https://doi.org/10.48047/AFJBS.6.14.2024.8418-8425

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Effect of foliar spray of NPK, Borax, ZnSO 4 & MgSO4 on Vegetative growth of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Winter Dawn:

DIVYANSH MISHRA[1], SANJAY PATHAK[2], AVDHESH KUMAR[3], PRABHAT KUMAR[4], IMRAN ALI[5], SAURABH TIWARI[6]

1,3,4,5 Research Scholar Dept. of Fruit Science, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture & Technology Kumarganj Ayodhya-224229 (U.P.) India.

2 Professor Dept. of Fruit Science, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture & Technology Kumarganj Ayodhya-224229 (U.P.) India.

5 Research Scholar Dept. of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture & Technology Kanpur 208202 (U.P.) India.

Email I.D. - divyansh.mishra1993@gmail.com

Volume 6, Issue 14, Aug 2024

Received: 15 June 2024

Accepted: 25 July 2024

Published: 15 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.8418-8425

ABSTRACT

The present investigation entitled "Effect of foliar spray of NPK, Borax, ZnSO 4 & MgSO4 on Vegetative growth of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Winter Dawn" was carried out during the year 2022-23 and 2023-24 at Main Experimental Station, Department of Fruit Science, College of Horticulture & forestry, A.N.D.U.A&T. Narendra nagar Kumarganj Ayodhya, Uttar Pradesh, India. The collected data were analyzed using RBD design with 9 treatments T1 (NPK @ 0.5%), T2 (NPK @ 1.0%), T3 (NPK @ 1.5%), T4 (NPK @1.0% +Borax @0.25%), T5 (NPK @ 1.0% +$ZnSO_4$ @ 0.25%), T6 (NPK @ 1.0% + $MgSO_4$ @ 0.25%), T7 (NPK @ 0.5% + Borax @0.25%+$ZnSO_4$ @ 0.25%), T8 (NPK @ 0.5% + Borax @ 0.25% + $ZnSO_4$ @ 0.25%+ $MgSO_4$ @ 0.25%) and T9 (control) with three replication. The results revealed that the treatment T8 (NPK @ 0.5% + Borax @ 0.25% + $ZnSO_4$ @ 0.25%+ $MgSO_4$ @ 0.25%) outperformed the rest with Plant height(18.61cm and 18.32cm), maximum Number of leaves(41.23 and 40.82), maximum Plant spread (37.60cm and 37.48cm), highest production of runners(4.82 and 4.71). The treatment T_8 is therefore recommended for the application to strawberry plant to obtain high yields.

Keywords: NPK, Borex, ZnSO4, MgSO4, Strawberry, spray.

INTRODUCTION

The strawberry, or *Fragaria* × *ananassa* Duch., is a member of the Rosaceae family. It is thought to be among the world's most beautiful, tasty, and revitalizing berries. According to **Bowling (2000)**, it is a hybrid of two species: *Fragaria virginiana* Duch. and *Fragaria chiloensis* Duch. Its fundamental chromosomal numbers are x=7 and 2n=56. Growing strawberries is reasonably simple in frost-free areas, which are also ideal for kitchen gardens.

The farmed strawberry is mostly eaten raw, but it can also be processed to make jam, crumble, pies, ice cream, milkshakes, and other desserts.

Temperature, photoperiod, and light intensity are some of the environmental elements that have a substantial impact on strawberry plants. 22°C to 25°C during the day and 7°C to 13°C at night are the ideal temperatures for it. Frost and winter damage severely diminish strawberry output in cold climates. Frost damage to the open flower's center might result in the unmistakable black eye. By applying mulch, covering the row with plastic, and ensuring adequate air drainage, the damage caused by frost can be minimized. Strawberry plant form, yield, and vegetative growth are all significantly impacted by photoperiod. With a rise in photoperiod comes an increase in stolon development, petiole length, leaf area, and yield.

The form of boron that is absorbed is H3BO4. It is a micronutrient that is mobile in soil and immobile in plants, and it is the most deficient mineral after zinc. The availability of boron in soil is decreased by liming, salinity, or calcareousness. There is a lack of knowledge regarding the mineral B found in soils.

The most important micronutrient of global concern is zinc, which is absorbed by plants in the form of Zn2+. Zinc is an immobile micronutrient in plants, and factors such as soil calcareousness, high phosphorus content, salinity or sodicity, overliming, etc. negatively impact its availability in soil.

Nitrate (NO3 -) and ammonium (NH4 +) are the forms of nitrogen that are taken up by strawberry plants. The most available form of Nitrogen is the nitrate form. NO3 - acts as a source of instant energy to the plants and is highly mobile in the soil. Sometimes NO3 - form of nitrogen is not available to the plant because of leaching and drainage losses, whereas, NH4 + form of nitrogen has more volatilization and denitrification losses. Different responses to NO3 - and NH4 + nitrogen fertilizers, as well as their relationship, can be observed depending on varieties and agronomic management (Cárdenas-Navarro et al., 2006). For strawberry NO3 - and NH4 + form of nitrogen has different impact on growth, flower emergence, number of flower, fruit quality and yield. Nitrogen is referred as the “balance wheel”, as its excess or scarcity is detrimental for the plant growth.

MATERIALS AND METHODS

The present experiment was conducted at the Main Experimental Station, Department of fruit science, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture

& Technology, Kumarganj. Ayodhya (U.P.) during year 2022-23 and 2023-24. The experiment was laid out in randomized block design with 9 treatment, namely: T1 (NPK @ 0.5%), T2 (NPK @ 1.0%), T3 (NPK @ 1.5%), T4 (NPK @1.0% +Borax @0.25%), T5 (NPK @ 1.0% +ZnSO4 @ 0.25%), T6 (NPK @ 1.0% + MgSO4 @ 0.25%), T7 (NPK @ 0.5% + Borax @0.25%+ZnSO4 @ 0.25%), T8 (NPK @ 0.5% + Borax @ 0.25% + ZnSO4 @ 0.25%+MgSO4 @ 0.25%) and T9 (control). The data was collected on vegetative growth like Plant height (cm), Number of leaves, Plant spread (cm), Total number of runners. The data noted from each replication of each treatment from the experiment were analysed by SAAS 9.1 statistical software.

RESULT AND DISCUSSION

4.1.1 Plant height (cm)

A perusal of the data Table no. 1 showed significant effect, During 2022-23, the maximum plant height (18.61cm) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @ 0.25% + $ZnSO_4$ @ 0.25%+ $MgSO_4$ @ 0.25%) which was statistically at par with T_3 (NPK @1.5%) 17.55cm. However, the minimum plant height was observed in the T_9 (control) 11.60cm. Similar trends was also observed in 2023-24 that the maximum plant height (18.32cm) was noted upon foliar application of treatment T_8 (NPK @ 0.5% + Borax @ 0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @ 0.25%) which was statistically at par with T_3 (NPK @1.5%) 17.74cm. However, the minimum plant height was observed in the T_9 (control) 11.30cm. Pooled data represents the maximum plant height (18.46 cm) was noted upon foliar application of treatment T_8 (NPK 0.5% + Borax 0.25% + $ZnSO_4$ 0.25%+ $MgSO_4$ 0.25%) which was statistically at par with T_3 (NPK 1.5%) 17.39 cm. However, the minimum plant height was observed in the T_9 (control) 11.45cm. The present findings accordance to the research of Raghu & Tripathi (2009), Verma *et al.*(2021)

Number of leaves per plant

The data in Table no. 1 showed significant effect. During 2022-23, the maximum number of leaves per plant (41.23) was noted upon foliar application of treatment T_8 (NPK @ 0.5% + Borax @ 0.25% + $ZnSO_4$ @ 0.25%+ $MgSO_4$ @ 0.25%) which was statistically at par with T_3 (NPK @1.5%) 40.12, T_6 (NPK @1% + $MgSO_4$ @0.25%) 39.42 and T_5 (NPK @1% +$ZnSO_4$ @ 0.25%) 38.82. However, the bare minimum of leaves each plant was noted in the T_9 (control) 25.23.Similar trends was also observed in 2023-24 that maximum number of leaves per plant

(40.82) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @ 0.25% + $ZnSO_4$ @ 0.25%+ $MgSO_4$ @ 0.25%) which was statistically at par with T_3 (NPK @ 1.5%) 40.23 and T_6 (NPK @1% + $MgSO_4$ @ 0.25%) 38.98. However, the minimum number of leaves per plant was observed in the T_9 (control) 25.11.Pooled data represents the maximum number of leaves per plant (41.02) was noted upon foliar application of treatment T_8 (NPK @ 0.5% + Borax @0.25% + ZnSO4 @ 0.25%+ $MgSO_4$ @ 0.25%) which was statistically at par with T_3 (NPK @1.5%) 40.17 and T_6 (NPK @ 1% + $MgSO_4$ @ 0.25%) 39.20. However, the minimum number of leaves per plant was observed in the T_9 (control) 25.17. These results are in conformity with the findings of Kaviani *et al*., (2012) in strawberry, Parmar *et al*., (2021) in strawberry, and Ekka *et al*., (2020) in strawberry.

Plant spread (cm)

A perusal of the data Table no. 1 showed significant effect During 2022-23, the maximum plant spread from (37.60cm) was noted upon foliar application of treatment T_8 (NPK @ 0.5% + Borax @ 0.25% + $ZnSO_4$ @0.25%+ MgSO4 @0.25%) which was statistically at par with T_3 (NPK @1.5%) 35.11cm, T_7 (NPK @0.5% + Borax @0.25%+$ZnSO_4$ @ 0.25%) 34.39cm and T_5 (NPK @1% +$ZnSO_4$ @ 0.25%) 32.39cm. However, the minimum plant spread from east to west was observed in the T_9 (control) 23.44 cm. During 2023-24, the maximum plant spread from (37.48cm) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @0.25%) which was statistically at par with T_3 (NPK @1.5%) 35.77cm, T_7 (NPK @ 0.5% + Borax @0.25%+ $ZnSO_4$ @ 0.25%) 35.14 cm and T_5 (NPK @1% +$ZnSO_4$ @ 0.25%) 32.97cm. However, the minimum plant spread from was observed in the T_9 (control) 23.07cm. Pooled data also represents the maximum plant spread (37.54cm was noted upon foliar application of treatment T_3 (NPK @1.5%) 35.44cm which was statistically at par with T_8 (NPK @0.5% + Borax @0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @ 0.25%) 37.54 cm and T_7 (NPK @ 0.5% + Borax @0.25%+$ZnSO_4$ @0.25%) 34.76cm. However, the minimum plant spread was observed in the T_9 (control) 23.26cm. These results elucidate the findings of Nazir *et al*.,(2006) in strawberry, Iqbal *et al*.,(2009) in strawberry, Meena *et al*., (2014) in strawberry, Hazarika *et al*., (2015) in strawberry and Subraya *et al*., (2017).

Number of runners per plant

A perusal of the data Table no. 1 showed significant effect of During 2022-23, the maximum number of runners per plant (4.82) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @0.25%) which was statistically at par with T_7 (NPK @0.5% + Borax @0.25%+ZnSO4 @0.25%) 4.50, T_3 (NPK @1.5%) 40.12, T_6 (NPK @1% + $MgSO_4$ @0.25%) 4.0 and T_5 (NPK @1% +$ZnSO_4$ @0.25%) 3.80. However, the minimum number of runners per plant was observed in the T_9 (control) 2.60. Similar trends were also observed in 2023-24 that maximum number of runners per plant (4.71) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @0.25%) which was statistically at par with T_7 (NPK @0.5% + Borax @0.25%+$ZnSO_4$ @0.25%) 4.61 and T_3 (NPK @1.5%) 4.10. However, the minimum number of runners per plant was observed in the T_9 (control) 2.41. Pooled data represents the maximum number of runners per plant (4.76) was noted upon foliar application of treatment T_8 (NPK @0.5% + Borax @0.25% + $ZnSO_4$ @0.25%+ $MgSO_4$ @0.25%) which was statistically at par with T_7 (NPK @0.5% + Borax @0.25%+$ZnSO_4$ @0.25%) 4.56.

Table No. 1: Effect of foliar spray of NPK, Borax, ZnSO4 & MgSO4 on Flowering and fruiting of Strawberry:

TREATMENT	**Plant height(cm)**			**Number of leaves / plant**			**Plant spread (cm)**			**Number of Runner / Plant**		
	2022-2023	**2023-2024**	**Pooled**	**2022-2023**	**2023-2024**	**Pooled**	**2022-2023**	**2023-2024**	**Pooled**	**2022-2023**	**2023-2024**	**Pooled**
T_1: NPK @ 0.5%	13.00c	12.85d	12.92d	33.86d	33.07d	33.47d	28.30d	27.59e	27.94e	2.95cd	2.90cd	2.93ef
T_2: NPK @ 1%	15.78b	15.52c	15.70c	36.67bcd	36.10c	36.38c	32.41c	31.97d	32.19d	3.32cd	3.10bc	3.21de
T_3: NPK 1.5%	17.55ab	17.74ab	17.39ab	40.12a	40.23ab	40.17ab	35.11ab	35.77ab	35.44b	4.00abc	4.10ab	4.05bc
T_4:NPK@1% + Borax @ 0.25%	15.90b	15.43c	15.60c	36.42cd	36.02c	36.21c	32.48bc	32.05d	32.27d	3.40cd	3.30cd	3.35de
T_5: NPK @1% +$ZnSO_4$ @ 0.25%	16.00b	15.92bc	15.96c	38.82abc	38.10bc	38.46b	32.29bc	32.97cd	33.13d	3.80abc	3.51bc	3.66cd
T_6:NPK@1%+$MgSO_4$ @ 0.25%	16.20b	16.05bc	16.12bc	39.42ab	38.98ab	39.20ab	33.45bc	32.95dc	33.20cd	3.67bc	3.42bc	3.54cd
T_7:NPK@0.5%+Borax@0.25%+$ZnSO_4$ @ 0.25%	16.53b	16.72abc	16.62bc	35.67d	35.70c	35.68c	34.39bc	35.14bc	34.76bc	4.50ab	4.61a	4.56ab
T_8:NPK@0.5%+Borax@0.25%+$ZnSO_4$ @ 0.25%+$MgSO_4$@ 0.25%	18.61a	18.32a	18.46a	41.23a	40.82a	41.02a	37.60a	37.48a	37.54a	4.82a	4.71a	4.76a
T_9: Control	11.60c	11.30d	11.45e	25.23e	25.11e	25.17e	23.44e	23.07f	23.26f	2.60d	2.41d	2.51f
MEAN	**15.68**	**15.54**	**15.58**	**36.38**	**36.01**	**36.19**	**32.27**	**32.11**	**32.19**	**3.67**	**3.56**	**3.62**
LSD (P≤0.05)	**1.66**	**1.91**	**1.29**	**2.86**	**2.50**	**1.97**	**2.69**	**2.19**	**1.62**	**1.05**	**0.80**	**0.61**

CONCLUSION

From the on-going summery of the present investigation, it can be inferred that vegetative growth parameters viz. Plant height (cm), Number of leaves, Plant spread (cm), Total number of runners. It can concluded that all the treatments shows good effects on increased plant height maximum area cover in plant spread, maximum number of leaves and maximum runner production as compared to the control but T 8 NPK@0.5% + Borex@0.25% + Znso4 @0.25%+ Mgso4@0.25% was more pronounced among all the treatments and can be used in increased plant height, plant spread and runner production.

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