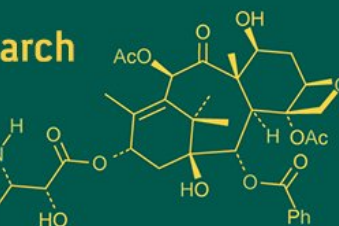
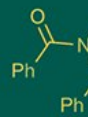


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Himanshu Patel
M.Sc. Scholar, Maharshi
School of Agriculture,
Maharshi University of
Information Technology
(MUIT), Lucknow, Uttar
Pradesh, India

Sharvan Kumar
Assistant Professor,
Department of Fruit Science,
Maharshi School of
Agriculture, Maharshi
University of Information
Technology (MUIT), Lucknow,
Uttar Pradesh, India

Dheeraj Yadav
Assistant Professor,
Department of Fruit Science,
Maharshi School of
Agriculture, Maharshi
University of Information
Technology (MUIT), Lucknow,
Uttar Pradesh, India

Nitin Gour
Ph.D., Research Scholar,
Department of Agronomy,
Banda University of
Agriculture and Technology
Banda, Uttar Pradesh, India

Pallavi Nandan
M.Sc. Scholar, Department of
Agronomy, Banda University
of Agriculture and Technology
Banda, Uttar Pradesh, India

Corresponding Author:
Nitin Gour
Ph.D., Research Scholar,
Department of Agronomy,
Banda University of
Agriculture and Technology
Banda, Uttar Pradesh, India

Response of organic and inorganic manures on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv. “Winter Dawn”

Himanshu Patel, Sharvan Kumar, Dheeraj Yadav, Nitin Gour and Pallavi Nandan

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Abstract

A field experiment was conducted during the *rabi* season of 2024-25 at the Research Farm of Maharshi School of Agriculture, Maharshi University of Information Technology (MUIT), Lucknow, Uttar Pradesh, To evaluate the effect of different organic and inorganic manures on growth, flowering, yield and fruit quality of strawberry (*Fragaria × ananassa* Duch.) cv. ‘Winter Dawn’. The experiment was laid out in a Randomized Block Design with eight treatments and three replications. The treatments comprised control, recommended dose of fertilizers (RDF), Panchagavya foliar spray (3%), Panchagavya soil drenching, seaweed extract foliar spray, microbial consortium soil application, Panchagavya + FYM and an integrated bio-enhancer package consisting of Panchagavya + seaweed extract + microbial consortium. Black and white polythene mulches were also evaluated for their influence on crop performance. Significant differences were observed among the treatments for major growth, flowering and yield attributes. RDF recorded the maximum crown height (1.84 cm), petiole length (13.08 cm), number of leaves plant⁻¹ (19.18) and total chlorophyll content (2.02 mg g⁻¹), while the control recorded the lowest values. RDF also resulted in the earliest flower initiation (77.53 days) and superior yield performance. The maximum fruit length (38.97 mm), fruit width (28.80 mm), average fruit weight (17.89 g), number of fruits plant⁻¹ (15.76) and fruit yield (229.49 g plant⁻¹) were recorded under RDF. Among the bio-enhancer treatments, the integrated bio-enhancer package, microbial consortium soil application and seaweed extract foliar spray showed comparatively better performance, producing fruit yields of 201.42, 200.13 and 198.78 g plant⁻¹, respectively. The L/D ratio was not significantly influenced by the treatments.

Keywords: Bio-enhancer, Panchagavya, Seaweed extract, Microbial, Yield

Introduction

Strawberry (*Fragaria × ananassa* Duch.) is an important fruit crop belonging to the family *Rosaceae* and is valued for its attractive appearance, pleasant flavour, delicate texture and high nutritional and commercial importance. Cultivated strawberry is octaploid (2n = 56) and is grown under both plains and hilly conditions. The crop has a relatively short production period, with fruits generally harvested within 60-155 days after transplanting, which makes it attractive for commercial production and rapid returns to growers. Besides fresh consumption, strawberry fruits are widely utilized by the processing, confectionery and food industries.

Strawberry production has expanded considerably in different parts of the world because of increasing consumer demand and its high-value nature. According to the FAO (2016) information reported in the present thesis, Asia contributed about 51.4% of global strawberry production, with approximately 1.77 lakh ha under cultivation and annual production of about 4.68 million tonnes. On the basis of these values, the approximate productivity works out to about 2.64 t ha⁻¹. Major strawberry-producing countries include China, Poland, the Russian Federation, the United States of America, Turkey, Germany, Mexico, Belarus, Ukraine and Spain. In India, strawberry is cultivated in Maharashtra, Haryana and several hill regions, including Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Meghalaya, Mizoram, Tamil Nadu and Darjeeling in West Bengal. The crop is also gaining importance in

the plains of northern India, where suitable winter conditions provide opportunities for commercial cultivation. Among the improved cultivars, 'Winter Dawn' has potential for cultivation under subtropical conditions because of its early maturity, attractive fruit characteristics, yield potential and adaptability Wani *et al.* (2013) [10]. However, successful strawberry production in subtropical regions requires appropriate management of plant nutrition, soil moisture and the soil microclimate. Strawberry is a surface-feeding crop with a shallow root system and therefore responds considerably to changes in soil moisture and nutrient availability. Efficient nutrient management is particularly important because nitrogen, phosphorus and potassium play major roles in vegetative growth, root development, flowering, fruit development, sugar accumulation and overall fruit quality Singh *et al.* (2010) [19].

Conventional fertilizer application can provide readily available nutrients and support rapid crop growth, but increasing emphasis on sustainable horticultural production has encouraged the evaluation of biological and organic inputs as complementary nutrient-management options. Bio-enhancers such as Panchagavya, seaweed extract and microbial consortia may improve plant physiological activity, nutrient-use efficiency and rhizospheric microbial activity Patel *et al.* (2022) [1]. Seaweed extracts have been reported to enhance vegetative growth, chlorophyll development, nutrient absorption and fruit production, whereas beneficial microbial inoculants can improve nutrient availability and plant nutrient uptake through enhanced microbial activity in the rhizosphere Sonker *et al.* (2025).

In view of the increasing importance of strawberry cultivation in subtropical regions and the need for efficient and sustainable nutrient-management practices, evaluation of bio-enhancer along with suitable mulching becomes relevant. The present investigation was therefore undertaken at Lucknow during *rabi* 2024-25 to assess the influence of selected bio-enhancers and nutrient-management treatments, namely recommended dose of fertilizers, Panchagavya, seaweed extract, microbial consortium, Panchagavya + FYM and their integrated application, in combination with black and white mulches, on the growth, flowering, yield and fruit quality of strawberry cv. 'Winter Dawn'. The experiment was designed to identify treatments capable of improving crop productivity while providing a more sustainable approach to strawberry production under subtropical conditions.

Materials and Methods

A field experiment was conducted during the *rabi* season of 2024-25 at the Research Farm of Maharshi School of Agriculture, Maharshi University of Information Technology (MUIT), Lucknow, Uttar Pradesh, India, located at approximately 26.85° N latitude, 80.95° E longitude and 123 m above mean sea level. The experimental soil was sandy loam, nearly neutral in reaction (pH 7.3), with 0.54% organic carbon, 265 kg ha⁻¹ available N, 22.4 kg ha⁻¹ available P and 248 kg ha⁻¹ available K. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments and three replications. The treatments comprised (T₁) control, (T₂) recommended dose of fertilizers (RDF), (T₃) Panchagavya foliar spray (3%), (T₄) Panchagavya soil drenching, (T₅) seaweed extract foliar spray, (T₆) microbial consortium soil application, (T₇)

Panchagavya + FYM and (T₈) integrated bio-enhancer package (Panchagavya + seaweed extract + microbial consortium). The RDF consisted of 100 kg N, 60 kg P₂O₅ and 60 kg K₂O ha⁻¹, while FYM was applied at 20 t ha⁻¹. Panchagavya foliar spray was applied at 30, 45 and 60 days after transplanting (DAT), soil drenching at transplanting and 30 DAT, seaweed extract at 30 and 60 DAT, and microbial consortium at transplanting. Healthy runners of strawberry cv. "Winter Dawn" were planted at 30 × 45 cm spacing on raised beds. Black and white plastic mulches were used to evaluate their influence on crop performance. Observations on growth, flowering, yield and fruit-quality attributes were recorded from randomly selected plants. The recorded data were subjected to analysis of variance appropriate for RBD, and treatment means were compared using the critical difference (CD) at the 5% level of significance.

Analysis of Attributes

Observations were recorded from five randomly selected plants per plot for growth, flowering, yield and fruit-quality attributes. Growth parameters included plant height, number of leaves plant⁻¹, leaf area, plant spread, crown diameter, number of crowns plant⁻¹ and root length. Flowering parameters comprised days to first flowering, days to 50% flowering, number of flowers plant⁻¹, flowering duration and fruit-set percentage. Yield attributes included number of fruits plant⁻¹, average fruit weight, yield plant⁻¹, yield plot⁻¹, yield hectare⁻¹, and marketable and non-marketable fruit percentage. Fruit-quality characteristics were assessed through fruit length, fruit width, individual fruit weight, firmness, colour, external appearance, pedicel length and shelf life. Fruit number was counted manually, fruit weight was measured using a digital balance, and fruit dimensions were measured using a vernier caliper. The recorded data were subjected to analysis of variance (ANOVA) under Randomized Block Design, and treatment means were compared using the critical difference (CD) at 5% significance level.

Results and Discussion

Crown Height (cm)

Crown height was significantly influenced by different bio-enhancer treatments. The maximum crown height was recorded under recommended dose of fertilizers (RDF) (1.84 cm), followed by seaweed extract foliar spray (1.60 cm), while the minimum was observed in control (0.98 cm). The higher crown height under RDF may be attributed to adequate and balanced nutrient availability, which promoted cell division, elongation and vegetative growth of strawberry plants. Similar improvement under bio-enhancer treatments may be associated with enhanced nutrient uptake and stimulation of plant growth-promoting physiological processes.

Petiole Length (cm)

The maximum petiole length was recorded with RDF (13.08 cm), followed by Panchagavya foliar spray (12.60 cm) and Panchagavya soil drenching (12.47 cm), whereas the control recorded the minimum value (10.01 cm). RDF produced significantly longer petioles than most bio-enhancer treatments, indicating the importance of adequate nutrient supply for vigorous vegetative development. The improvement with Panchagavya treatments may be due to

the presence of beneficial microorganisms, growth-promoting substances and readily available nutrients that favour cell elongation and leaf development.

Number of Leaves Plant⁻¹

The number of leaves plant⁻¹ varied considerably among the treatments, with RDF recording the maximum number of leaves (19.18), followed by Panchagavya foliar spray (17.84) and seaweed extract foliar spray (16.79). The control produced the fewest leaves (12.84). The greater leaf production under RDF could be attributed to better nitrogen and other nutrient availability, which enhanced meristematic activity and leaf initiation. bio-enhancer also improved leaf production over control, probably through improved nutrient assimilation and stimulation of physiological activity.

Total Chlorophyll Content (mg g⁻¹)

Total chlorophyll content was highest under RDF (2.02 mg g⁻¹), followed by Panchagavya soil drenching (1.89 mg g⁻¹) and Panchagavya foliar spray (1.83 mg g⁻¹), while the lowest value was observed in control (1.60 mg g⁻¹). The higher chlorophyll concentration under RDF may be associated with adequate nitrogen and other essential nutrients required for chlorophyll synthesis and maintenance of photosynthetic pigments. Panchagavya and other bio-enhancer also improved chlorophyll content, possibly by enhancing nutrient availability and microbial activity in the

rhizosphere.

Plant Spread (East-West) (cm)

Plant spread in the East-West direction was maximum with RDF (27.65 cm), followed by Panchagavya foliar spray (26.43 cm) and Panchagavya + FYM treatment (25.78 cm), whereas the control recorded the lowest spread (20.55 cm). RDF resulted in the highest plant spread because balanced nutrient availability promoted leaf expansion, crown development and overall vegetative growth. Although Panchagavya foliar spray recorded a relatively high value, its difference from RDF was not statistically significant as per the reported CD (1.87 cm), suggesting comparable performance for this attribute.

Plant Spread (North-South) (cm)

The maximum North-South plant spread was observed with Panchagavya foliar spray (25.13 cm), followed by RDF (24.53 cm), whereas the minimum was recorded under control (21.45 cm). The higher plant spread under Panchagavya foliar application may be attributed to improved physiological activity and the presence of growth-promoting substances that favour canopy expansion. However, the difference between Panchagavya foliar spray and RDF was smaller than the CD (1.66 cm) and therefore was not statistically significant, indicating comparable performance of both treatments.

Table 1: Effect of different organic and inorganic sources of nutrients on growth attributes of strawberry (*Fragaria × ananassa* Duch.) cv. 'Winter Dawn'

Treatment	Crown height (cm)	Petiole length (cm)	Number of leaves plant ⁻¹	Total chlorophyll content (mg g ⁻¹)	Plant spread (East-West)	Plant spread (North-South)
Control	0.98	10.01	12.84	1.60	20.55	21.45
Recommended Dose of Fertilizers (RDF)	1.84	13.08	19.18	2.02	27.65	24.53
Panchagavya foliar spray (3%)	1.31	12.60	17.84	1.83	26.43	25.13
Panchagavya soil drenching	1.44	12.47	16.21	1.89	24.86	23.87
Seaweed extract foliar spray	1.60	10.79	16.79	1.77	24.74	23.58
Microbial consortium soil application	1.39	10.89	15.63	1.75	23.89	22.94
Panchagavya + FYM (soil + foliar application)	1.69	10.87	15.34	1.72	25.78	23.44
Integrated bio-enhancer package	1.40	10.45	15.89	1.74	25.42	23.76
SEm ±	0.01	0.14	0.17	0.06	0.64	0.57
CD (P=0.05)	0.04	0.44	0.51	0.18	1.87	1.66

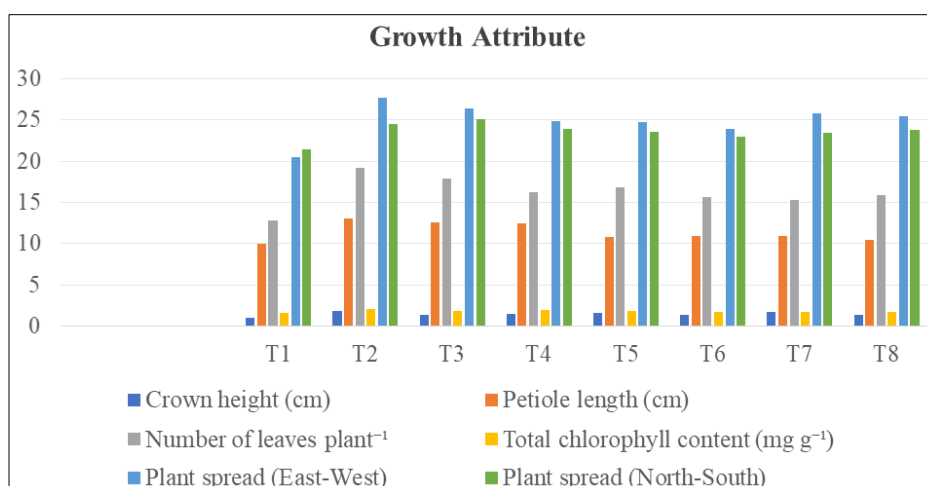


Fig 1: Effect of different organic and inorganic sources of nutrients on growth attributes of strawberry (*Fragaria × ananassa* Duch.) cv. 'Winter Dawn'

Fruit Length (cm)

Fruit length was significantly influenced by different bio-enhancer treatments. The maximum fruit length was recorded under RDF (38.97 cm), followed by integrated bio-enhancer package (36.85 cm) and Panchagavya + FYM (35.96 cm), whereas the minimum was observed under control (34.57 cm). The superiority of RDF may be attributed to balanced and adequate nutrient availability, which enhanced cell division, cell elongation and fruit development. The improvement under bio-enhancer treatments may be associated with better nutrient availability and stimulation of physiological processes.

Fruit Width (cm)

The maximum fruit width was recorded with RDF (28.80 cm), followed by microbial consortium soil application (26.97 cm) and Panchagavya soil drenching (25.89 cm), while the minimum was observed in control (23.60 cm). RDF produced significantly wider fruits than most treatments, indicating the importance of balanced nutrition for fruit enlargement. The beneficial effect of microbial consortium may be due to enhanced nutrient solubilization and uptake, which supported cell expansion and fruit growth.

L/D Ratio

The L/D ratio ranged from 1.34 in control to 1.47 under RDF. RDF recorded the highest numerical L/D ratio, followed by seaweed extract foliar spray and Panchagavya + FYM (1.39), whereas the lowest value was recorded under

control. However, the treatment effect was non-significant (NS), indicating that the different bio-enhancer treatments did not significantly alter fruit shape. The numerical variation may nevertheless reflect differences in the relative expansion of fruit length and width.

Fruit Fresh Weight (g)

Fruit fresh weight was significantly affected by the treatments, with RDF recording the maximum fresh weight (17.89 g), followed by Panchagavya soil drenching (16.02 g) and seaweed extract foliar spray (16.34 g). The minimum fresh weight was observed in control (14.59 g). Higher fresh weight under RDF may be attributed to improved nutrient supply and enhanced assimilate accumulation during fruit development. bio-enhancer also improved fruit fresh weight over control, possibly by enhancing nutrient uptake and physiological efficiency.

Fruit Dry Weight (g)

The maximum fruit dry weight was recorded under RDF (0.87 g), followed by Panchagavya soil drenching (0.79 g) and seaweed extract foliar spray (0.77 g), whereas the lowest value was recorded under integrated bio-enhancer package (0.70 g). RDF was superior due to the availability of balanced nutrients that promoted photosynthesis and translocation of assimilates towards developing fruits. The higher dry matter accumulation under bio-enhancer treatments compared with control may be associated with improved nutrient assimilation and plant metabolic activity.

Table 2: Effect of different organic and inorganic sources of nutrients on yield attributes of strawberry (*Fragaria × ananassa* Duch.) cv. “Winter Dawn”

Treatment	Fruit length (mm)	Fruit width (mm)	L/D ratio	Fruit fresh weight (g)	Fruit dry weight (g)
Control	34.57	23.60	1.34	14.59	0.71
RDF	38.97	28.80	1.47	17.89	0.87
Panchagavya foliar spray (3%)	35.31	24.63	1.38	15.72	0.76
Panchagavya soil drenching	34.93	25.89	1.36	16.02	0.79
Seaweed extract foliar spray	34.86	25.33	1.39	16.34	0.77
Microbial consortium soil application	35.75	26.97	1.35	15.84	0.72
Panchagavya + FYM	35.96	25.86	1.39	16.56	0.71
Integrated bio-enhancer package	36.85	24.33	1.37	16.11	0.70
SEm ±	0.19	0.32	0.12	0.28	0.015
CD (P=0.05)	0.42	0.75	NS	0.63	0.03

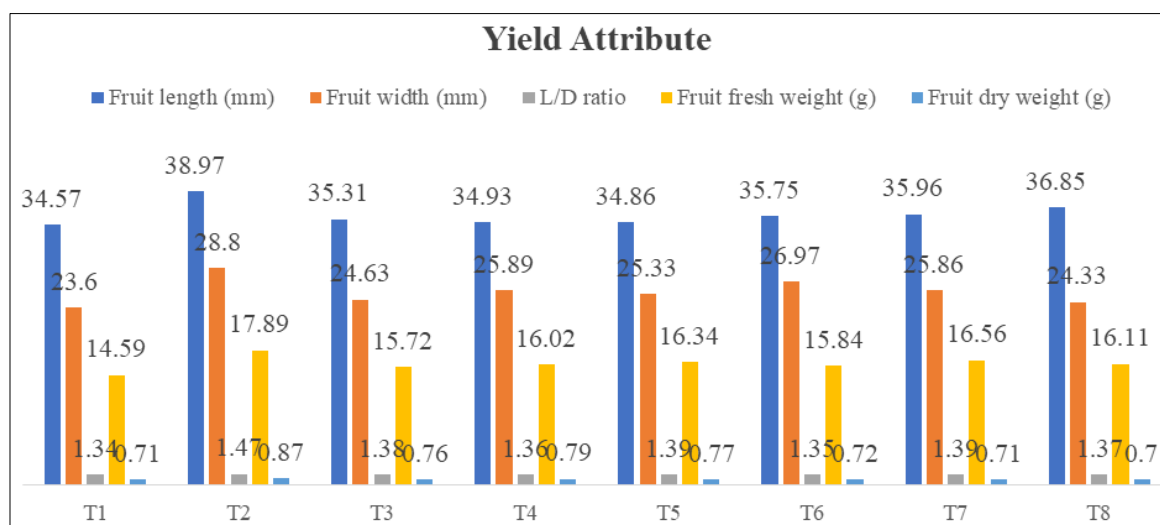


Fig 2: Effect of different organic and inorganic sources of nutrients on yield attributes of strawberry (*Fragaria × ananassa* Duch.) cv. “Winter Dawn”

Number of Fruits Plant⁻¹

The number of fruits plant⁻¹ was significantly influenced by different bio-enhancer treatments. The maximum number of fruits (15.76 plant⁻¹) was recorded under RDF, followed by Panchagavya foliar spray (14.07) and microbial consortium soil application (13.56), whereas the minimum was observed under control (12.67). The superiority of RDF may be attributed to balanced nutrient availability, which promoted better vegetative growth, flowering and fruit setting. bio-enhancer treatments also improved fruit number over control, possibly through enhanced nutrient uptake and stimulation of reproductive growth.

Average Fruit Weight (g)

Average fruit weight varied significantly among the treatments, with RDF recording the highest fruit weight (17.89 g), followed by Panchagavya + FYM (16.56 g), seaweed extract foliar spray (16.34 g) and integrated bio-enhancer package (16.11 g). The lowest average fruit weight was recorded under control (14.59 g). Higher fruit weight under RDF may be attributed to adequate availability of essential nutrients that enhanced cell division, fruit enlargement and assimilate accumulation. The positive response to bio-enhancer may be associated with improved nutrient-use efficiency and enhanced physiological activity.

Fruit Yield Plant⁻¹ (g)

Fruit yield plant⁻¹ was significantly affected by the application of different bio-enhancer. The highest fruit yield (229.49 g plant⁻¹) was obtained with RDF, followed by

integrated bio-enhancer package (201.42 g), microbial consortium soil application (200.13 g) and seaweed extract foliar spray (198.78 g), while the control recorded the lowest yield (184.74 g). The higher yield under RDF resulted from the combined effect of greater fruit number and higher average fruit weight. The improved yield under bio-enhancer treatments may be attributed to enhanced nutrient availability, better plant growth and improved fruit-setting and assimilate translocation.

Number of fruits plant⁻¹

RDF produced the maximum number of fruits plant⁻¹ (15.76), significantly higher than the control (12.67). Panchagavya foliar spray (14.07) and integrated bio-enhancer package (13.78) also improved fruit number, while Panchagavya + FYM recorded the lowest among the bio-enhancer (12.45). White mulch produced 15.78 fruits plant⁻¹ compared with 14.76 under black mulch, indicating better fruit-set and retention.

Fruit yield plant⁻¹ (g)

Fruit yield plant⁻¹ was maximum under RDF (229.49 g) and minimum under control (184.74 g). Among bio-enhancer, the integrated package (201.42 g) and microbial consortium (200.13 g) showed comparatively higher yields. White mulch significantly increased yield to 217.34 g plant⁻¹ compared with 203.34 g under black mulch, demonstrating its advantage in maintaining favourable conditions for fruit development and yield.

Table 3: Effect of different organic and inorganic sources of nutrients on yield of strawberry (*Fragaria × ananassa* Duch.) cv. 'Winter Dawn'

Treatment	Number of fruits plant ⁻¹	Average fruit weight (g)	Fruit yield plant ⁻¹ (g)
Control	12.67	14.59	184.74
RDF	15.76	17.89	229.49
Panchagavya foliar spray (3%)	14.07	15.72	184.87
Panchagavya soil drenching	13.40	16.02	196.43
Seaweed extract foliar spray	12.85	16.34	198.78
Microbial consortium soil application	13.56	15.84	200.13
Panchagavya + FYM	12.45	16.56	190.34
Integrated bio-enhancer package	13.78	16.11	201.42
SEm ±	0.17	0.31	4.2
CD (P=0.05)	0.36	0.63	9.38

Conclusion

The study revealed that RDF was the most effective treatment, producing superior growth, flowering and yield attributes of strawberry cv. 'Winter Dawn', including the highest fruit number (15.76 plant⁻¹), average fruit weight (17.89 g) and fruit yield (229.49 g plant⁻¹). Among the bio-enhancer, the integrated bio-enhancer package, microbial consortium and seaweed extract showed appreciable improvement in yield over the control. Thus, RDF in combination with suitable bio-enhancer and white mulch may be considered a promising nutrient and crop-management strategy for improving strawberry productivity under subtropical conditions of Lucknow.

References

- Patel N, Sharma DK, Chakraborty B. Effect of foliar application of liquid organics on growth, yield and quality of strawberry (*Fragaria × ananassa* Duch.) cv. Winter Dawn. Journal of Plant Development Sciences. 2022;14(5):521-525.
- Sonkar S, Tripathi VK. Influence of biofertilizers and bioenhancer on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Chandler. Plant Science Today. 2025;12(Special Issue 4).
- Sonkar S, Tripathi VK. Economic analysis of organic strawberry production influenced by biofertilizers and biostimulants application. International Journal of Plant & Soil Science. 2025;37(3):207-214.
- Patel N, Sharma DK, Chakraborty B. Effect of foliar application of biostimulants on fruiting of strawberry cv. Winter Dawn. Journal of Plant Development Sciences. 2022;14(5):521-525.
- Singh A, Patel RK. Organic nutrient management affecting growth and yield in strawberry (*Fragaria × ananassa* Duch.) cv. Flavia under Punjab conditions. Indian Journal of Horticulture. 2023.
- Hazarika TK, Ralte Z, Nautiyal BP, Shukla AC. Influence of bio-fertilizers and bio-regulators on growth, yield and quality of strawberry (*Fragaria ×*

- ananassa*). The Indian Journal of Agricultural Sciences. 2015;85(9).
7. Kachwaya DS, Chandel JS. Effect of fertigation on growth, yield, fruit quality and leaf nutrients content of strawberry (*Fragaria × ananassa*) cv. Chandler. The Indian Journal of Agricultural Sciences. 2015;85(10):1319-1323.
 8. Tripathi VK, Jain A, Kumar S, Dubey V, Kumar A. Efficacy of bio-fertilizers and mulching on growth, yield and quality of strawberry (*Fragaria × ananassa*) cv. Chandler. The Indian Journal of Agricultural Sciences. 2017;87(9).
 9. Singh SR, Zargar MY, Singh U, Ishaq M. Influence of bio-inoculants and inorganic fertilizers on yield, nutrient balance, microbial dynamics and quality of strawberry (*Fragaria × ananassa*) under rainfed conditions of Kashmir valley. The Indian Journal of Agricultural Sciences. 2010;80(4).
 10. Wani RA, Sheema S, Malik TH, Geelani S, Bashir S, Dar NA, *et al.* Impact of integrated nutrient management on growth, yield and quality of strawberry (*Fragaria × ananassa* Duch.) cultivation in India. Advances in Horticultural Science. 2013;27(4):147-151.
 11. Singh S, Mishra S, Bahadur V. Effect of bio-fertilizers on growth, yield and quality of strawberry (*Fragaria × ananassa* Duch.) cv. Winter Dawn in Prayagraj (U.P.) conditions. Journal of Advances in Biology & Biotechnology. 2024;27(8):740-747.
 12. Bakshi P, Jasrotia A, Wali VK, Sharma A, Bakshi M. Influence of pre-harvest application of calcium and micro-nutrients on growth, yield, quality and shelf-life of strawberry cv. Chandler. The Indian Journal of Agricultural Sciences. 2013;83(8).
 13. Gupta AK, Tripathi VK. Efficacy of *Azotobacter* and vermicompost alone and in combination on vegetative growth, flowering and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Chandler. Progressive Horticulture. 2012;44(2):256-261.
 14. Mishra AN, Tripathi VK. Influence of different levels of *Azotobacter*, PSB alone and in combination on vegetative growth, flowering, yield and quality of strawberry cv. Chandler. International Journal of Applied Agricultural Research. 2011;6(3):203-210.
 15. Rana RK, Chandel JS. Effect of bio-fertilizers and nitrogen on growth, yield and fruit quality of strawberry. Indian Journal of Horticulture. 2003.
 16. Gutal GB, Barai VN, Mane TA, Purkar JK, Bote NL. Scheduling of nitrogen through drip method of irrigation for strawberry. Journal of Maharashtra Agricultural Universities. 2005;30:215-216.
 17. Singh R, Asrey R, Kumar S. Effect of plastic tunnel and mulching on growth and yield of strawberry. Indian Journal of Horticulture. 2006;63:18-20.
 18. Gupta R, Acharya CL. Effect of mulch induced hydrothermal regime on root growth, water use efficiency, yield and quality of strawberry. Journal of the Indian Society of Soil Science. 1993;41(1):17-25.
 19. Singh SR, Zargar MY, Singh U, Ishaq M. Influence of bio-inoculants and inorganic fertilizers on yield, nutrient balance, microbial dynamics and quality of strawberry under rainfed conditions of Kashmir valley. The Indian Journal of Agricultural Sciences. 2010;80(4).
 20. Kumar R, Tripathi VK, *et al.* Impact of biofertilizers, vermicompost and *Trichoderma* on growth and yield in strawberry (*Fragaria × ananassa* Duch.) cv. Sweet Charlie. The Indian Journal of Agricultural Sciences. 2020;90(10).
 21. Sonkar S, Tripathi VK. Influence of biofertilizers and bioenhancer on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Chandler. Plant Science Today. 2025;12(Special Issue 4).
 22. Sonkar S, Tripathi VK. Economic analysis of organic strawberry production influenced by biofertilizers and biostimulants application. International Journal of Plant & Soil Science. 2025;37(3):207-214.
 23. Singh D, Chandel JS. Effect of fertigation on growth, yield, fruit quality and leaf nutrient content of strawberry cv. Chandler. The Indian Journal of Agricultural Sciences. 2015;85(10):1319-1323.
 - 24.