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EFFECT OF PLANT GROWTH REGULATORS, BIOSTIMULANTS AND MICRONUTRIENTS ON GROWTH, YIELD AND QUALITY OF STRAWBERRY (*FRAGARIA X ANANASSADUCH.*) CV. WINTER DAWN UNDER RAHURI MAHARASHTRA CONDITIONS

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ABSTRACT

The present investigation was conducted during the winter season of 2024-25 at Instructional cum Horticulture Research Farm, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahilyanagar (MS), to assess the effect of plant growth regulators, biostimulants and micronutrients on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.) cv. Winter Dawn under Rahuri. The experiment was laid out in Randomized Block Design with nine treatments and three replications. On the basis of the results obtained during the course of present investigation, foliar application of (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%) at 30, 45 and 60 days after transplanting produced maximum vegetative growth in terms of plant height (19.83 cm, 29.16 cm, 36.63 cm), maximum plant spread in East-West direction of (29.71 cm, 37.03 cm, 40.56 cm) and highest number of crowns per plant of (3.87, 5.47, 6.63) were obtained at 60 DAP, 90 DAP and at final harvest respectively. The maximum plant spread in North-South direction of (28.59 cm) was obtained in T₂ (GA₃ @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5 %) at 60 DAP, at 90 DAP maximum plant spread (34.62 cm) was obtained with application of (GA₃ @ 25 ppm (Recommended dose) and at final harvest (37.78 cm) was recorded from (GA₃ @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%). However, non-significant results for plant height, plant spread in North-South and East-West direction and number of crowns per plant were obtained at 30 DAP. Foliar application of (GA₃ @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5 %) was found suitable with respect to maximum flowering and yield characters viz., days to flower initiation (37.13 days) and took minimum number of days (59.53 days) to first harvest, maximum fruit length (4.83 cm), fruit diameter (3.70 cm), highest average fruit weight (18.12 g), total number of fruits per plant (22.35), maximum fruit yield per plant (404.91 g), yield/plot (8.10 kg) and yield (20.25 t/ha). Shelf life (hrs) at ambient conditions and quality parameters like TSS (°B), titratable acidity (%), ascorbic acid content (mg/100 g of pulp), total sugars (%), reducing sugars (%) and non-reducing sugars (%) showed the non-significant results.

Key words: Strawberry, GA₃, biostimulants, micronutrients, growth, yield.

Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the world's most appealing, delicious and nutritious fruit crop belonging to the family of Rosaceae with an octaploid chromosome number of 2n = 56. It is extremely popular in modern times because of its better taste and appearance, as well as its health benefits. Strawberry

was first bred in France in 1750's via a cross of *Fragaria chiloensis* which was brought from Chile and *Fragaria virginiana* from North America. Both the wild species are products of polyploidization and natural selection. It is presently cultivated in many countries of the world from the arctic to the tropics due to wider climatic as well as soil adaptation. It is basically a temperate fruit

crop. However, in recent years, there has been phenomenal increase in its area and production in tropical and subtropical plains of India (Sharma and Sharma, 2004). In temperate climatic conditions, it behaves as a small perennial herb with shallow root system whereas in sub-tropical climate it behaves as an annual.

Strawberry is a rich source of vitamins and minerals and coupled with delicate flavour and red colour of the fruit is mainly due to the presence of the anthocyanin, pelargonidin, 3 monoglucoside and traces of cyaniding. It is a rich source of vitamin A (60 IU/100g of edible portion), vitamin C (30–120 mg/100 g of edible portion), fibre, pectin (0.55%) and has a low calorie carbohydrate content and is high in carotenoids, flavonoids, phenols and glutathione (Sharma and Negi, 2019).

Strawberry response positively to the application of plant growth regulators. The plant growth regulators are the plant hormone enhancers which are man-made or naturally derived. Different plant growth regulators perform different function on strawberry. Various PGRs like Auxin, gibberellin and cytokinin are used in strawberry. Gibberellic acid (GA_3) is a growth regulator which stimulate the effect of long day lengths in a short-day plant by improving vegetative development and increasing runner production. Gibberellic acid progressively increases the plant height, canopy spread, leaf area, number of leaves, petiole length and induces stem elongation when applied exogenously to strawberry plants (Sharma and Singh 2009). Biostimulants are the substances applied to agricultural and horticultural crops to enhance the yield, quality, augment plant tolerance to biotic or abiotic stress and increase nutritional efficacy (Jardin, 2015). Isabion is an amino acid, nutrient based bio-stimulant, a natural biological activator which activates plant potency, regulates plant metabolism, increases plant vigour, maximizes crop performance in terms of growth, vigour, yield and quality (Botta, 2013). Prophite is a biostimulant known as Potassium Salt of Active Phosphorous which is chemically known as potassium phosphonate (H_3PO_3) a dynamic component chemical within the plants as phosphonate (phosphate) or phosphonic acid which is the active constituent working against the plant pathogen (Dunhill, 1990). Strawberry is a heavy feeder of nutrients it requires a balanced supply of macro and micronutrients to ensure the high yield and quality.

Micronutrients performs an essential role in the production of fruit crops and their deficiencies largely affect the quality of fruits. Zinc plays an important role in photosynthesis and related enzymes resulting in increasing sugar and decreasing the acidity. It is effective in plant

nutrition for the synthesis of plant hormones and balancing the intake of P and K inside the plant cells. Iron is an essential component of many enzymes which has several important functions in plant growth and development such as involvement in the biosynthesis of chlorophyll, respiration, chloroplast development and improves the performance of photosystems. Boron is essential for plant growth, new cell division in meristematic tissue, translocation of sugar, starch, nitrogen, phosphorus, certain hormones, synthesis of amino acids and protein, regulations of carbohydrate metabolism, development of phloem etc. Manganese (Mn) participates in the assimilation of carbon dioxide in photosynthesis. It aids in the synthesis of chlorophyll and in nitrate assimilation. Manganese activates the fat forming enzymes and functions in the formation of riboflavin, ascorbic acid, carotene and electron transport during photosynthesis. Copper is essential for photosynthesis and mitochondrial respiration and for carbon and nitrogen metabolism. Copper supports enzymatic processes and nutrient uptake, vital for plant vigour and fruit development, thereby enhancing the overall yield. Molybdenum (Mo) is a micronutrient which is a trace element for plant growth. Once molybdate enters the cell, it is subsequently incorporated by complex biosynthetic machinery into Mo co-factors (Moco). Mo is involved in nitrogen (N) metabolism of plants.

Materials and Methods

The present investigation was carried out at Instructional cum Horticulture Research Farm, Department of Horticulture, MPKV., Rahuri during the year 2024-2025 to study the effect of plant growth regulators, biostimulants and micronutrients on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.) cv. Winter Dawn under Rahuri conditions. Rahuri is situated in semi-arid region of eastern side of Western Ghat 19°47 North latitude and 74°19 East longitudes, falls under the rain shadow area. The transplanting was carried during October 2024. A unit of twenty runners comprising a treatment was planted in each replication at spacing of 30 × 30 cm on the raised beds taking care that the crown of the runners lies just at the surface of soil. Silver Black polythene mulch (30 micron thickness) was applied at the time of transplanting. All plant were kept with uniform cultural practices. *i.e.* fertigation, irrigation and plant protection etc. A total of nine treatments replicated thrice were executed in randomized block design. Nine treatments viz., T_1 GA_3 @ 25 ppm (Recommended dose), T_2 (GA_3 @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%), T_3 (Isabion @ 2ml/lit), T_4 (Isabion @ 2ml/lit and Phule liquid micronutrient grade II @ 0.5%),

T₅(Profite @ 4 g/lit), T₆(Profite @ 4 g/lit and Phule liquid micronutrient grade II @ 0.5%), T₇ (Phule liquid micronutrient grade II @ 0.5%), T₈(Phule liquid micronutrient grade II @ 1.0%) and T₉(Control (Water spray) which were applied at 30, 45 and 60 days after planting.

The observations on plant height, plant spread NS and EW recorded in centimeter with the help of meter scale, number of crowns per plant was measured by visual observation and these growth parameters were recorded at 30, 60, 90 and at final harvest from five random competitive plants from each replication and observations were recorded. The average value of each observation was calculated. Total number of fruits per plant, average fruit weight in gram was computed and yield of fruit per plant gram was recorded. The yield per hectare in tons were recorded by yield per plant multiplied with total number of plants per hectare. Data pertaining to fruit weight were recorded at each harvest and average was taken after completion of all harvests. Fully ripen fruits were collected for estimation of biochemical constituents of fruits like TSS (°Brix), titratable acidity, ascorbic acid (mg/100 g of pulp), total sugars (%), reducing sugars (%) and non-reducing sugar (%) determined by standard procedure of A.O.A.C. (1990). These data were subjected to statistical analysis following standard procedures (Panse and Sukhatme, 1978).

Results and Discussion

The experimental results are presented under the following heads and sub heads.

Growth parameters

The data pertaining to plant height, plant spread NS-EW and number of crowns per plant were found non-significant at 30 DAP as there was no application of plant growth regulators, biostimulants and micronutrients before 30 DAP.

Plant height

During the course of the investigation, it has been observed that a significant increase in plant height of (19.83cm, 29.16 cm, 36.63 cm) in T₂ (GAf @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%) at 60, 90 DAP and at final harvest respectively. While minimum plant height (13.72 cm, 22.09 cm, 28.78 cm) was recorded in T₉ Control (Water spray) at 60, 90 DAP and at final harvest respectively. The increase in plant height might be due to the fact that gibberellins regulated the growth of strawberry plants by causing cell elongation and increased cell division. Thereby enhanced vegetative growth in strawberry by overcoming genetic dwarfism. And due to availability of optimum quantity of

micronutrient like iron, zinc, magnesium, boron and copper within the plant system as these element plays an essential role in plant growth resulted in increasing the plant height are in line with the results obtained by Bakshi *et al.*, (2013), Mehraj *et al.*, (2015), Palei *et al.*, (2016), Vishal *et al.*, (2016), Ekka *et al.*, (2018), Singh *et al.*, (2020), Krishna *et al.*, (2024).

Plant spread (cm)

Significant difference was observed with respect to plant spread in both North-South and East-West direction. The maximum plant spread (28.59 cm) in North-South direction was obtained in T₂ (GAf @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%) at 60 DAP, (34.62 cm) was obtained from T₁ (GA₃ @ 25 ppm (Recommended dose) at 90 DAP and at final (37.78 cm) was recorded from T₂ (GAf @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%). The maximum plant spread in East -West direction of (29.71 cm, 37.03 cm, 40.56 cm) was obtained in T₂ (GAf @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%) at 60 DAP, 90 DAP and at final harvest. The minimum plant spread (18.81 cm, 24.45 cm, 27.54 cm) North-South direction, (19.94 cm, 26.81 cm, 30.39 cm) in East-West direction were obtained at 60, 90 DAP and at final harvest respectively in T₉ Control (Water spray). The increase in plant spread might be due to the fact that gibberellins regulate the growth of strawberry plants by causing cell elongation and a corresponding increase in epidermal and parenchyma's cell length. It could be attributed to increased length and upright growth of leaf petioles which lean outwards resulting in higher plant spread. And also due to the application of micronutrients like Zn + B + Fe might have stimulated cell division and cell elongation resulting in increased plant spread. These results are in close agreement with the findings reported by Bakshi *et al.*, (2013), Palei *et al.*, (2016), Vishal *et al.*, (2016), Ekka *et al.*, (2018), Kharjana *et al.*, (2022), Krishna *et al.*, (2024) in strawberry.

Number of crowns per plant

The maximum number of crowns per plant (3.87, 5.47, 6.63) was found in treatment T₂ (GAf @ 25 ppm + Phule liquid micronutrient Grade II @ 0.5%). While the least number of crowns per plant (2.53, 3.53, 4.20) was recorded in T₉ Control (Water spray) at 60, 90 DAP and at final harvest respectively. The increase in number of crowns per plant was due to GA₃ regulation increases the cell elongation. And influence of micronutrients like iron, zinc and boron help in cell division, elongation and growth of meristematic tissue and also due to enhanced photosynthesates which forced plant to produce maximum

Table 1: Effect of PGR's, biostimulants and micronutrients on plant height (cm) and plant spread NS (cm) of strawberry cv. Winter Dawn.

Treatment No.	Plant height (cm)				Plant spread NS (cm)			
	30DAP	60 DAP	90 DAP	At final harvest	30 DAP	60 DAP	90 DAP	At final harvest
T ₁	12.33	17.86	27.79	35.74	13.33	27.15	34.62	36.89
T ₂	12.69	19.83	29.16	36.63	13.69	28.59	34.30	37.78
T ₃	11.66	17.46	24.51	30.15	12.66	26.67	30.18	31.77
T ₄	12.58	17.87	24.00	28.91	13.58	25.69	32.07	34.13
T ₅	10.79	15.65	22.15	27.35	11.79	23.17	28.66	31.67
T ₆	12.24	16.11	25.62	33.27	13.24	25.83	28.93	32.78
T ₇	10.60	16.57	25.42	32.50	11.60	24.36	28.52	31.40
T ₈	11.75	16.83	27.80	36.57	12.75	24.85	30.13	33.98
T ₉	10.13	13.72	22.09	28.78	12.47	18.81	24.45	27.54
S.Em. ±	0.67	0.85	0.88	1.18	0.81	1.27	1.20	1.10
C. D. at 5%	NS	2.56	2.64	3.53	NS	3.80	3.59	3.30
(T ₁ GA ₃ @ 25 ppm (Recommended dose), T ₂ (GA ₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%), T ₃ (Isabion @ 2ml/lit), T ₄ (Isabion @ 2ml/lit and Phule liquid micronutrient grade II @ 0.5%), T ₅ (Profite @ 4 g/lit), T ₆ (Profite @ 4 g/lit and Phule liquid micronutrient grade II @ 0.5%), T ₇ (Phule liquid micronutrient grade II @ 0.5%), T ₈ (Phule liquid micronutrient grade II @ 1.0%) and T ₉ (Control (Water spray)								

number of crowns per plant. These findings are in line with the results obtained by Tripathi and Shukla (2008) and Ruchitha *et al.*, (2020).

Flowering characters

Days to flower initiation

It is evident from the data that the combined T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5 %) took minimum number of days (37.13 days) to initiate its first flower. However, T₉ Control (Water spray) took maximum number of days (40.73 days) to initiate its first flower among the various treatments. Gibberellins which is responsible for vigorous growth of plant in all the vegetative stages, where they can store sufficient amount of photosynthates for producing a greater number of flowers. Gibberellins also known to overcome the endogenous dormancy factors and promotes flowering by causing rapid growth of flower primordia thereby initiating the early flower in plants sprayed with gibberellins. Also might be due to the foliar application micronutrient mainly boron and iron which promotes the formation of florigen (hypothetical hormone) from leaf to the leaf axils thus produces early flowering in strawberry plants. The results are in the conformity with the findings of Tripathi and Shukla (2008), Prasad *et al.*, (2012), Kumar *et al.*, (2014), Mehraj *et al.*, (2015), Yadav *et al.*, (2017), Kumar *et al.*, (2021), Rathod *et al.*, (2021), Kharjana *et al.*, (2022), Bagh *et al.*, (2024), Deshwal *et al.*, (2024), Krishna *et al.*, (2024).

Yield characters

Days to first harvest

It is clear from the data, that treatment T₂ (GA₃ @

25 ppm and Phule liquid micronutrient grade II @ 0.5 %) took minimum number of days (59.53 days) to first harvest. In contrast T₉ Control (Water spray) took the maximum number of days (67.29 days) to first harvest. It might be due to exogenous application of GA₃ increases the level of endogenous gibberellins and plays an important role in breaking dormancy which ultimately took fewer days to first fruit set and first harvesting. Foliar application of iron also decreased the number of days taken to flower, fruit development and early harvesting since iron is important for formation of a large number enzymes and degradation of chlorophyll. These are in conformity with the findings of Prasad *et al.*, (2012), Yadav *et al.*, (2017), Kumar *et al.*, (2021) and Bagh *et al.*, (2024).

Fruit length (cm)

The maximum length of the fruit (4.83 cm) was noticed in T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%) while the minimum fruit length (3.03 cm) was recorded in T₉ Control (Water spray).

Fruit diameter (cm)

The maximum fruit diameter (3.70 cm) was found in T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%) and T₉ Control (Water spray) resulted in minimum diameter of the fruit (2.57 cm). The increase in fruit length and fruit diameter could be owing to the higher carbohydrate levels and GA₃ could have encouraged cell division and cell elongation, role in plant metabolism in terms of better supply of water, nutrients and other compounds vital for their proper growth and development resulting in maximum fruit length and diameter of the fruits. And also, it might be due to the effect of zinc, as

Table 2: Effect of PGR's, biostimulants and micronutrients on plant spread EW (cm) and number of crowns per plant of strawberry cv. Winter Dawn.

Treatment No.	Plant spread EW (cm)				Number of crowns per plant			
	30DAP	60 DAP	90 DAP	At final harvest	30 DAP	60 DAP	90 DAP	At final harvest
T ₁	14.83	26.65	33.17	37.15	1.47	3.73	5.07	6.13
T ₂	15.19	29.71	37.03	40.56	1.53	3.87	5.47	6.63
T ₃	14.16	26.13	32.35	35.34	1.33	2.87	4.33	5.33
T ₄	15.08	24.75	30.50	33.95	1.53	3.40	4.80	5.95
T ₅	13.29	22.49	28.95	33.29	1.47	2.67	4.02	4.87
T ₆	14.74	24.29	29.83	33.45	1.67	2.80	3.87	4.85
T ₇	13.10	24.38	29.76	35.13	1.20	3.33	4.93	5.93
T ₈	14.25	26.67	33.52	37.35	1.53	3.80	5.10	6.33
T ₉	13.67	19.94	26.81	30.39	1.33	2.53	3.53	4.20
S.Em. ±	0.74	1.26	1.34	1.12	0.14	0.18	0.18	0.27
C. D. at 5%	NS	3.78	4.01	3.35	NS	0.54	0.53	0.80
(T ₁ GA ₃ @ 25 ppm (Recommended dose), T ₂ (GA ₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%), T ₃ (Isabion @ 2ml/lit), T ₄ (Isabion @ 2ml/lit and Phule liquid micronutrient grade II @ 0.5%), T ₅ (Profite @ 4 g/lit), T ₆ (Profite @ 4 g/lit and Phule liquid micronutrient grade II @ 0.5%), T ₇ (Phule liquid micronutrient grade II @ 0.5%), T ₈ (Phule liquid micronutrient grade II @ 1.0%) and T ₉ (Control (Water spray)								

zinc plays an important role in the starch formation and other activity involving in the plant is transportation of carbohydrate and another function of zinc in plant is faster loading and mobilization of photo assimilates to the fruits and involvement in cell division, cell expansion, ultimately reflected into more length and diameter of the fruits in treated plants. The current results are in the accordance with the findings of Bakshi *et al.*, (2013), Mehraj *et al.*, (2015), Ekka *et al.*, (2018), Singh *et al.*, (2020), Yadav *et al.*, (2017), Paikra *et al.*, (2020), Kumar *et al.*, (2021), Rathod *et al.*, (2021), Singh *et al.*, (2022), Beniwal *et al.*, (2024) and Krishna *et al.*, (2024).

Average fruit weight (g)

The maximum average fruit weight (18.12 g) was observed in T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5 %). In contrast the minimum average fruit weight (15.10 g) was observed in T₉ Control (Water spray). It might be due to GA₃ accelerated all vegetative components and as a result, these plants have generated more food material for fruit development. And application of micronutrients like boron, zinc and iron increases the fruit weight by cell division, cell elongation, sugar metabolism and accumulation of carbohydrates and other photosynthates ultimately reflected into more weight of fruits in treated plants. The results are in accordance with the findings of Bakshi *et al.*, (2013), Mehraj *et al.*, (2015), Yadav *et al.*, (2017), Ekka *et al.*, (2018), Kumar *et al.*, (2021), Rathod *et al.*, (2021), Singh *et al.*, (2022), Bagh *et al.*, (2024), Beniwal *et al.*, (2024), Deshwal *et al.*, (2024) and Krishna *et al.*, (2024).

Total number of fruits per plant

Among different treatments T₂ (GA₃ @ 25 ppm and

Phule liquid micronutrient grade II @ 0.5 %) recorded the maximum number of fruits/plant (22.35). While, the least number of fruits/plant (18.35) was found in T₉ Control (Water spray). Highest number of fruits per plant is due to the gibberellins causes the production of large number of flowers with rapid elongation of peduncle, leading to full development of flower buds having all reproductive parts functional thereby accelerates development of differentiated inflorescence, which increases fruit set and number of berries per plant. Also influence of micronutrients like iron, boron and zinc where iron is involved in synthesis of chlorophyll, the pigment that facilitates photosynthesis, thereby promoting the growth of primary flowers, increasing the output of viable flowers and boron enhancing pollination and facilitating a greater number of fruit setting. The current results are in the accordance with the findings reported by Tripathi and Shukla (2008), Prasad *et al.*, (2012), Paikra *et al.*, (2020), Ruchitha *et al.*, (2020), Singh *et al.*, (2020), Rathod *et al.*, (2021) and Singh *et al.*, (2022).

Fruit yield/plant (g)

It is evident from the data presented that the highest fruit yield per plant (404.91 g) was registered in treatment T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5 %). Whereas, T₉ Control (Water spray) recorded the minimum fruit yield/plant (277.09 g). The increase in fruit yield per plant is due to gibberellins treated plants increased in vegetative growth (plant spread, number of crowns and leaves etc.) which enables higher fruit set and fruit weight. And due to the formation of more metabolites by large leaves and high rate of photosynthesis. The beneficial effect of zinc and boron

Table 3: Effect of PGR's, biostimulants and micronutrients on days to flower initiation, days to first harvest, fruit length (cm) and fruit diameter (cm) strawberry cv. Winter Dawn.

Tr. No.	Days to flower initiation	Days to first harvest	Fruit length (cm)	Fruit diameter (cm)
T ₁	38.47	60.07	4.69	3.58
T ₂	37.13	59.53	4.83	3.70
T ₃	37.87	61.01	3.83	3.13
T ₄	37.27	61.20	4.52	3.42
T ₅	37.87	62.27	3.45	3.05
T ₆	38.27	63.07	3.81	3.38
T ₇	38.73	62.20	4.09	3.23
T ₈	38.40	60.27	4.33	3.44
T ₉	40.73	67.29	3.03	2.57
S.E.m. ±	0.66	1.43	0.12	0.10
C. D. at 5%	1.97	4.28	0.36	0.30

(T₁ GA₃ @ 25 ppm (Recommended dose), T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%), T₃ (Isabion @ 2ml/lit), T₄ (Isabion @ 2ml/lit and Phule liquid micronutrient grade II @ 0.5%), T₅ (Profite @ 4 g/lit), T₆ (Profite @ 4 g/lit and Phule liquid micronutrient grade II @ 0.5%), T₇ (Phule liquid micronutrient grade II @ 0.5%), T₈ (Phule liquid micronutrient grade II @ 1.0%) and T₉ (Control (Water spray)

on fruit set and reducing fruit drop might be due to the higher availability of photosynthates. These chemicals are also associated with hormone metabolism which promotes synthesis of auxin resulting in increasing the maximum fruit yield per plant. The results are in accordance with the findings of Prasad *et al.*, (2012), Kumar *et al.*, (2014), Ekka *et al.*, (2018), Paikra *et al.*, (2020), Ruchitha *et al.*, (2020), Singh *et al.*, (2020), Kumar *et al.*, (2021), Singh *et al.*, (2022), Bagh and Mishra (2024), Beniwal *et al.*, (2024), Deshwal *et al.*, (2024) and Krishna *et al.*, (2024).

Yield/plot (kg)

The highest fruit yield/ plot (kg) (8.10 kg) was found maximum in T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5 %). However, the lowest yield/plot (5.54 kg) was noticed in T₉ Control (Water spray).

Yield (t/ha)

The data concerning to the yield (t/ha) was found to have a significant result to the foliar application of treatment T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5 %) confirmed the highest yield (20.25 t/ha). While, the T₉ Control (Water spray) resulted lowest yield (13.85 t/ha). The highest yield may be due to increased flowering and more fruit set, higher fruit weight and size, Higher diversion of photosynthates

Table 4: Effect of PGR's, biostimulants and micronutrients on average fruit weight, total number of fruits/plant and yield parameters on strawberry cv. Winter Dawn.

Tr. No.	AFW	TNF	FYP	YP	Y
T ₁	17.72	20.37	360.83	7.22	18.04
T ₂	18.12	22.35	404.91	8.10	20.25
T ₃	15.90	19.40	308.46	6.17	15.42
T ₄	16.32	20.25	330.41	6.61	16.52
T ₅	15.88	18.93	300.72	6.01	15.04
T ₆	16.22	20.08	325.68	6.51	16.28
T ₇	16.15	19.98	322.73	6.45	16.14
T ₈	17.45	21.08	367.90	7.36	18.40
T ₉	15.10	18.35	277.09	5.54	13.85
S.E.m. ±	0.62	0.67	17.71	0.35	0.89
C. D. at 5%	1.85	2.01	53.08	1.06	2.65

[AFW: Average fruit weight (g); TNF: Total number of fruits/plant; FYP: Fruit yield/plant(g); YP: Yield/plot (kg); Y: Yield (t/ha)]
(T₁ GA₃ @ 25 ppm (Recommended dose), T₂ (GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5%), T₃ (Isabion @ 2ml/lit), T₄ (Isabion @ 2ml/lit and Phule liquid micronutrient grade II @ 0.5%), T₅ (Profite @ 4 g/lit), T₆ (Profite @ 4 g/lit and Phule liquid micronutrient grade II @ 0.5%), T₇ (Phule liquid micronutrient grade II @ 0.5%), T₈ (Phule liquid micronutrient grade II @ 1.0%) and T₉ (Control (Water spray)

to sink (berries), resulting in increased fruit yield. Additionally, GA₃ boosted the nutrient supply and other chemicals to the fruits, which is essential for their optimal growth and development, resulting in increased fruit size and ultimately, higher production. The micronutrients like boron enhances flower formation and pollen germination, crucial for robust flowering in plants like strawberries, zinc role in enhancing pollination and fruit set. Additionally, zinc is known to accelerate photosynthetic activity and the translocation of photosynthates, thereby contributing to the enlargement of fruit size, copper supports enzymatic processes and nutrient uptake, vital for plant vigour and fruit development, thereby enhancing overall yield. The similar results were in the conformity with Prasad *et al.*, (2012), Kumar *et al.*, (2014), Paikra *et al.*, (2020), Singh *et al.*, (2020), Singh *et al.*, (2022), Bagh and Mishra (2024), Beniwal *et al.*, (2024) and Krishna *et al.*, (2024).

Quality parameters

The quality parameters like TSS (°B), titratable acidity (%), ascorbic acid content (mg/100 g of pulp), total sugars (%), reducing sugars (%) and non- reducing sugars (%) showed the non-significant results among the treatments with the application of plant growth regulators, biostimulants and micronutrients on strawberry cv. Winter Dawn. However, the treatment T₈ (Phule liquid micronutrient grade II @ 1.0%) recorded the highest numerical value for TSS (8.22°B), ascorbic acid content

(58.41 (mg/100 g of pulp), total sugars (7.43%), reducing sugars (5.86 %) and least numerical value for titratable acidity (0.84 %). The treatment T₇ (Phule liquid micronutrient grade II @ 0.5%) recorded the highest numerical value (2.40 %) for non-reducing sugar. The treatment T₉ Control (Water spray) showed the maximum numerical value for titratable acidity (0.98 %) and minimum numerical value for TSS (7.77⁰B), ascorbic acid content (55.53 mg/100 g of pulp), total sugars (6.30 %), reducing sugars (4.93 %) and non-reducing sugars (1.30 %).

Conclusion

On the basis of forgoing results, it may be inferred that application of GA₃ @ 25 ppm and Phule liquid micronutrient grade II @ 0.5% at 30, 45 and 60 days found to be the best treatment over rest of the treatment for enhancing growth and yield of strawberry cv. Winter Dawn under Rahuri, Maharashtra conditions.

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