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Effect of Foliar Application of Nano Urea, Boron and Zinc Sulphate on Growth Fruit Yield and Quality of Strawberry (*Fragaria × ananassa* Duch.) cv. Winter Dawn

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Prayagraj during the session 2023 - 2024. The experiment was laid out in randomized block design with three replications, and the study consists of Ten treatment combinations including control by using

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different Effect of Foliar Application of Nano Urea, Boron and Zinc sulphate On Growth Fruit Yield and Quality of Strawberry. The best treatment was T_9 (Nano urea 1.5% + Zinc Sulphate 0.6% + Boron 0.6%) &T_8 (Nano urea 1.5% + Zinc Sulphate 0.4% + Boron 0.4%) which shows highest values in all the parameters viz., Petiole length 90 DAT (10.00 cm), number of leaf/plant (36.95), plant spread N-S (cm) (35.69 cm), plant spread E-W (cm) (32.01 cm), runner production/plant (8.56), Fruit length (mm) (62.50 mm), Fruit width (39.67 mm), Fresh weight (g) (31.86), Number of fruit/plant (17.52), Fruit yield/ha. (54.79 q), TSS (11.29 brix), Vitamin C (50.83 mg/100 g), Acidity (0.57%). All the treatments were significantly superior in their growth, flowering, fruit yield and quality of strawberry over control (T_0) and (T_9).

Keywords: Strawberry; nano urea; boron; zinc; growth; yield; quality.

1. INTRODUCTION

Strawberry (*Fragaria ananassa*) is one of the world's most popular soft fruits. It belongs to the Rosaceae family and the majority of cultivated forms are octaploid (2n=56). The fruit is an achene and attached to juicy enlarged receptacles. The cultivated strawberry is a man-made hybrid that evolved from a cross between two American species, *Fragaria chiloensis* and *Fragaria virginiana.*

Strawberry is native to North America and commercially grown in Europe and North American countries. Major strawberry growing countries are China, USA, Mexico, Turkey, Egypt, Spain, Russia, South Korea, Poland and Morocco. China is leading strawberry producer in the world. In India it was introduced in early sixties by National Bureau of Plant Genetic Resources Regional Station, Shimla (Himachal Pradesh). Area under strawberry cultivation in India is 3000 ha with production of 20,000 MT [1]. Strawberry is cultivated commercially in Maharashtra, Punjab, Haryana, hills of Himachal Pradesh, Jammu & Kashmir, Uttarakhand, Rajasthan and West Bengal. In Himachal Pradesh, area under strawberry cultivation is 40 ha with an annual production of 210 MT [1] and commercially grown in district Kullu, Sirmour, Solan, Kangra, Shimla and Una. In the lower hills, it is cultivated mainly for marketable fruits, while in higher hills it is commonly grown for runner production.

In the present scenario, nanotechnology opens a wide range of opportunities in the field of agriculture and other fields. Use of nanofertilizers instead of traditional fertilizers has a major impact on crop nutrition [2]. Nanofertilizers increases the nutrient use efficiency by making nutrients more available to leaves [3]. Some properties of nano particles such as large surface area, unique magnetic/optical properties, electronic states and catalytic reactivity confer nanpoarticles a better reactivity than the equivalent bulk materials [4]. Application of nanotechnology provide fertilizers that release nitrogen when crop needs it, consequently increasing nitrogen efficiency through reduction in nitrogen leaching and emissions and long-term incorporation by soil microorganisms [5,6].

Micronutrients, boron facilitates sugar transport over short and long distance by forming borate-sugar complexes and also participates in different metabolic processes including transfer of sugars during the growth and development of fruits [7], and also boron has important role in pollen germination and fruit set [8,9]. However, zinc is necessary for the tryptophan synthesis, the precursor of phytohormone ‘auxin’, participates in the synthesis of chlorophyll, promotes photosynthesis and nitrogen metabolism [10].

2. MATERIALS AND METHODS

This experiment was laid out during the August 2023 to March 2024 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The horticulture research farm is situated at 25^0 39” 42” N latitude, 81^0 67” 56” E longitude and at an altitude of 98 m above mean sea level. The treatment consisted of T_0 - Control (N:P:K 0.4%: 0.2%: 0.2%), T_1 - Nano urea 0.5% + Zinc sulphate 0.2% +boron 0.2%, T_2 - Nano urea 0.5% + Zinc sulphate 0.4% +boron 0.4%, T_3 - Nano urea 0.5% + Zinc sulphate 0.6% +boron 0.6%, T_4 - Nano urea 1.0% + Zinc sulphate 0.2% +boron 0.2%, T_5 Nano urea 1.0% + Zinc sulphate 0.4% +boron 0.4%, T_6 - Nano urea 1.0% + Zinc sulphate 0.6% +boron 0.6%, T_7 - Nano urea 1.5% + Zinc sulphate 0.2% +boron 0.2%, T_8 -

Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%, T_9 - Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%. The experiment was laid out in a Randomized Block Design with 10 treatments and replicated thrice. Data recorded on different aspects of fruit crop, *viz.,* growth, yield were subjected to statistically analysis by analysis of variance method. (Gomez and Gomez, 1976) and economic data analysis mathematical method.

3. RESULTS AND DISCUSSION

3.1 Plant Stands and Growth

3.1.1 Petiole length (cm)

The data Petiole height of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 1.

The data reveals that the Petiole height of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Petiole height of (10.00 cm) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) and the minimum (6.17 cm) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate + boron to the amount or water required for foliar spray significantly influenced the petiole height.

The maximum in number Petiole height of strawberry due to treatment might be due to fact that nano-urea regulate the growth by causing cell division and cell elongation in plant system. These results are in conformity with Nikbakht et al*.* [11]. reported decreases in number of Petiole height of strawberry with the use of nano urea Abobatta and Ahmed [12] reported increase in growth parameters with nano urea in guava. While the minimum value in treatment T1 (control) may owe to its inhibitory effect because this treatment occupies only recommended dose of fertilizers in strawberry. Increase in growth parameters (number of days to anthesis) use of nano urea may be due to its effect in cell division and cell enlargement Bhatti et al*.* [13].

3.1.2 Number of leaves plant^{-1}

The data Number of leaves plant^{-1} of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 1.

The data reveals that the Number of leaves plant^{-1}of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Number of leaves plant^{-1} of (36.95) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in 120 DAT recorded, while the minimum (26.58) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate + boron to the amount or water required for foliar spray significantly influenced the Number of leaves plant^{-1}.

The maximum number of leaves plant^{-1} in treatment in nano-urea, zinc and boron was closely observed by Singh et al. [14]. Higher levels of sugar due to $ZnSO_4$ application might be explained behind increase in P^H content which is synthesized from sugar Kumar et al*.* [15] and Singh et al., [16].

3.1.3 Plant spread cm (East – West and North - South)

The data Plant spread N-S (cm) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 1.

The data reveals that the Plant spread N-S (cm)of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Plant spread N-S (cm) of (35.69) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in 120 DAT recorded, while the minimum (27.89) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Plant spread N-S (cm).

The data reveals that the Plant spread E-W (cm) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Plant spread E-W (cm) of (32.01) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in 120 DAT recorded, while the minimum (23.89) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Plant spread E-W (cm).

The maximum plant spread in treatment in nano-urea, zinc and boron was closely observed by Singh et al. [14]. Higher levels of sugar due to $ZnSO_4$ application might be explained behind increase in pH content which is synthesized from sugar Kumar et al*.* [15] and Singh et al., [16].

3.1.4 Runner production plant^{-1}

The data Runner production/plant of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 1.

The data reveals that the Runner production/plant of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Runner production/plant of (8.56) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (4.41) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Runner production/plant.

The maximum runner production plant^{-1} in treatment in nano-urea, zinc and boron was closely observed by Singh et al. [14]. Higher levels of sugar due to $ZnSO_4$ application might be explained behind increase in P^H content which is synthesized from sugar Kumar et al*.* [15] and Singh et al., [16].

3.2 Yield Attributes

3.2.1 Fruit length (mm)

The data Fruit length (mm) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 2.

The data reveals that the Fruit length (mm) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Fruit length (mm) of (62.50) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (38.38) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Fruit length (mm).

The maximum Increase in fruit length (mm) following use of zinc might be due to its effect in cell division and cell elongation. Zinc is also reported to promote growth by increasing plasticity of cell wall followed by hydrolysis of starch into sugar which reduces cell wall potential, resulting in the entry of water into the cell and causing its elongation [17] reported maximum length and minimum days to first harvesting in guava and ‘Brighton’ with zinc 2%. These results are in close similarity with the findings of Thakur et al*.* [18]; Yadav et al. [19].

3.2.2 Fruit width (mm)

The data Fruit width (mm) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 2.

The data reveals that the Fruit width (mm) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Fruit width (mm) of (39.67) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (30.82) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Fruit width (mm).

The maximum increase in fruit width following use of zinc sulphate and boric acid might be due to its effect in cell division and cell elongation. The beneficial effect of zinc sulphate and boric acid 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, Abobatta and Ahmed [12] reported increase in growth parameters with Nano urea in guava. While the minimum value in treatment T1 (control) may owes to its inhibitory effect because this treatment occupy only recommended dose of fertilizers in guava. Increase in growth parameters (fruit diameter) use of nano urea may be due to its effect in cell division and cell enlargement Zahid et al*.* [20].

3.2.3 Fresh weight of fruit (g)

The data Fruit weight of fruit (g) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 2.

The data reveals that the Fruit weight of fruit (g) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Fruit weight of fruit (g) of (31.86 g) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (13.89 g) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Fruit weight of fruit (g).

The maximum Increase in fruit weight following use of zinc might be due to its effect in cell division and cell elongation. Zinc is also reported to promote growth by increasing plasticity of cell wall followed by hydrolysis of starch into sugar which reduces cell wall potential, resulting in the entry of water into the cell and causing its elongation Shreekant et al. [21]. Zagade et al. [22] reported maximum fruit weight guava with nano urea and zinc 2%. These results are in close similarity with the findings of Tiwari et al. [23].

3.2.4 Number of fruit plant^{-1}

The data Number of fruit plant^{-1} of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 2.

The data reveals that the Number of fruit plant^{-1} of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Number of fruit plant^{-1} of (17.52) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (12.12) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Number of fruit plant^{-1}.

Increase in number of fruits per plant with the use of zinc might be due to fact that benzyl adenine causes the production of large number of fruits with rapid elongation of peduncle, leading to full development of flower buds having all reproductive parts functional which increases the fruit set and number of berries per plant. It could also be due to the fact that zinc application accelerates the development of differentiated inflorescence. Singh et al., [16] observed increase in yield parameters following use of treatment Nano urea and zinc in guava. Similar results have been reported by Tripathi and Shukla [24]; Saima et al. [25].

3.2.5 Fruit yield/hac (q)

The data Fruit yield/ha (q) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 2.

The data reveals that the Fruit yield/ha (q) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Fruit yield/ha (q) of (54.79) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (14.42) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Fruit yield/ha (q).

The maximum increase in fruit yield/plant following use of zinc Sulphate and boric acid might be due to its effect in cell division and cell elongation. The beneficial effect of zinc sulphate and boric acid 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. Abobatta and Ahmed [12]. While the minimum value in treatment T1 (control) may owe to its inhibitory effect because this treatment occupy only recommended dose of fertilizers in guava. Increase in growth parameters (fruit yield per tree) use of zinc Sulphate and boric acid may be due to its effect in cell division and cell enlargement Zahid et al. [20].

3.3 Quality Parameter

3.3.1 TSS °Brix

The data TSS °Brix of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 3.

The data reveals that the TSS °Brix of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum TSS °Brix of (11.29) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (10.03) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the TSS °Brix.

Maximum TSS in treatment- nano-urea, zinc Sulphate and boric acid might be attributed to rapid mobilization of sugars and other soluble solids to developing fruits Singh and Singh [26]. It may be due to fact that Boric acid increases palatability of fruit by influencing blend of TSS, total sugar, vitamin C and juice content as observed by, Prasad et al. [27] and Saima et al. [25].

3.3.2 Titratable acidity

The data Titratable acidity of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 3.

The data reveals that the Titratable acidity of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The minimum Titratable acidity of (0.57) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the maximum (1.26) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Titratable acidity.

The interaction effect of nano urea, boron and zinc sulphate significantly influenced the titrable acidity percent in strawberry. Singh et al., [16] reported promontory effect of Boron on quality parameters in guava. The decrease in acidity in boron treated plants might be due to their better utilization in respiration and rapid metabolic transformation of organic acids into sugars Kumar et al. [15] and Tripathi et al. [24].

3.3.3 Vitamin C (mg/100 ml)

The data Vitamin C (mg/100 ml) of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 3.

The data reveals that the Vitamin C (mg/100 ml) of strawberry increased significantly by the application of Nano Urea boron and zinc sulphate essence under experiment over the control. The maximum Vitamin C (mg/100 ml) of (50.83) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) in recorded, while the minimum (40.41) was recorded under control. Further, the interaction effect of Nano urea + Zinc sulphate +boron to the amount or water required for foliar spray significantly influenced the Vitamin C (mg/100 ml).

The maximum Vitamin C content in treatment Boron was closely observed by Singh et al. [14]. Higher levels of sugar due to $ZnSO_4$ application might be explained behind increase in ascorbic acid content which is synthesized from sugar Kumar et al. [15] and Singh et al., [16].

3.4 Economics

The data economics of strawberry as influenced by Nano Urea, Boron and Zinc sulphate are summarized in Table 4.

The data reveals that the economics bitter gourd increased significantly by the application of growth regulator under experimentation over the control.

The maximum cost of cultivation (175000 Rs.) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) while the minimum cost of cultivation (95000 Rs.) was recorded under control.

The maximum gross return (821844 Rs.) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) while the minimum gross return (216240 Rs.) was recorded under control.

The maximum net return (646844 Rs.) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) while the minimum net return (121240 Rs.) was recorded under control.

The maximum B:C ratio (3.70) was recorded with treatments 9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) while the minimum B:C ratio (1.28) was recorded under control.

Table 1. Effect of foliar application of Nano Urea, Boron and Zinc sulphate on Growth of strawberry

Treatment Symbol	Treatment combinations	Petiole length (cm) 90 DAT	Number of leaves plant^{-1} (120 DAT)	Plant spread N-S (cm) (120 DAT)	Plant spread E-W (cm) (120 DAT)	Runner production/ plant
T_0	Control (N:P:K 0.4%: 0.2%: 0.2%)	6.17	26.58	27.89	23.89	4.41
T_1	Nano urea 0.5% + Zinc sulphate 0.2% +boron 0.2%	6.27	27.83	28.81	24.81	4.72
T_2	Nano urea 0.5% + Zinc sulphate 0.4% +boron 0.4%	6.37	28.86	29.85	25.85	5.53
T_3	Nano urea 0.5% + Zinc sulphate 0.6% +boron 0.6%	7.37	29.98	31.12	27.12	5.81
T_4	Nano urea 1.0% + Zinc sulphate 0.2% +boron 0.2%	7.57	31.10	31.79	27.79	6.65
T_5	Nano urea 1.0% + Zinc sulphate 0.4% +boron 0.4%	7.77	32.22	32.72	28.72	6.93
T_6	Nano urea 1.0% + Zinc sulphate 0.6% +boron 0.6%	8.17	33.34	33.99	29.99	7.15
T_7	Nano urea 1.5% + Zinc sulphate 0.2% +boron 0.2%	8.50	35.46	34.56	30.56	7.15
T_8	Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%	9.70	36.58	35.48	31.61	8.23
T_9	Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%	10.00	36.95	35.69	32.01	8.56
	F-test	**S**	**S**	**S**	**S**	**S**
	SEm(±)	0.51	0.94	0.98	0.91	0.26
	CD (p=0.05)	1.50	2.79	2.92	2.72	0.77

Table 2. Effect of foliar application of Nano Urea, Boron and Zinc sulphate on Yield of strawberry

Treatment Symbol	Treatment combinations	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Number of fruit plant^{-1}	Fruit yield/hac (q)
T_0	Control (N:P:K 0.4%: 0.2%: 0.2%)	38.38	30.82	13.89	12.12	14.42
T_1	Nano urea 0.5% + Zinc sulphate 0.2% +boron 0.2%	39.96	31.65	16.89	12.76	14.68
T_2	Nano urea 0.5% + Zinc sulphate 0.4% +boron 0.4%	41.86	32.96	16.96	13.53	18.73
T_3	Nano urea 0.5% + Zinc sulphate 0.6% +boron 0.6%	46.18	33.58	19.86	13.57	23.69
T_4	Nano urea 1.0% + Zinc sulphate 0.2% +boron 0.2%	49.86	34.69	19.96	13.67	27.92
T_5	Nano urea 1.0% + Zinc sulphate 0.4% +boron 0.4%	51.71	36.17	22.25	14.22	34.91
T_6	Nano urea 1.0% + Zinc sulphate 0.6% +boron 0.6%	55.86	37.35	22.86	14.98	41.66
T_7	Nano urea 1.5% + Zinc sulphate 0.2% +boron 0.2%	57.85	38.38	24.03	16.16	51.18
T_8	Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%	62.08	39.29	28.15	17.32	54.53
T_9	Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%	62.50	39.67	31.86	17.52	54.79
	F-test	**S**	**S**	**S**	**S**	**S**
	SEm(±)	1.47	1.10	0.93	0.77	1.33
	CD (p=0.05)	4.37	3.28	2.75	2.30	3.94

Table 3. Effect of foliar application of Nano Urea, Boron and Zinc sulphate on Quality of strawberry

Treatment Symbol	Treatment combinations	TSS °Brix	Titratable acidity	Vitamin C (mg/100 ml)
T_0	Control (N:P:K 0.4%: 0.2%: 0.2%)	10.03	1.26	40.41
T_1	Nano urea 0.5% + Zinc sulphate 0.2% +boron 0.2%	10.22	1.15	42.53
T_2	Nano urea 0.5% + Zinc sulphate 0.4% +boron 0.4%	10.23	0.97	42.86
T_3	Nano urea 0.5% + Zinc sulphate 0.6% +boron 0.6%	10.27	0.95	44.98
T_4	Nano urea 1.0% + Zinc sulphate 0.2% +boron 0.2%	10.25	0.94	46.89
T_5	Nano urea 1.0% + Zinc sulphate 0.4% +boron 0.4%	10.61	0.87	46.96
T_6	Nano urea 1.0% + Zinc sulphate 0.6% +boron 0.6%	10.86	0.84	49.03
T_7	Nano urea 1.5% + Zinc sulphate 0.2% +boron 0.2%	10.95	0.83	49.73
T_8	Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%	11.14	0.73	50.34
T_9	Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%	11.29	0.57	50.83
	F-test	**S**	**S**	**S**
	SEm(±)	0.40	0.12	1.42
	CD (p=0.05)	1.19	0.37	4.22

Table 4. Effect of foliar application of Nano Urea, Boron and Zinc sulphate on Economics of strawberry

Treatment Symbol	Treatment Combination	Cost of cultivation/ha	Gross Return/ha	Net Return/ha	B:C Ratio
T_0	Control (N:P:K 0.4%: 0.2%: 0.2%)	95000	216240	121240	1.28
T_1	Nano urea 0.5% + Zinc sulphate 0.2% +boron 0.2%	105000	220187	115187	1.10
T_2	Nano urea 0.5% + Zinc sulphate 0.4% +boron 0.4%	115000	280886	165886	1.44
T_3	Nano urea 0.5% + Zinc sulphate 0.6% +boron 0.6%	125000	355369	230369	1.84
T_4	Nano urea 1.0% + Zinc sulphate 0.2% +boron 0.2%	135000	418856	283856	2.10
T_5	Nano urea 1.0% + Zinc sulphate 0.4% +boron 0.4%	145000	523710	378710	2.61
T_6	Nano urea 1.0% + Zinc sulphate 0.6% +boron 0.6%	155000	624871	469871	3.03
T_7	Nano urea 1.5% + Zinc sulphate 0.2% +boron 0.2%	165000	767728	602728	3.65
T_8	Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%	175000	817934	642934	3.67
T_9	Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%	175000	821844	646844	3.70

4. CONCLUSION

Based on the results of the present study, it is concluded that, overall treatment T_9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) performed best in terms in growth, yield and quality of the strawberry was also obtained from this treatment.

The maximum benefit cost ratio was observed in T_9 (Nano urea 1.5% + Zinc sulphate 0.6% +boron 0.6%) followed by T_8 (Nano urea 1.5% + Zinc sulphate 0.4% +boron 0.4%) while the minimum benefit cost ratio was observed in T_0 (Control).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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