Original Research Article

Assessment of the Effect of Different Bio-Stimulants on the Growth, Quality, and Yield of Strawberries in a Sub-Tropical Climatic Region: A Case Study

Abstract:

This case study investigates the impact of different bio-stimulants, including Novel prime organic liquid nutrient, Vermiwash, and Cow urine, on vegetative growth, flowering, and fruit yield of sweet sensation variety of strawberry plants. An intensive research work was carried out at an experimental land located in north Konkan zone of Maharashtra, India. The experiment employs a Completely Randomized Design (CRD) with three replications to evaluate growth at various stages and yield parameters.The results demonstrate that the application of 2% Novel prime organic liquid nutrient and 2% Vermiwash significantly improves the growth and yield of strawberry plants. The results highlight the suggesting their potential in sustainable strawberry cultivation.Strawberry cultivation is an economically significant horticultural practice worldwide. Enhancing the growth, quality, and yield of strawberry plants is crucial for improving production and profitability.

Keywords: Strawberry, Bio-stimulants, Plant GrowthRegulatory, Quality, Yield, Organic nutrients

1. INTRODUCTION

The strawberry, a member of the Rosaceae family, is adored for its delicious taste, delicate flavours, and rich levels of antioxidants, vitamins C, iron, and essential minerals (Sharma, 2002) [1].In India, strawberry cultivation is primarily concentrated in regions such as Himachal Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Delhi, Haryana, Punjab, and Rajasthan. Additionally, sub-tropical areas also have the potential to cultivate this crop under irrigated conditions.

The study began in November 2022, during the early phase of the winter season, at the ASPEE Agricultural Research and Development Foundation (ARDF) in the North Konkan region of Maharashtra, India.The climate in this area is characterized as subtropical, hot, and humid, with a maximum temperature reaching 40.6°C, a minimum of 8.3°C, and an annual rainfall of 2293 mm (Government of Maharashtra)[2].

Strawberries grow well under temperate climates, typically in the range of 15-27°C. However, certain cultivars can also flourish in sub-tropical conditions. Crucially, flower-bud formation relies on a sunlight period of 12 hours or less and moderate temperatures, with each cultivar having unique day length and temperature preferences.Sandy loam to loamy soil with a pH of 5.7-6.5 is ideal for its cultivation.Prominent strawberry varieties cultivated in India include Chandler, Tioga, Torrey, Selva, Belrubi, Fern, and Pajaro, Premier, Red cost, Local Jeolikot, Dilpasand, Bangalore, Florida 90, Katrain Sweet, Pusa Early Dwarf, and Blakemore (NHBI)[3].

The present study considers the Sweet Sensation variety of strawberries with the aim of analysing how various bio-stimulants affect the growth and yield parameters of strawberry plants.Bio-stimulants, such as organic liquid nutrients, vermiwash, and cow urine, have gained attention as potential enhancers of plant growth and fruit production.This transformation has unlocked fresh prospects for agricultural practices in nations such as India, Pakistan, and Bangladesh, where rain-fed crops have historically been the linchpin of livelihoods. The subsequent sections describe a noteworthy literature review, materials and methods, experimental details, a discussion of results, and conclude with final remarks.

2. LITERATURE REVIEW

In recent decades, significant studies have been documented in the form of books, journals, and conference proceedings. Noteworthy and relevant works are briefly mentioned here.

Verkleij (1992) conducted a comprehensive review of seaweed extracts, specifically Seamino. The findings revealed that these extracts can fortify plant resistance against pests and diseases, foster plant growth, and enhance crop yield and quality[4]. In the similar study Crouch and Staden (1994) emphasized the importance of seaweed extracts in agriculture, citing their high concentrations of organic matter, microelements, vitamins, fatty acids, and growth regulators such as auxins, cytokinins, and gibberellins[5].

Paroussi et al. (2002) assessed the impact of GA3 (gibberellic acid) and different photoperiod regimes on the growth and flowering of strawberry plants[6]. Pérez et al. (2002) investigated the growth and developmental patterns of several strawberry cultivars, which included Elsanta, Bolero, and Everest[7].

Taha (2008) discovered that applying seaweed extracts, specifically Soluamine, to strawberry plants significantly increased fruit size, the number of fruits per plant, and overall plant yield, while Marmarine seaweed extracts notably increased fruit fresh weight [8].

Adesemoem and Kloepper (2009) highlighted the significance of plant growth-promoting rhizobacteria (PGPR) as biofertilizers or microbial inoculants, highlighting their crucial role in an integrated nutrient management system [9].Esitken et al. (2010) performed an analysis on the effects of plant growth-promoting bacteria (PGPB) on the yield, growth, and nutrient content of organically grown strawberries [10].

Karlidag et al. (2013) carried out research to explore the capacity of plant growth-promoting rhizobacteria in alleviating the detrimental effects of salt stress on strawberry plants [11].

Sharma et al. (2014) conducted field studies to examine the growth and flowering attributes of different strawberry cultivars in Himachal Pradesh, India [12].

In the Kurdistan Region of Iraq, Taha and Haji (2015) conducted a study to explore the effects of biostimulants and seaweed extracts on the vegetative growth and fruit characteristics of two short-day strawberry cultivars. The experimental field was organized in a split-plot design with four replicates [13-15].

In their latest study, conducted in 2023, Rana et al. evaluated the improvement in the growth, yield, and nutritional qualities of strawberry plants (Fragaria × ananassa Duch.) through the application of a bio-stimulant in the form of seaweed extract in the region of Himachal Pradesh, India[14].

3. MATERIALS AND METHODOLGY

The experiment was conducted using a Completely Randomized Design (CRD) with three replications. The treatments consisted of six different bio-stimulants, each applied at two different concentrations, resulting in a total of 12 experimental units. The experimental setup and treatment details are summarized in Table 1 and Table 2, respectively.

Table 1: Experimental Design

Particular	Details
Transplanting Date:	November 12, 2022
Variety of Strawberry	Sweet sensation
Planting Spacing:	45cm × 45cm
Plants per Treatment:	15
Net Plot size:	2.25m × 1.35m
Gross Plot size:	2.70m × 1.80m
Total Plants per Replication:	90

Table 2: Treatment Details

Comment [H1]: This section does not follow the structure recommended by the revue.
The point about the literary review should be taken back to the introduction.

Formatted: Highlight

Treatment	Action
T1:	T1: Novel prime organic liquid nutrient (1%)
T2:	T2: Novel prime organic liquid nutrient (2%)
T3:	T3: Vermiwash (1%)
T4:	T4: Vermiwash (2%)
T5:	T5: Cow urine (1%)
T6:	T6: Cow urine (2%)

3.1 Parameters Measured

During the trails, the following parameters were recorded in due time of experiment to assess the impact of different bio-stimulants:

Plant Height (cm), Plant Spread (cm), Number of Leaves per Plant, Number of Runners per Plant, Number of Flowers per Plant, Number of Berries per Plant, Fruit Length (cm), Fruit Weight (g) and Fruit Yield (kg/ha). The experimental results, including the mean values and standard errors, are summarized in Table 3.

Table 3: Performance Metrics of Different Treatments on Strawberry Plants

Treatment	Plant height (cm)	Plant Spread (cm)	No. of leaves per plant	No. of runners per plant	No. of flowers per plant	No. of berries per plant	Fruit length (cm)	Fruit weight (g)	Fruit Yield (kg/ha)
T 1	27.28	29.98	40.53	7.07	18.87	16.87	3.52	20.4	4321
T 2	34.47	34.11	52.13	8.47	24.53	22.53	4.28	24.91	5418
T 3	23.89	28.18	36.47	6.2	17.2	15.20	3.27	18.4	3978
T 4	31.24	31.99	44.93	7.67	22.47	20.47	3.91	22.28	4733
T 5	18.36	18.96	25.2	4.07	13.33	11.33	2.57	13.11	2743
T 6	21.95	24.63	30.9	5.53	15.47	13.47	2.9	16.01	3429

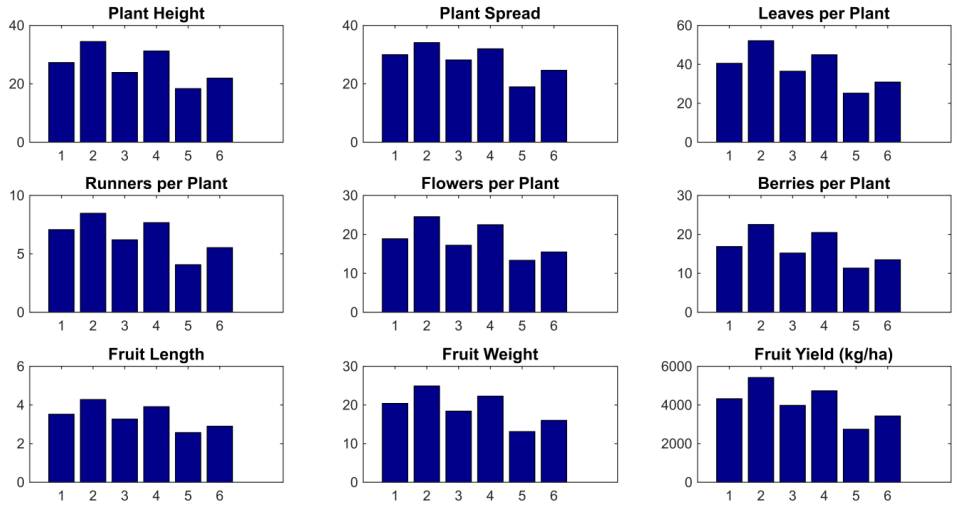

Fig.1: Effect of different treatments on various parametrs

4. RESULTS&DISCUSSION

Yield and fruit characteristics

The analysis of variance revealed significant differences among the treatments for all parameters. The highest values were observed in T2 (2% Novel prime organic liquid nutrient) and T4 (2% Vermiwash) for most parameters, indicating their positive effects on strawberry growth and yield. Notably, T2 exhibited the highest fruit yield of 5418 kg/ha, followed by T4 with 4733 kg/ha. The graphical illustrations are shown in Figures 1 and 2.

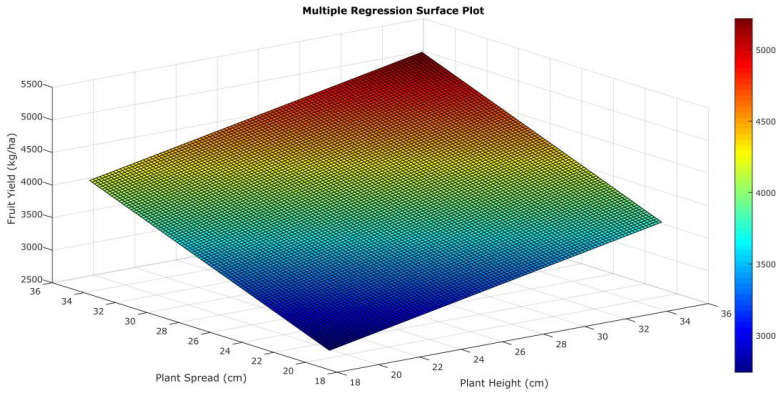

Fig.2: Illustration of regresion surface with yield pattern

The findings of this study revealed that the application of 2% Novel prime organic liquid nutrient and 2% Vermiwash can significantly improve the growth and yield of strawberry plants. These bio-stimulants may enhance nutrient uptake, promote root development, and contribute to increased flowering and fruit production.

The improved vegetative growth, with increased plant height, plant spread, and the number of leaves, is likely attributed to the enhanced nutrient availability in the soil due to the bio-stimulant application. Furthermore, the increased number of runners per plant suggests better vegetative propagation, potentially resulting in a denser strawberry canopy.

The substantial increase in the number of flowers and berries per plant in T2 and T4 indicates a more productive reproductive phase. This could be due to enhanced nutrient availability, which is crucial during the flowering and fruit development stages of strawberry plants. Moreover, the increased fruit length, fruit weight, and fruit yield in these treatments underscore the importance of optimal nutrition for high-quality strawberry productionan average yield of 175-300 q./ha. may be taken from a well-managed orchard.A fertilizer dose of 25-50 tonnes farmyard manure, 75-100 kg. N, 40-120 kg. P_2O_5, 40-80 kg. K_2O/ha may be applied according to soil type and variety planted [3](NHBI)

CONCLUSION

The detailed investigation revealed that the application of 2% Novel Prime organic liquid nutrient and 2% Vermiwash led to significant improvements in the growth, flowering, and fruit yield of strawberry plants, achieving a remarkable yield of 5418 kg/ha. This yield is particularly notable in the sub-tropical region, as the national average typically ranges from 45-100 q/ha (NHBI). These bio-stimulants show great potential for integration into strawberry cultivation practices, offering the prospect of enhanced crop productivity and quality.Implementing appropriate nutritional strategies in

strawberry cultivation may lead to consistently higher yields, potentially achieving an average yield of 175-300 q./ha, even in subtropical regions.

Further research is essential to explore the long-term effects and determine the optimal application rates of bio-stimulants such as organic liquid nutrients, vermiwash, and cow urine. These substances have garnered attention for their potential to enhance plant growth and fruit production, particularly in the context of commercial strawberry farming.

REFERENCES

1. Sharma, R.R. "Growing strawberry": Int. Book Distributing Co., Indian. (2002).
2. Govt. of Maharashtra, https://palghar.gov.in/en/geographical-information-2/.
3. National Horticulture Board of India (NHBI), Govt. Of India, https://nhb.gov.in/.
4. Verkleij, F. N. "Seaweed extracts in agriculture and horticulture: A review",Biol. Agric.Hortic., 8, pp. 309-324,(1992).
5. Crouch, I.J. and Van Staden J. "Commercial seaweed products as bio stimulants in horticulture", J. of Home and Consumer Horticulture 1, pp. 19–76. (1994).
6. Paroussi, G., Voyiatzis, D.G., Paroussis, E., and Drogoudi, P. D. "Effect of GA3 and photoperiod regime on growth and flowering in strawberry", Acta Hort, 567, pp. 273-276. (2002).
7. Pērez de Camacaro, M.E., Camacaro, G.J., Hadley, P., Battey, N.H., and Carew, J. G. "Pattern of Growth and Development of the Strawberry Cultivars Elsanta, Bolero, and Everest", J. Amer. Soc. Hort. Sci. 127(6), pp. 901-907. (2002).
8. Taha, Sh. M. "Effect of foliar spray of Gibbrellic acid, Cycocel and three seaweed extracts on some vegetative growth flowers and yieldcomponents characteristics of two varieties of strawberry (Fragaria x ananassa Duch.)",Ph.D. Dissertation, Collage of Agriculture, University of Salahaddin, Erbil. Iraq. (2008).
9. Adesemoem, A.O. and Kloepper J.W. "Plant-microbes interactions in enhanced fertilizer use efficiency", Appl MicrobiolBiotechnol. 85, pp.1–12.(2009).
10. Esitken, A., Yildiz, E. H., Ercisli, S., Donmez, M.F., Turan, M., and Gunes, A. " Effects of Plant Growth Promoting Bacteria (PGPB) on yield, growth and nutrient contents of organically grown strawberry", Scientia Hort. 124, pp.62-66. (2010).
11. Karlidag, H., Yildirim, E., Turan, M., Pehluvan, M., and Donmez, F. "Plant Growth-promoting Rhizobacteria Mitigate Deleterious Effects of Salt Stress on Strawberry Plants (Fragaria x ananassa)", HortScience 48(5), pp. 563– 567, (2013).
12. Sharma, G., Yadav, A., and Thakur A."Studies on Growth and Flowering Attributes of Different Strawberry Cultivars (Fragaria x ananassa Duch.) in Himachal Pradesh", Asian J. of Adv. Basic Sci. 3(1), pp. 1-4(2014).
13. Shler M. Taha and Ghazi Faiq Haji, “Influence of some biostimulants and Seaweed Extracts on Growth & Fruit Char. of Strawberry (Fragaria x ananassa Duch.)” JZS (2015),17- 4 (Part-A).
14. Rana, V.S., Lingwal, K., Sharma, S. et al. Enhancement in growth, yield and nutritive characteristics of strawberry (Fragaria × ananassa Duch.) by the application of biostimulant: seaweed extract. Acta Physiol Plant 45, 122 (2023). https://doi.org/10.1007/s11738-023-03602-y.
15. Gupta, P.K. "Vermicomposting for sustainable agriculture", Agrobios, Jodhpur. pp, 19-50. (2003).