Effect of Foliar Application of Nano Urea, Boron and Zinc Sulphate on Growth, Yield and Quality of Guava (*Psidium guajava* L.) cv. Allahabad Surkha

Abstract

The present experiment entitled "Effect of Foliar Application of Nano Urea, Boron and Zinc Sulphate on Growth, Yield and Quality of Guava (*Psidium guajava* L.) cv. Allahabad Surkha" was conducted at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the session 2022 - 2024. The experiment was laid out in randomized block design with three replications, and the study consists of ten treatment combinations including control. The best treatment was T9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) &T8 (Nano urea 2.0% + zinc sulphate 0.4% + boron 0.4%) which shows the highest values in all the parameters viz., number of flower/tree (86.47), Days taken to fruit harvesting (49.19), fruit set (74.00%), Number fruit/tree (63.25), Fruit length (7.42 cm), fruit weight (178.73g), fruit diameter (7.12 cm), fruit yield/tree (11.29 kg). Increased flowering, fruit yield and quality might be due to the increased absorption of nutrients when given as foliar application.

Keywords: Guava, Zinc sulphate, *Psidium, guajava*, boron

INTRODUCTION

Guava (*Psidium guajava* L.) known as the "Apple of the tropics" belongs to the family Myrtaceae and is a highly remunerative crop. It is an important fruit of tropical and subtropical areas of the world and was introduced in India in the 17th century by the Portuguese. The genus Psidium belongs to a myrtle family and emerged from Central America and Mexico. The genus guajava consists of different types like - yellow fruited cherry guava, strawberry and red apple guava. The commonly consumed guava is with yellow skin and either white or pink flesh. It is a fruit with high production in tropical and subtropical countries. The principal producers of guava in the world are India, Pakistan and Brazil.

Guava is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Maharashtra and Bihar. The excellent quality guava fruit in the world is produced in Allahabad district of Uttar Pradesh. Uttar Pradesh occupied first rank in the production of guava in India with production of 4,86,700 Metric tons. Approximately 30 – 50 percent of losses are seen in post-harvest handling due to the lack of marketing and storage facilities **(Pooja *et al.* 2020).** It contains remarkable mineral levels that include calcium, phosphorus, iron and vitamins such as niacin, pantothenic acid, thiamin, riboflavin and vitamin C. It has large amounts of antioxidant properties due to the existence of polyphenolic compounds and carotenoids in it.

Micronutrients like Zinc and Boron perform a specific role in the growth and development of plants, quality produce and uptake of major nutrients. Boron is much required for cell division and development in the growth regions of the plant near the tips of shoots and roots. A shortage of Boron also causes cracking and distorted growth in fruit with the appearance of red spots on the newly emerged leaves. It can be managed by foliar application of Borax.Because boron is essential for the translocation of carbohydrates, auxin production, enhanced pollen viability, and fertilisation, borax produced a more beneficial reaction. Fruit set, pollen tube expansion, and ovule development all depend on boron. Cell membranes contain boron, which is necessary for cell division. It aids in the plant's uptake of nitrogen and the translocation of sugar, and it regulates the ratio of potassium to calcium in the plant. In plants, boron improves the availability of nitrogen. It is thought that boron causes T9 growth hormone to become inactive by forming a complicated molecule.

Zinc is necessary for the production of tryptophan, which is a precursor to auxin and helps prevent fruit drop (Hassan et al. 2010). Applying zinc at a greater concentration raises the zinc content in the leaves, which in turn promotes the body's natural synthesis of auxin, which decreases fruit drop. It is crucial for the metabolism of starch and serves as a cofactor for several enzymes that impact protein formation, nucleic acid metabolism, and photosynthetic reactions. Low levels of auxin in tissue cause the severe stunting of leaves and shoots that characterises crops lacking in zinc. Young leaves are often the most damaged; they are typically tiny, thin, chlorotic, and frequently rosetted as a result of the shoot's inability to lengthen. Zinc is essential for growth and development, as well as for the growth, quality, and blooming of fruits. It also raises the chlorophyll content of leaves and plays a significant part in enzymatic activities.

Nitrogen is essential for oxidation-reduction processes and plays a role in the development of porphyrin ring structure, which forms chlorophyll molecules. An increase in the nitrogen content of leaves is linked to the development of green colour in those leaves. In stress situations as well as plant development, production, and quality, potassium is essential for a number of physiological and biochemical processes (Marschner, 1995). It is important for metabolic activities such as the synthesis of carbohydrates and the growth of meristematic tissue. In addition, potassium controls the transpiration process and water absorption while promoting the lignification of the cell walls. In a similar vein, zinc plays a crucial part in the activation of enzymes like catalase, peroxidase, and cytochrome oxidase as well as raising the chlorophyll content of leaves. Applications of zinc, potassium, and urea had positive effects on fruit crop output and vegetative development. Therefore, for the guava crop to thrive and produce more effectively, the prudent administration of both macro and micronutrients is necessary.

MATERIALS AND METHODS

The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^oC – 48^oC and seldom falls as low as 4ºC – 5ºC. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. Prayagraj has a sub- tropical and semi- arid climate with rain mostly during July- September.

The experiment was laid out in Randomized Block Design Which consisting of ten treatments with T_0 – Control (N:P:K 0.8 % : 0.2% : 0.2%), T_1 – Nano urea 1.0% + zinc sulphate 0.2% + boron 0.2%, T_2 – Nano urea 1.0% + zinc sulphate 0.4% + boron 0.4%, T_3 - Nano urea 1.0% + zinc sulphate 0.6% + boron 0.6%, T_4 - Nano urea 1.5% + zinc sulphate 0.2% + boron 0.2%, T_5 - Nano urea 1.5% + zinc sulphate 0.4% + boron 0.4%, T_6 - Nano urea 1.5% + zinc sulphate 0.6% + boron 0.6%, T_7 - Nano urea 2.0% + zinc sulphate 0.2% + boron 0.2%, T_8 Nano urea 2.0% + zinc sulphate 0.4% + boron 0.4%, T_9 - Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%.The biometrical observation were recorded on five randomly selected plants of each replication to assess the morphological characters, *i.e*. Flowering Parameters, Physical Characteristics of fruit, Chemical Characteristics of fruit and Economics.

RESULT AND DISCUSSION

Flowering parameters

1. **Number of days to anthesis**

The data on number of days to anthesis of guava as influenced by Foliar Application of Nano-urea Boron and Zinc Sulphate are summarized in Table number 1

The data reveals that the number of days to anthesis of guava decreased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The minimum number of days to anthesis (12) was recorded with treatments 9 (nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%). While the maximum number of days to anthesis (27) was recorded under control. A decrease in number of days to anthesis might be due to the increased absorption of nutrients.

The minimum in number of days to anthesis of guava 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 conformed with **Nikbakht *et al.* (2021).** reported decreases in number of days to anthesis of guava with the use of nano urea **Abobatta and Ahmed (2023**) reported increase in growth parameters with nano urea in guava. While the maximum value in treatment T1 (control) may owes to its inhibitory effect because this treatment occupies only the recommended dose of fertilizers in guava, 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.* (2023).**

2. **Number of flowers/trees**

The data on number of flowers/trees guava as influenced by Foliar Application of Nano Urea, Boron and Zinc Sulphate are summarized in Table No. 2

The data reveals that the number of flowers/trees of guava increased significantly by the application of foliar application of nano-urea, boron, zinc and sulphate under experimentation over the control. The maximum number of flower/tree (86.47) was recorded with treatment9 (nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%). While the minimum Number of flower/tree (62.53) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the number of flowers/trees in guava.

The maximum increase in number of flowers per tree of guava due to treatment might be due to fact that zinc sulphate and boron regulate the growth by causing cell division and cell elongation in plant system. 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, These results are in conformity with **Zagade *et al.* (2017)** reported increase in number of flowers per tree of guava with the use of zinc Sulphate and boric acid. **Abobatta and Ahmed (2023)** 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 guava. Increase in growth parameters (number of flowers per trees) use of nano urea may be due to its effect in cell division and cell enlargement **Sharif *et al.* (2000).**

3. **Days number of taken to fruit harvesting**

The data reveals that the days taken to fruit harvesting of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experiment over the control. The minimum number days taken to fruit harvesting (49.19) was recorded with treatments 9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) while the maximum number days taken to fruit harvesting (60.20) was recorded under control. Further, the interaction effect of nano urea, boron, zinc sulphate significantly influenced the number of days taken to fruit harvesting.

The minimum number days taken to fruit harvesting of guava due to treatment might be due to fact that zinc sulphate and boron regulate the growth by causing cell division and cell elongation in plant system. 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, These results are in conformity with **Raj Kumar *et al.* (2014)** reported decreases in number of days taken to fruit harvesting of guava with the use of zinc Sulphate and boric acid. **Singh *et al.* (2017)** reported increase in growth parameters with nano urea in guava.

While the maximum 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 (number of days taken to fruit harvesting) use of Nano urea may be due to its effect in cell division and cell enlargement **Yadav *et al.* (2017)**.

4. **Fruit Set Percentage**

The data reveals that the Fruit set percent of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum fruit set (74%) was recorded in treatments 9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%). while the minimum fruit set (54.78%) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the fruit set per cent in guava.

Increase in fruit set percent with the use of zinc might be due to fact that benzyle 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 and Tripathi (2010) observed increase in yield parameters following use of treatment Nano urea and zinc in guava. Similar results have been reported by **Saima *et al*. (2014).**

5. **Number of fruit/tree**

The data reveals that the Number of Fruit/tree of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum Number of fruits/tree (66.40) was recorded with treatments 9 (nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) while the minimum Number of fruits/tree (35.50) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the fruit set per cent in guava. Increase number of fruit plant was might be due to the increased duration of flowering. This might be due to the fact their more food reserves were available for less number of flower buds.

Increase in number of fruits per tree 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.

Bhatti *et al.* (2023) observed increase in yield parameters following use of treatment Nano urea and zinc in guava. Similar results have been reported by **Saima *et al.* (2014).**

Physical Characteristics of fruit

1. **Fruit length (cm)**

The data reveals that the fruit Length of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum fruit length (7.42 cm) was recorded with treatments 9 (nano urea 2.0%+ zinc sulphate 0.6% + boron 0.6%) while the minimum fruit Length (5.59 cm) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the fruit length in guava.

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 (**Richard, 2006).**

Singh *et al.* (2017) 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 **Lal and Das (2017); Yadav *et al*. (2017).**

2. **Diameter of fruit**

The data reveals that the diameter of fruit of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum diameter of fruit (7.12 cm) was recorded with treatments 9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) while the minimum diameter of fruit (5.99 cm) was recorded under control. The interaction effect of Nano Urea, boron, zinc sulphate significantly influenced the fruit set per cent in guava.

The maximum increase in fruit diameter 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, These results are in conformity with **Rajkumar *et al.* (2017)** reported increase in fruit diameter of guava with the use of zinc Sulphate and boric acid. **Abobatta and Ahmed (2023)** 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 **Sharif *et al.* (2000).**

3. **Fruit weight (g)**

The data reveals that the fruit weight of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum fruit weight (178.73g) was recorded with treatment 9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) while the minimum fruit weight (142.37g) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the fruit weight in guava.

The maximum increase in fruit weight following the 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. (*2017).**

Zagade *et al.* (2017) reported maximum fruit weight guava with nano urea and zinc 2%. These results are in close similarity with the findings of **Singh *et al.* (2013).**

4. **Fruit yield/tree**

The data reveals that the fruit yield/tree of guava increased significantly by the application of foliar application of nano urea, boron, zinc and sulphate under experimentation over the control. The maximum fruit yield/tree (11.29kg) was recorded with treatments 9 (Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%) while the minimum fruit yield/tree (5.03kg) was recorded under control. The interaction effect of nano urea, boron, zinc sulphate significantly influenced the fruit yield/tree in guava.

The maximum increase in fruit yield/tree 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, These results are in conformity with **Chander *et al.* (2017)** reported increase in fruit yield per tree of guava with the use of zinc Sulphate and boric acid. **Abobatta and Ahmed (2023)**.

While the minimum value in treatment T1 (control) may owe to its inhibitory effect because this treatment occupies only the 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 on cell division and cell enlargement **Sharif *et al.* (2000).**

CONCLUSION:

Based on the above findings it can be concluded that guava with the application of nano urea along with the application of micronutrient $ZnSO_4$ and boron recorded the highest number of days to anthesis, number of flower tree^{-1}, daystaken to fruit harvesting, fruit set percent, number of fruits tree^{-1}, fruit length, diameter of fruit, fruit weight, fruit yield tree^{-1}.

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Treatment Symbol	Treatment combinations	No. of days to anthesis	No. of flowers/tree	Number of Days taken to fruit harvest	Fruit set (%)	Number of fruit/tree
T_0	Control (N:P:K 0.8% : 0.2% : 0.2%)	27	62.53	59.28	54.78	35.50
T_1	Nano urea 1.0% + zinc sulphate 0.2% + boron 0.2%	16	69.88	60.20	58.58	39.18
T_2	Nano urea 1.0% + zinc sulphate 0.4% + boron 0.4%	17	74.98	59.35	58.16	44.53
T_3	Nano urea 1.0% + zinc sulphate 0.6% + boron 0.6%	19	76.74	58.17	58.56	66.40
T_4	Nano urea 1.5% + zinc sulphate 0.2% + boron 0.2%	21	78.14	57.26	62.99	46.99
T_5	Nano urea 1.5% + zinc sulphate 0.4% + boron 0.4%	24	81.73	56.11	67.29	51.99
T_6	Nano urea 1.5% + zinc sulphate 0.6% + boron 0.6%	19	63.87	54.37	67.56	56.05
T_7	Nano urea 2.0% + zinc sulphate 0.2% + boron 0.2%	14	82.87	54.24	68.01	60.48
T_8	Nano urea 2.0% + zinc sulphate 0.4% + boron 0.4%	13	85.31	51.53	70.82	60.84
T_9	Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%	12	86.47	49.19	74.00	63.25
	F-test	S	S	S	S	S
	SEm(±)	1.55	2.19	1.64	2.23	1.55
	CD (p=0.05)	0.58	6.52	4.89	6.63	4.60

Table no. 2 EffectofFoliarApplicationofNanoUrea,BoronandZincSulphateonPhysical Characteristics of fruit ofGuava(*Psidiumguajava*L.) cv. Allahabad Surkha

Treatment Symbol	Treatment combinations	Fruit length (cm)	Diameter of fruit (cm)	Fruit weight (g)	Fruit yield /tree(kg)
T_0	Control (N:P:K 0.8% : 0.2% : 0.2%)	5.59	5.99	142.36	5.03
T_1	Nano urea 1.0% + zinc sulphate 0.2% + boron 0.2%	5.83	5.99	147.23	5.77
T_2	Nano urea 1.0% + zinc sulphate 0.4% + boron 0.4%	6.98	6.19	153.70	6.84
T_3	Nano urea 1.0% + zinc sulphate 0.6% + boron 0.6%	5.92	6.38	158.60	7.45
T_4	Nano urea 1.5% + zinc sulphate 0.2% + boron 0.2%	6.55	6.47	163.80	8.51
T_5	Nano urea 1.5% + zinc sulphate 0.4% + boron 0.4%	6.78	6.56	169.40	9.47
T_6	Nano urea 1.5% + zinc sulphate 0.6% + boron 0.6%	6.98	6.73	173.56	10.49
T_7	Nano urea 2.0% + zinc sulphate 0.2% + boron 0.2%	7.28	6.82	175.80	10.69
T_8	Nano urea 2.0% + zinc sulphate 0.4% + boron 0.4%	7.36	6.94	175.93	11.11
T_9	Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%	7.42	7.12	178.73	11.91
	F-test	S	S	S	S
	SEm(±)	0.20	0.19	4.81	0.30
	CD (p=0.05)	0.58	0.57	14.28	0.88