

Original Research Article

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 highest values in all the parameters viz., number of flower/tree (86.47), Day 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 “Apple of the tropics” belongs to family Myrtaceae and is a highly remunerative crop. It is an important fruit of tropical and subtropical areas of 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 from Allahabad district of Uttar Pradesh. Uttar Pradesh occupied first rank in production of guava in India with production of 4,86,700 Metric tonnes. 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 includes calcium, phosphorus, iron and vitamins such as niacin, pantothenic acid, thiamin, riboflavin and vitamin C. It has large amounts of antioxidants and 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 plant, 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 appearance of red spots on the newly emerged leaves. It can be managed by foliar application of Borax. Borax response was more positive due to boron which plays an important role in translocation of carbohydrates, auxin synthesis and increased pollen viability and fertilization. Boron is important for ovule development, pollen tube growth and fruit set. Boron is a constituent of cell membrane and essential for cell division. It acts as a regulator of potassium/calcium ratio in the plant and helps in nitrogen absorption and translocation of sugar in plant. Boron increases nitrogen availability in a plant. It is believed that boron brings about inactivation of T_9 growth hormone by formation of complex compound.

Zinc is required for the synthesis of tryptophan a precursor of auxin thus helps in reducing fruit drop (**Hassan et al. 2010**). Application of zinc at higher level increased the foliar zinc content which ultimately encourages the endogenous production of auxin thereby reducing fruit drop. It has important role in starch metabolism and acts as cofactor for many enzymes, affects photosynthesis reaction, nucleic acid metabolism and protein biosynthesis. The severe stunting of leaves and shoots, which is so typical of zinc deficient crops, is a consequence of low auxin levels in tissue. Young leaves are usually the most affected and are small, narrow, chlorotic and often rosetted due to failure of the shoot to elongate. Zinc increases the chlorophyll content of leaves and plays an important role in enzymatic activities and is necessary for growth and development and is also important element for flowering, fruiting, growth and quality of fruits.

Nitrogen is important in oxidation–reduction reactions and is involved in formation

of chlorophyll molecule through synthesis of porphyrin ring structure. The development of green color in leaves is associated with an increase in nitrogen content of the leaves. Potassium plays an important role in various physiological and biochemical processes vital to the plant growth, yield and quality and in stress conditions (Marschner, 1995). It has a pertinent role in metabolic processes like carbohydrate synthesis and in development of meristematic tissue. Potassium also encourages the lignification of the cell walls and regulates water absorption and transpiration process. Similarly, zinc also increases the chlorophyll content of leaves and plays an important role in the activation of enzymes like catalase, peroxidase and cytochrome oxidase. The application of urea, potassium and zinc showed favorable effect on vegetative growth and yield in fruit crops. So, the judicious application of both macro and micronutrients are essential for getting better growth and productivity in guava crop.

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°C – 48°C and seldom falls as low as 4°C – 5°C. 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 T₀ – Control (N:P:K:0.8 % : 0.2% : 0.2%), T₁ – Nano urea 1.0%+zinc sulphate 0.2%+ boron 0.2%, T₂ – Nano urea 1.0%+zinc sulphate 0.4%+ boron 0.4%, T₃ – Nano urea 1.0%+zinc sulphate 0.6%+ boron 0.6%, T₄ – Nano urea 1.5%+zinc sulphate 0.2%+ boron 0.2%, T₅ – Nano urea 1.5%+zinc sulphate 0.4%+ boron 0.4%, T₆ – Nano urea 1.5%+zinc sulphate 0.6%+ boron 0.6%, T₇ – Nano urea 2.0%+zinc sulphate 0.2%+ boron 0.2%, T₈ – Nano urea 2.0%+zinc sulphate 0.4%+ boron 0.4%, T₉ – Nano urea 2.0%+zinc sulphate 0.6%+ boron 0.6%. The biometrical observations 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. 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 in conformity 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 occupy only 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 flower/tree

The data on number of flower/tree 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 flower/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 flower/tree (86.47) was recorded with treatments 9 (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 flower/tree 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 **Zagadeet *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 flower per tree) 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 owe to its inhibitory effect because this treatment occupies 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 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**).

Singhet *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 treatments 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 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)**.

Zagadeet al. (2017) reported maximum fruit weight guava with nano urea and zinc 2%. These results are in close similarity with the findings of **Singhet 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 owes 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 **Sharif et al. (2000)**.

CONCLUSION:

Based on the above findings it can be concluded that lentil with the application of nano urea along with the application of micronutrient $ZnSO_4$ and boron recorded highest number of days to anthesis, number of flower tree⁻¹, days number of taken 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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UNDER PEER REVIEW

Table no. 1 Effect of Foliar Application of Nano Urea, Boron and Zinc Sulphate on Flowering parameters of Guava (*Psidium guajava* L.) cv. Allahabad Surkha

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 Effect of Foliar Application of Nano Urea, Boron and Zinc Sulphate on Physical Characteristics of fruit of Guava (*Psidium guajava* 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
T ₁	Nano urea 1.0% + zinc sulphate 0.2% + boron 0.2%	5.83	5.99	147.23	5
T ₂	Nano urea 1.0% + zinc sulphate 0.4% + boron 0.4%	6.98	6.19	153.70	6
T ₃	Nano urea 1.0% + zinc sulphate 0.6% + boron 0.6%	5.92	6.38	158.60	7
T ₄	Nano urea 1.5% + zinc sulphate 0.2% + boron 0.2%	6.55	6.47	163.80	8
T ₅	Nano urea 1.5% + zinc sulphate 0.4% + boron 0.4%	6.78	6.56	169.40	9
T ₆	Nano urea 1.5% + zinc sulphate 0.6% + boron 0.6%	6.98	6.73	173.56	1
T ₇	Nano urea 2.0% + zinc sulphate 0.2% + boron 0.2%	7.28	6.82	175.80	1
T ₈	Nano urea 2.0% + zinc sulphate 0.4% + boron 0.4%	7.36	6.94	175.93	1
T ₉	Nano urea 2.0% + zinc sulphate 0.6% + boron 0.6%	7.42	7.12	178.73	1
	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

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