Kg/cm^2) were also at par with each other. However, significant difference was observed in T_4 (7.50 Kg/cm^2) and T_6 (8.36 Kg/cm^2). NAA and IBA promote the synthesis of pectin and hemicellulose, which contribute to stronger cell walls. These hormones delay the breakdown of pectic substances, maintaining the rigidity of cell walls for a longer duration. IBA enhances lignin deposition in the cell walls reinforces fruit firmness. The findings are in agreement with Palei et al., [8] in strawberry.

Chemical attributes

Juice content (ml)

The results depicted in table 4 and figure 9 reported that there were significant differences in juice content among the different plant growth regulators treatment. The maximum juice content (12.20 ml) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum juice content (5.70 ml) was recorded in T_0 (control). Juice content in T_1 (6.16 ml) and T_2 (6.83 ml) were at par with each other. Similarly, the juice content in T_3 (7.60 ml), T_4 (7.76 ml), T_5 (9.00 ml) and T_7 (9.30 ml) were also at par with each other. However, significant difference were observed in T_3 (7.60 ml), T_5 (9.00 ml) and T_8 (10.76 ml). NAA enhances the translocation of water, nutrients and sugars into the fruit, resulting in better hydration and higher juice content. It regulates osmotic balance**,** which helps retain more water within the fruit cells. The similar finding was reported by Palei et al., [8] in strawberry.

Juice content (%)

The results displayed in table 4 and figure 10 revealed that there were significant differences in juice content among the different plant growth regulators treatment. The maximum juice content (73.48 %) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum (52.52 %) was recorded in T_0 (control). Juice percentage in T_1 (56.43 %), T_2 (57.38 %) and T_4 (58.12 %) were at par with each other. Likewise, the juice percentage in T_3 (61.17 %) and T_5 (62.64 %) were also at par with each other. However, significant difference were observed in T_1 (56.43 %), T_5 (62.64 %) and T_8 (68.35 %). This might happen due to fact that as fruits mature, enzymes like pectinases and cellulases break down pectic substances and cellulose in the cell wall, softening the tissues and allowing more juice to be released when the fruit is pressed. The similar finding was reported by Palei et al., [8] in strawberry.

Total soluble solids (^{0}Brix)

The results shown in table 4 and figure 11 revealed that there were significant differences in total soluble solids among the different treatments. The maximum TSS (8.19 ^{0}Brix) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum (5.14 ^{0}Brix) in T_0 (control). The TSS of T_1 (6.34 ^{0}Brix) and T_2 (6.50 ^{0}Brix) were at par with each other. Likewise, the TSS of T_3 (7.13 ^{0}Brix), T_7 (7.24 ^{0}Brix), T_4 (7.30 ^{0}Brix) and T_5 (7.36 ^{0}Brix) were also at par with each other. However, significant difference was observed in T_2 (6.50

^{0}Brix) and T_6 (7.72 ^{0}Brix). This might be due to use of NAA in strawberry plants could have enhanced the concentration of volatile compounds while also breaking down starchy materials, which ultimately resulted in a higher total soluble solids level. The findings are in agreement with Rathod et al., [10] in strawberry.

Titratable acidity (%)

The results shown in table 4 and figure 12 revealed that there were significant differences in titratable acidity content among the different plant growth regulators treatment. The maximum titratable acidity (0.99 %) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum (0.43 %) was recorded in T_0 (control). Titratable acidity in T_1 (0.66 %), T_5 (0.69 %) and T_7 (0.77 %) were at par with each other. Likewise, the titratable acidity in T_3 (0.81 %), T_6 (0.81 %) and T_8 (0.84 %) were also at par with each other. However, significant difference was observed in T_1 (0.66 %) and T_8 (0.84 %). NAA enhances the creation of malic acid, which plays a significant role in titratable acidity. It also boosts the production of citric acid, adding to the overall titratable acidity. Additionally, NAA helps maintain a balance between the synthesis and breakdown of acids, promoting their accumulation. The results are conformity with Saha et al., [11] in strawberry.

Moisture content (%)

The results displayed in table 4 and Figure 13 revealed that there were significant differences in moisture content among the different plant growth regulators treatments. The maximum moisture content (91.67 %) was recorded in T_9 with IBA @ 75 ppm + NAA @ 75 ppm and minimum moisture content (75.11 %) was recorded in T_0 (control) which were at par with T_1 (76.62 %) and T_2 (77.30 %). Moisture content in T_3 (79.94 %) and T_4 (78.98 %) were at par with each other. Likewise, the moisture content in T_6 (84.81 %) and T_7 (83.05 %) were also at par with each other. However, significant difference was observed in T_2 (77.30 %), T_5 (81.38 %) and T_8 (88.46 %). NAA can reduce transpiration rates by enhancing cuticle thickness and reducing stomatal openings, thus maintaining higher moisture levels in fruits. **IBA** stimulates root growth**,** improving water and nutrient absorption from the soil. The findings are in agreement with Rathod et al., [10] in strawberry.

Table 2: Effect of IBA and NAA on fruit length (mm), fruit diameter (mm), fresh weight of fruits (g) and dry weight of fruits (g) of strawberry

Treatment	Fruit length (mm)	Fruit diameter (mm)	Fresh weight of fruits (g)	Dry weight of fruits (g)
T_0	34.46	24.66	10.85	2.70
T_1	36.23	25.66	10.91	2.30
T_2	36.56	25.66	11.89	2.63
T_3	36.66	26.33	12.42	2.50
T_4	37.13	27.00	13.38	2.86
T_5	37.69	24.66	14.36	2.76
T_6	38.86	24.76	15.65	2.13
T_7	37.38	27.66	15.3	2.23
T_8	40.26	28.33	15.74	1.50
T_9	41.48	26.33	16.60	1.26
C.D (0.05%)	NS	NS	1.41	0.45
SE(m) ±	2.08	1.41	0.47	0.15
SE(d) ±	2.94	2.00	0.67	0.21
C.V.	9.58	9.45	6.01	11.63

Table 3: Effect of IBA and NAA on fruit volume (ml), specific gravity, fruit shape index and fruit firmness (kg/cm²) of Strawberry

Treatment	Fruit volume (ml)	Specific gravity	Fruit shape index	Fruit firmness (kg/cm²)
T_0	6.57	1.34	1.39	5.66
T_1	7.80	1.19	1.41	6.43
T_2	8.71	1.27	1.42	6.93
T_3	9.20	1.39	1.49	7.28
T_4	8.33	1.12	1.37	7.50
T_5	9.23	1.33	1.52	7.90
T_6	10.88	1.27	1.57	8.36
T_7	10.75	1.23	1.34	7.76
T_8	11.20	1.44	1.42	8.53
T_9	11.51	1.52	1.57	7.9
C.D (0.05%)	1.41	0.11	0.11	0.27
SE(m) ±	0.47	0.03	0.03	0.09
SE(d) ±	0.67	0.05	0.05	0.12
C.V.	8.74	4.89	4.69	2.12

Table 4: Effect of IBA and NAA on TSS (⁰Brix), titratable acidity (%), juice content (ml), juice content (%) and moisture content (%) of Strawberry

Treatment	Total soluble solid (⁰Brix)	Titratable Acidity (%)	Juice content (ml)	Juice content (%)	Moisture content (%)
T_0	5.14	0.43	5.70	52.52	75.11
T_1	6.34	0.66	6.16	56.43	76.62
T_2	6.50	0.73	6.83	57.38	77.30
T_3	7.13	0.81	7.60	61.17	79.94
T_4	7.30	0.77	7.76	58.12	78.98
T_5	7.36	0.69	9.00	62.64	81.38
T_6	7.72	0.81	10.10	64.50	84.81
T_7	7.24	0.77	9.30	60.81	83.05
T_8	7.90	0.84	10.76	68.35	88.46
T_9	8.19	0.99	12.20	73.48	91.67
C.D (0.05%)	1.04	0.20	0.97	3.74	2.52
SE(m) ±	0.35	0.06	0.32	1.25	0.85
SE(d) ±	0.49	0.09	0.46	1.78	1.20
C.V.	8.61	15.75	6.66	3.54	1.80

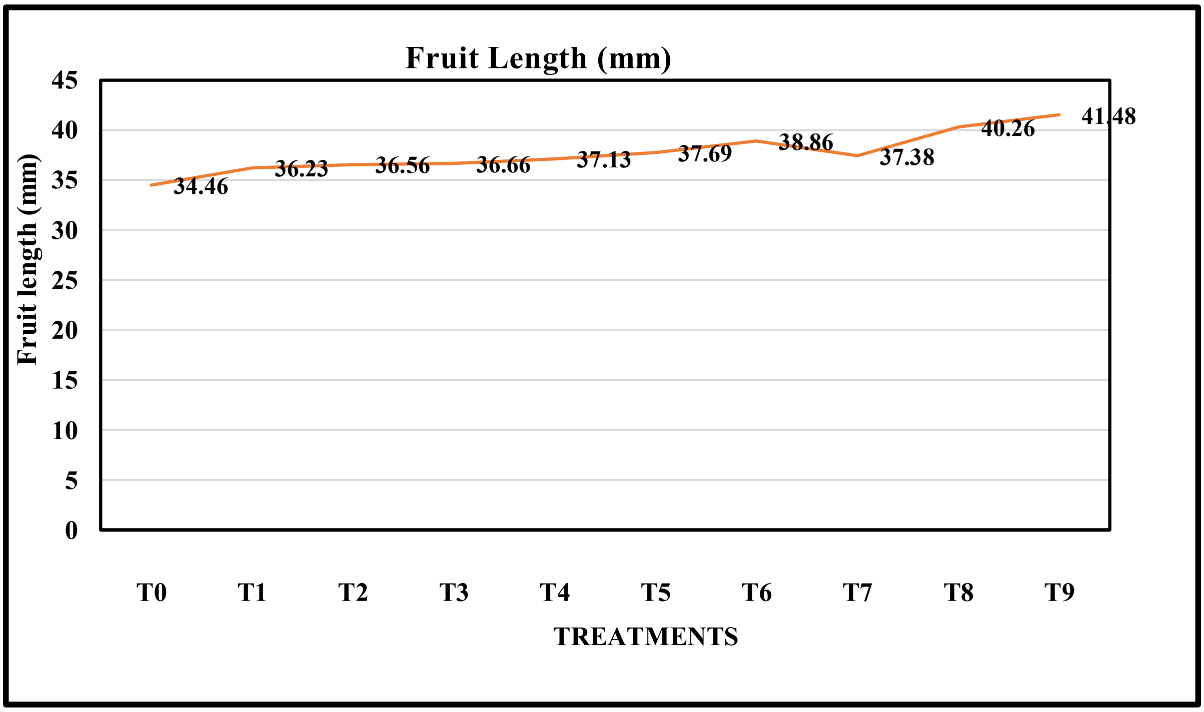

Fig. 1: Fruit length (mm) as influenced by different concentrations of IBA and NAA

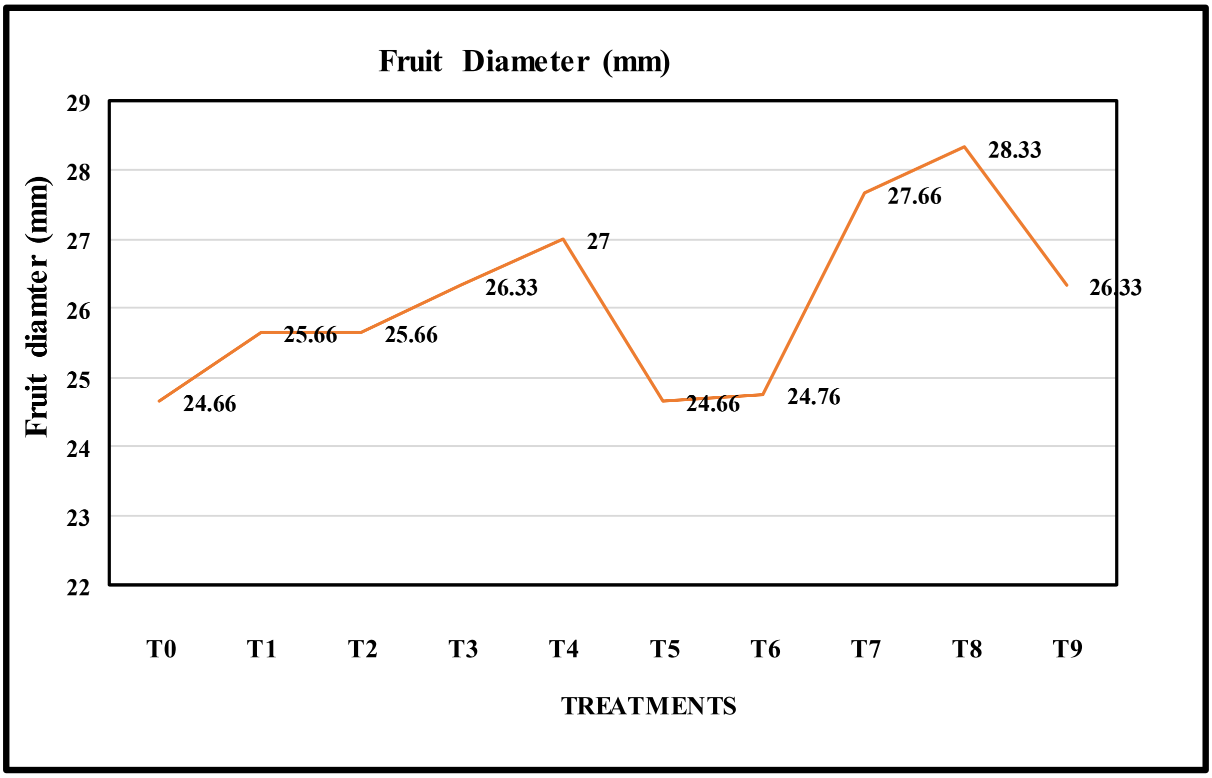

Fig. 2: Fruit diameter (mm) as influenced by different concentrations of IBA and NAA

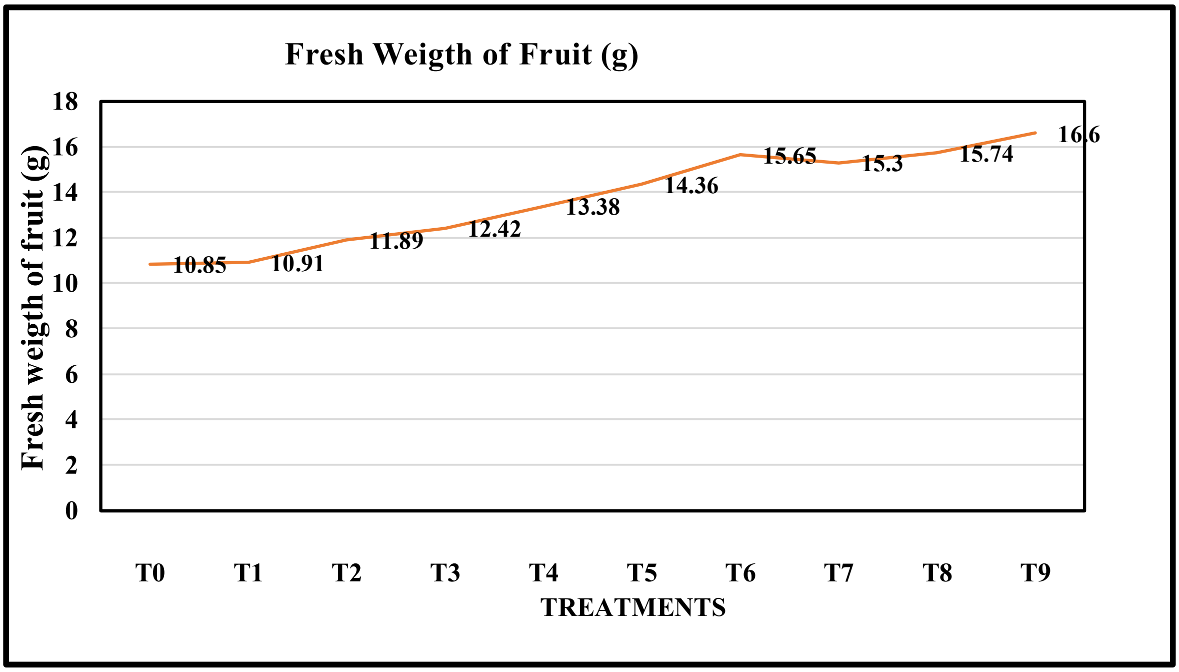

Fig. 3: Fresh weight of fruit (g) as influenced by different concentrations of IBA and NAA

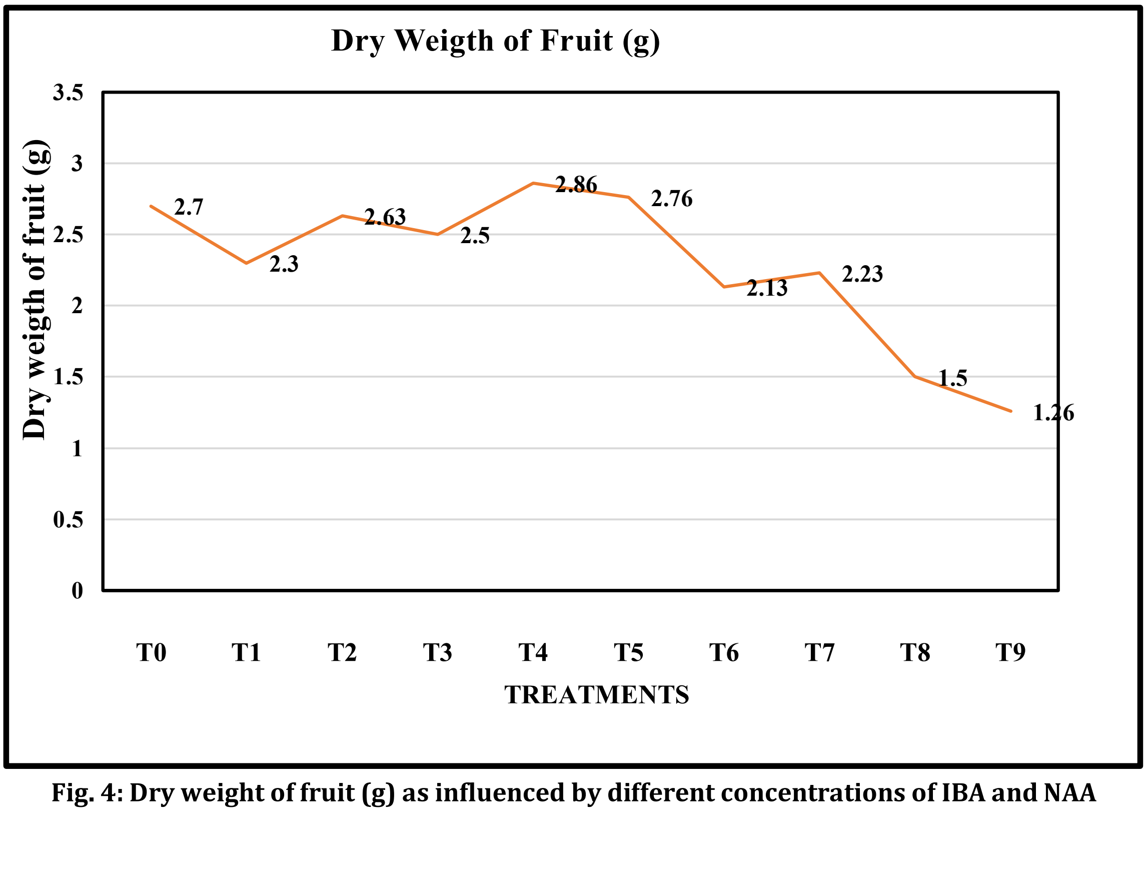

Fig. 4: Dry weight of fruit (g) as influenced by different concentrations of IBA and NAA

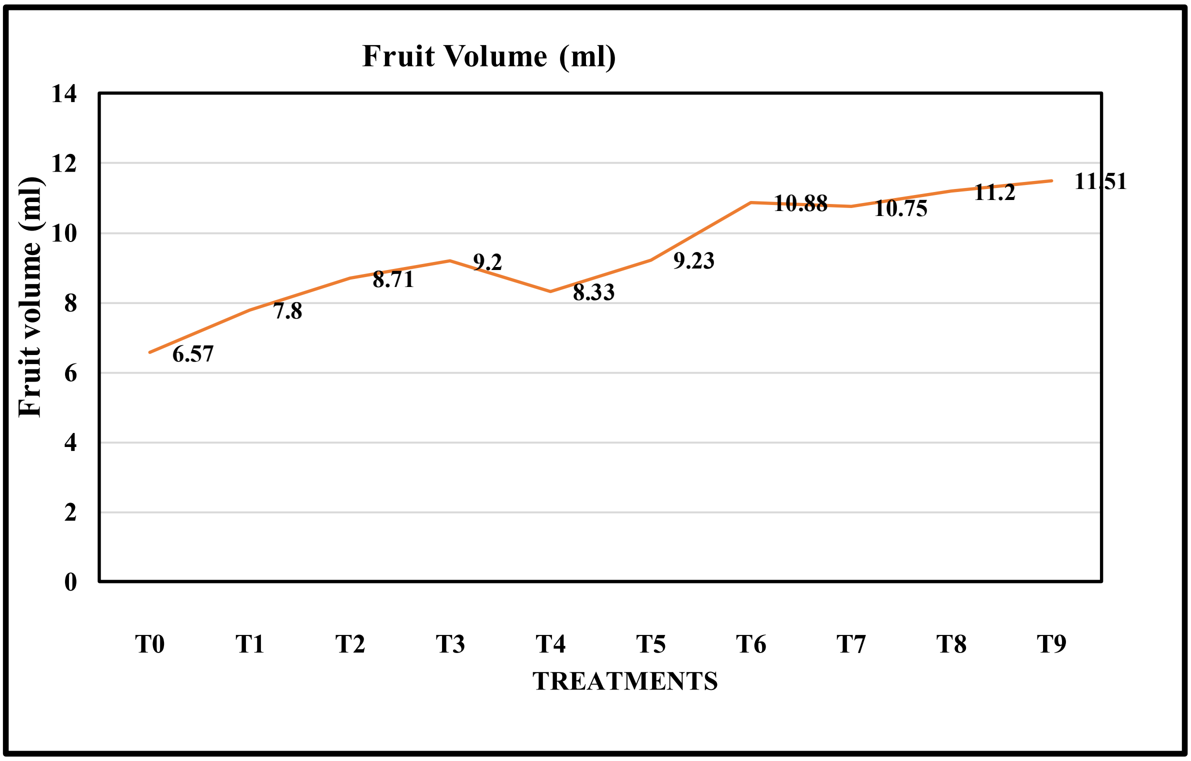

Fig. 5: Fruit volume (ml) as influenced by different concentrations of IBA and NAA

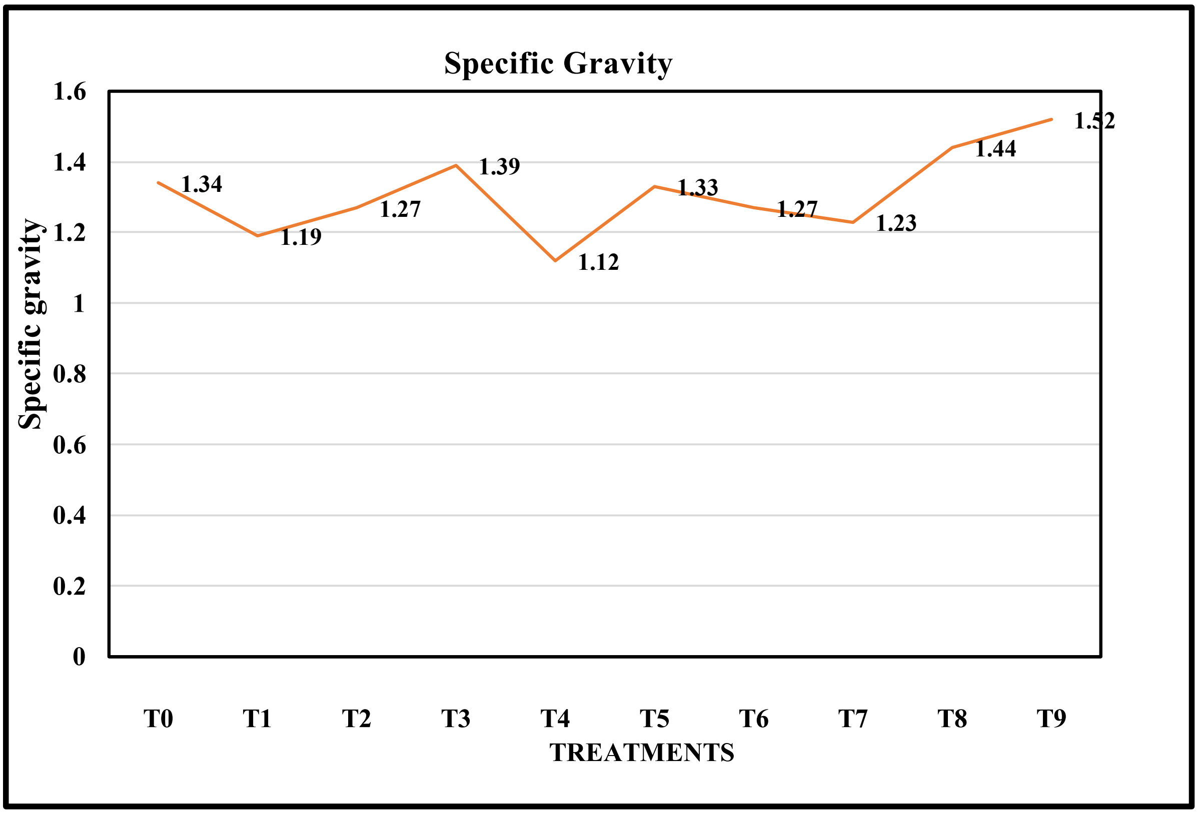

Fig. 6: Specific gravity as influenced by different concentrations of IBA and NAA

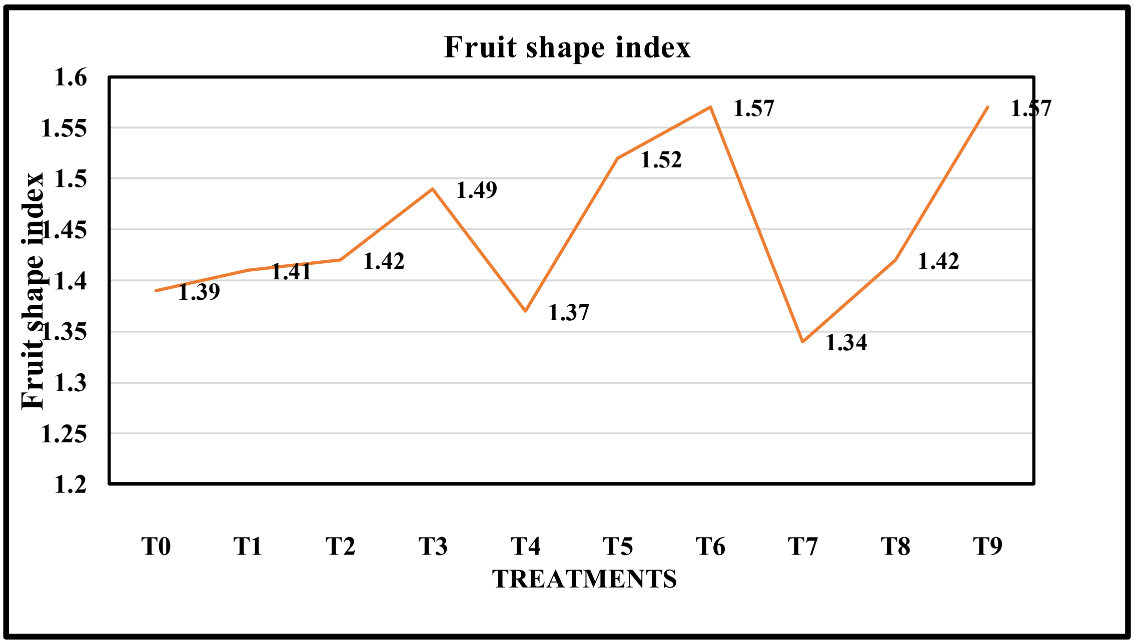

Fig. 7: Fruit shape index as influenced by different concentrations of IBA and NAA

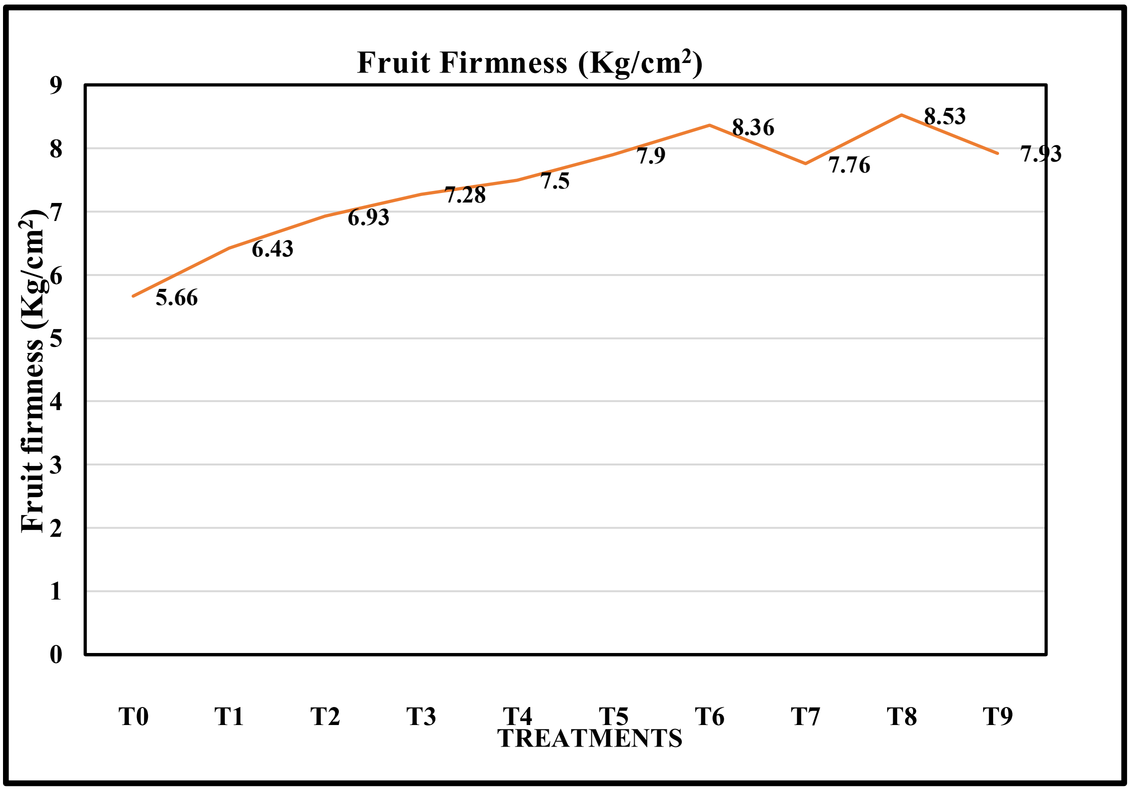

Fig. 8: Fruit firmness (kg/cm²) as influenced by different concentrations of IBA and NAA

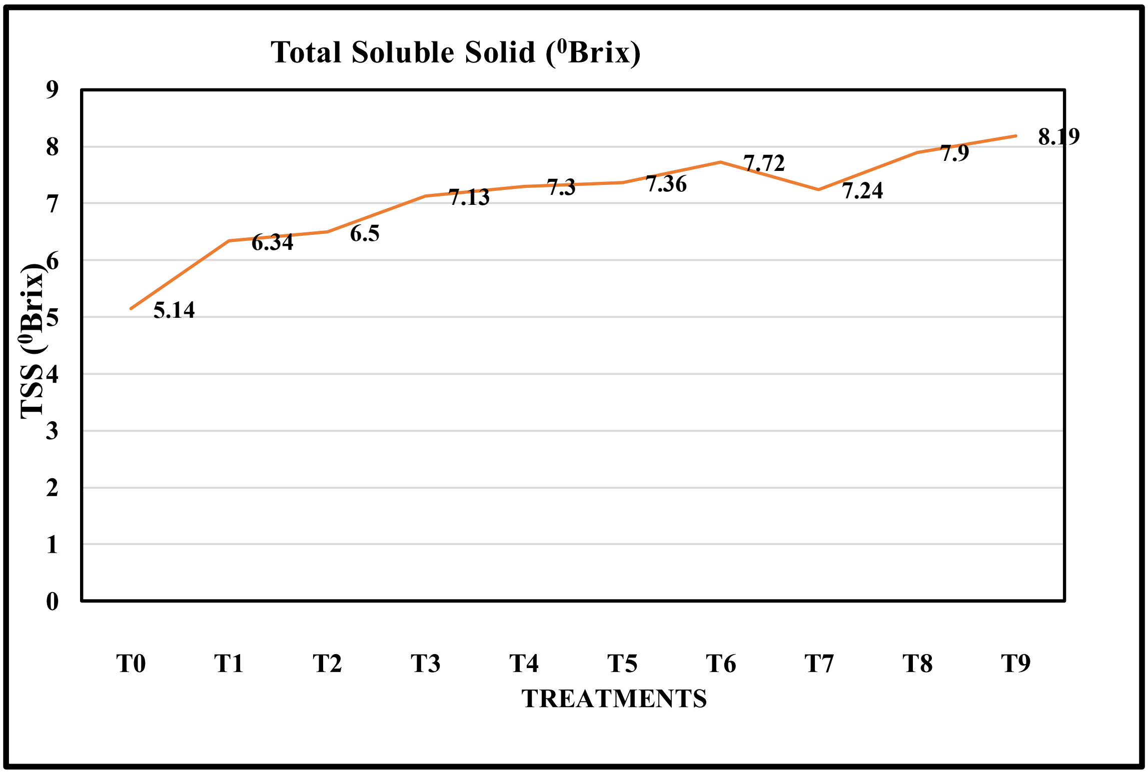

Fig. 9 Total Soluble Solid (⁰Brix) as influenced by different concentrations of IBA and NAA

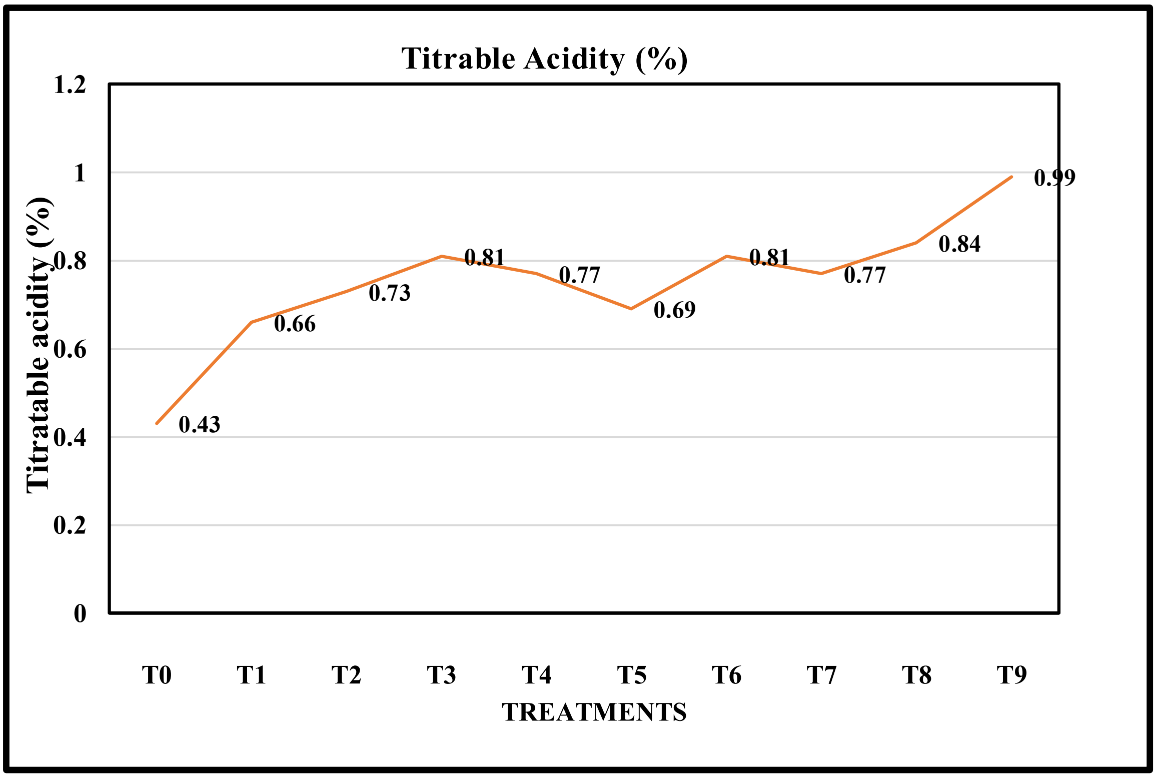

Fig. 10: Titratable acidity (%) as influenced by different concentrations of IBA and NAA

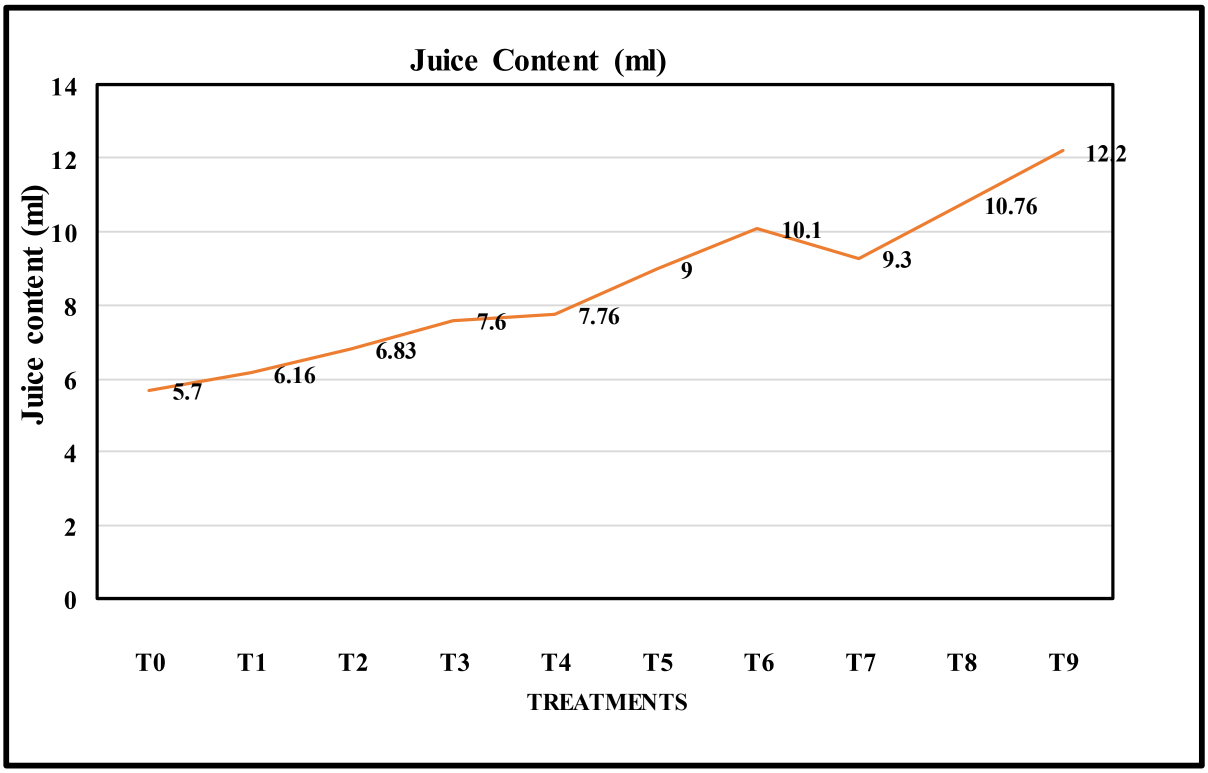

Fig. 11: Juice content (ml) as influenced by different concentrations of IBA and NAA

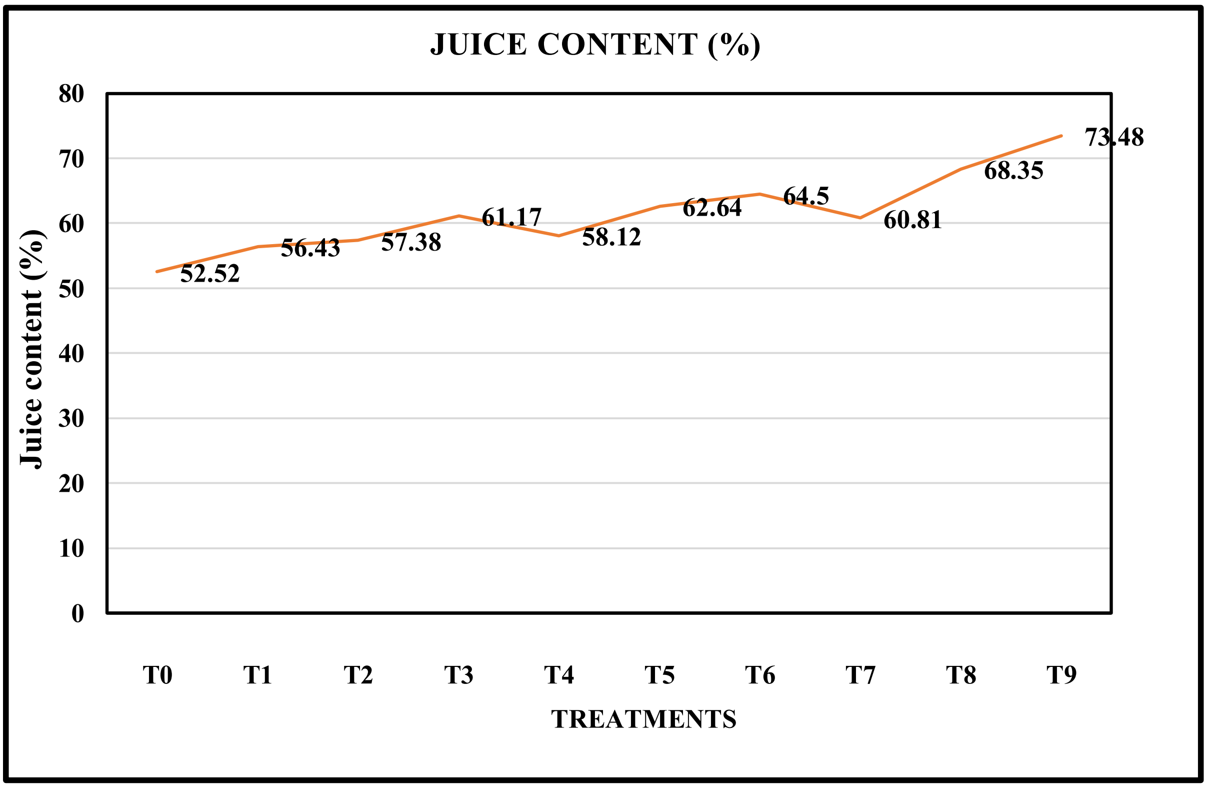

Fig. 12: Juice content (%) as influenced by different concentrations of IBA and NAA

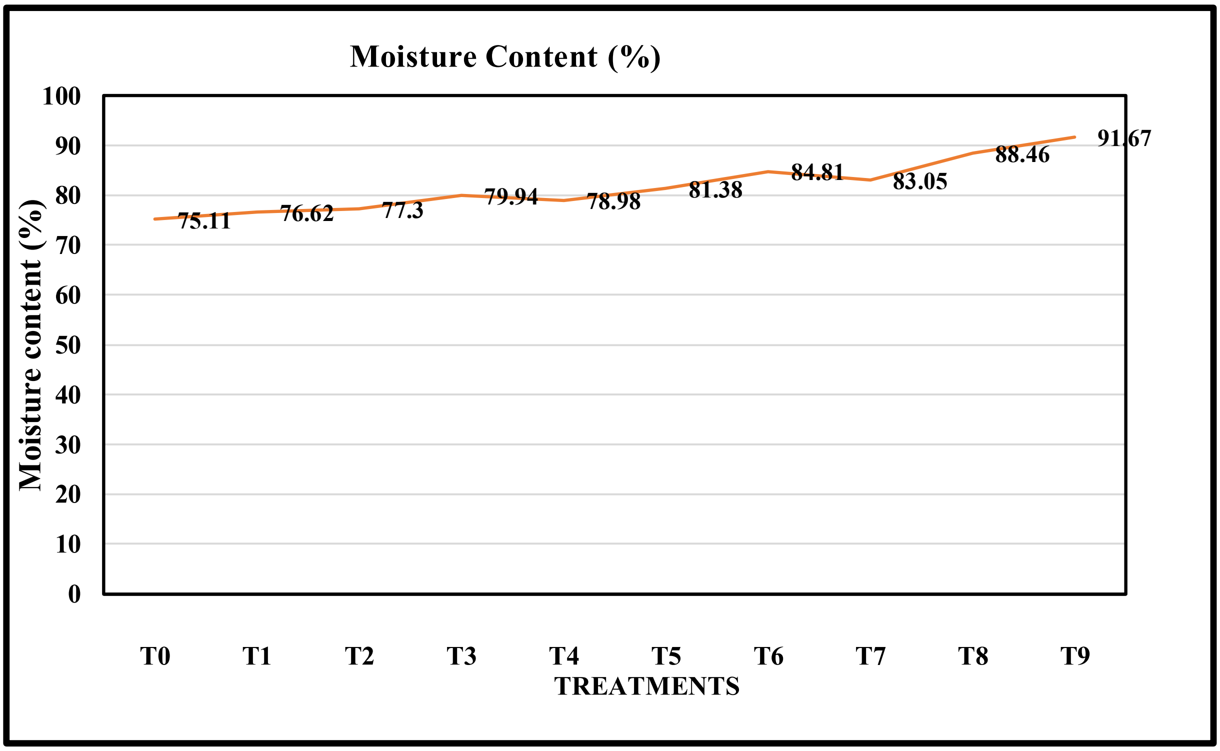

Fig. 13: Moisture content (%) as influenced by different concentrations of IBA and NAA

CONCLUSION

On the basis of present experimental research entitled "Effect of Foliar Feeding of NAA and IBA on Physico-chemical attributes of Strawberry (Fragaria × ananassa Duch.) grown under open ventilated Polyhouse" in cv. Chandler, it can be concluded that among different plant growth regulators treatment applications, the treatment combination of IBA @75ppm + NAA @75ppm i.e., T_9 was found to be most effective in terms of maximum fruit length (cm), fresh weight of fruits (g), dry weight of fruits (g), fruit volume (ml), specific gravity, fruit shape index, total soluble solids (^{0}Brix), titratable acidity (%), juice content (ml), juice content (%) and moisture content (%). However, the maximum fruit diameter (mm) and fruit firmness (kg/cm^2) was recorded in T_8 with IBA @ 50 ppm + NAA @ 50 ppm.

REFERENCES

1. Bellini C., Pacurar D. I. and Perrone I. (2014). Adventitious roots and lateral roots. similarities and differences. *Annual Review of Plant Biology.* 65: 639-666.
2. Bhople A. A., Kullarkar P. P., Singh S. K. and Saxena D. (2020). Studies On Impact of Growth Regulators on Performance of Strawberry cv. Camarosa under polyhouse condition. *Annals Agriculture Biology Research.* 25(2): 234-238.
3. Chadha K. L. (2019). Handbook of Horticulture. 2nd Edition. ICAR, Pusa, New Delhi.
4. Gautam M. K. and Mishra S. (2024). Impact of Plant Growth Regulators on Growth, Fruit Yield and Quality of Strawberry (*Fragaria × anassa* Duch.) cv. Winter Dawn. *Journal of Experimental Agriculture International.* 46(7): 1205-1212.
5. Honkanen S. and Dolan L. (2016). Growth regulation in tip-growing cells that develop on the epidermis. *Current Opinion in Plant Biology*. 34:77-83.
6. Khunte S., Kumar A., Kumar V., Singh S. and Saravanan S. (2014). Effect of Plant Growth Regulators and Organic Manure on Physicochemical Properties of Strawberry (*Fragaria x ananassa* Duch.) cv. Chandler. *International Journal of Scientific Research and Education*. 7(2): 1424-1435.
7. Mehraj H., Taufique T., Ali M. R., Sikder R.K. and Uddin A.F.M.J. 2015. Impact of GA_3 and NAA on horticultural traits of Abelmoschus esculentus. *World Applied Science Journal*. 33(11): 1712-1717.
8. Palei S., Das A. K., Sahoo A. K., Dash D. K. and Swain S. (2016). Influence of Plant Growth Regulators on Strawberry (*Fragaria x ananassa*) cv. Chandler under Odisha Condition. *International Journal of Recent Scientific Research.* 7(4): 9945-9948.
9. Panse V. G. and Sukhatme P. V. (1989). Statistical Methods for Agricultural Workers. ICAR, New Delhi.
10. Rathod K. D., Ahlawat T. R., Kumar S., Sarkar M. and Chakraborty B. (2021). Effect of Plant Growth Regulators on Growth, Yield and Quality of Strawberry (*Fragaria × ananassa* Duch.) cv. Winter Dawn under Open Field Conditions of South Gujarat. *Agricultural Science Digest.* 41(2): 329-333.

11. Saha T., Ghosh B., Debnath S., Kundu S. and Bhattacharjee A. (2019). Effect of Plant Growth Regulators on Growth, Yield and Quality of Strawberry (*Fragaria × ananassa* Duch.) cv. Winter Dawn in the Gangetic Alluvial Region of West Bengal, India. *International Journal of Current Microbiology and Applied Sciences.* 8(3): 1706-1713.
12. Sevan D. K., Anil K., Vijay, K., Shambu S. and Saravanam S. (2014). Effect of growth regulators and organic manure on physico-chemical properties of Strawberry (*Fragaria* x *ananassa* Duch.) cv. Chander. *Int. J. scient. Res. Edu.* 2(7): 1424-1435.
13. Singh B. and Goswami A., (2015). A Text Book of Fruit Production. 268-271p.
14. Tiwari P., Tripathi V. and Singh A. (2017). Effect of foliar application of plant bio-regulators and micronutrients on fruit retention, yield and quality attributes of aonla. *An International Journal*. 12(IV): 2565-2568.
15. Vishal V. C., Thippesha D., Chethana K., Maheshgowda B. M., Veeresha B.G. and Basavraj A. K. (2016): Effect of various growth regulators on vegetative parameters of strawberry (*Fragaria × ananassa* Duch.) cv. Sujatha. *Research Journal of Chemical and Environmental Sciences.* 4(4): 68-71.
16. Yadav A., Pratap B., Shivam A. K. and Patro A. (2018**):** Assess the effect of micronutrients and plant growth regulators on quality parameters of strawberry cv. Chandler. *The Pharma Innovation***.** 7(1): 303-305.
17. Yadav I., Singh J., Meena B., Singh P., Meena S., Neware S. and Patidar, D. K. (2017): The effect of foliar application of growth regulators and micronutrients on production of strawberry (*Fragaria* x *ananassa* Duch.) cv. Winter Dawn under open field conditions. *Chem. Sci. Rev. Lett.* 6(21): 589- 594.