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Response of Guava to Foliar Application of Urea and Zinc on Fruit Set, Yield and Quality

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ABSTRACT

Experiment on effects of foliar application of urea and zinc with nine treatments combination on guava was carried out during 2012-13 at Fruit Research Station at Junagadh. The results showed that the 1.5% urea treatment gave significantly the maximum number of fruit retention (63.17%), fruit weight (155.47g), highest number of fruits per plant (511.07) and yield of fruits (22095kg/ha) were noted in treatment (1.5% Urea). With respect to effect of zinc sulphate the data indicated that the, fruit retention (62.86%), fruit weight (153.89g), highest number of fruits per plant (489.69) and yield of fruits (20984kg/ha) were recorded in treatment Z_3 (0.6% $ZnSO_4$). It was found that application of 1.5% urea and Z3 (0.6% ZnSO4) prove superior among tested dose of both the urea and zinc under Junagadh conditions.

Kewwords **:** Guava, urea, zinc, flowering, yield, quality.

INTRODUCTION

Fruits are nature's gift to mankind. These are not only delicious and refreshing but are also the chief source of vitamins, minerals and proteins. These constituents are essential for normal physiological well-being and help in maintaining healthy state through development of resistant against pathogen. The guava is one of the most common and important fruit crop cultivated all over India. It is fourth most important fruit crop in area and production after mango, banana and citrus (Pedapati and Tiwari, 2014). Guava belongs to family Myrtaceae. It is classified under genus *Psidium*, which contains 150 *species*, but only *Psidium guajava* has been exploited commercially. The guava is the native of tropical America from where it was introduced in 17th century in India by Portuguese people. Much of interest in common guava has been due to its delightful taste and flavour(Pedapati and Tiwari, 2014). It is the fruit that has been often referred as "Apple of tropics." Guava can be grown profitability in central and north Gujarat. Of late it is becoming inferior in qualitative and quantitative characters and as such new variety or cultivar like 'Lucknow-49' is introduced. Micronutrients like Fe, Zn, B, Cu, Mn, Mo and Cl plays a vital role in plants. Micronutrients can be applied to plants by soil and foliar application. Foliar application of micronutrients is more successful than soil application. Zinc takes part in chlorophyll synthesis, involved in biosynthesis of plant growth hormone (IAA) and plays positive role in photosynthesis and nitrogen metabolism. It was observed that urea had significantly improved the extension of terminal shoots as compared to the control. The shoots sprayed with urea had early maturity of fruits observations recorded also indicated that fruit set, fruit retention, fruit diameter, fruit weight and yield as well as total soluble solids and acidity content of fruits were increased, whereas, total carbohydrates and C/N ratio of leaves were decreased by the application showed good results for most of the characters. Considering all the above facts and with a view to have better flowering, yield and quality of fruits, a field experiment was carried out with the following objective to study the effect of urea and zinc on flowering, fruiting, yield and quality of guava.The details of the materials and experimental methods followed during the course of the present

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MATERIALS AND METHODS

The experiment entitled "Response of guava to foliar application of urea and zinc on fruit set, yield and quality" was carried out at Madhadi Baug, Fruit Research Station, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during 2012-13. The experiment was laid out in a Factorial Randomized Block Design (F-RBD) with three replications and nine treatment combinations comprising of urea and zinc sulphate.

Experimental details: The details of the experiment are presented in Table 1.

Table1 : Experimental detail

Experimental site	:	Fruit Research Station (Madhadi Baug), Department of Horticulture, Junagadh Agricultural University, Junagadh
Season and year of experiment	:	*Kharif* – 2012
Experimental design	:	Randomized Block Design.(Factorial- arrangement)
Number of treatments	:	Nine (9)
Number of replications	:	Three (3)
Name of fruit and variety	:	Guava cv. Bhavnagar Red
Number of Plants treatment	:	Two (2)
Total number of plants	:	Fifty four (54)
Age of Tree	:	Eighteen (18) Years old
Size of Plot	:	6 × 6 m
No. of sprays	:	Two sprays
Details of spray	:	First spray was done at the time of flowering and second was done three weeks after first spray

Table 2 : Treatment Details

Symbol Used	Treatment Combinations
U_1Z_1	Urea spray 1.0% + Zinc sulphate spray 0.2%
U_1Z_2	Urea spray 1.0% + Zinc sulphate spray 0.4%
U_1Z_3	Urea spray 1.0% + Zinc sulphate spray 0.6%
U_2Z_1	Urea spray 1.5% + Zinc sulphate spray 0.2%
U_2Z_2	Urea spray 1.5% + Zinc sulphate spray 0.4%
U_2Z_3	Urea spray 1.5% + Zinc sulphate spray 0.6%
U_3Z_1	Urea spray 2.0% + Zinc sulphate spray 0.2%
U_3Z_2	Urea spray 2.0% + Zinc sulphate spray 0.4%
U_3Z_3	Urea spray 2.0% + Zinc sulphate spray 0.6%

Planting material

The present study was conducted on eighteen years old guava plants of variety 'Bhavnagar Red' planted at the Fruit Research Station, Junagadh Agricultural University, Junagadh. All the plants selected were uniform in growth and size at the distance of 6× 6 meters. All the plants were subjected to uniform application of manures and fertilizers, plant protection measures etc.

RESULTS AND DISCUSSION

The present investigation on the "Response of guava to foliar application of urea and zinc on fruit set, yield and quality" has lead to some important revelations, are discussed below. The appropriate reasons with observed variation recorded during the course of present study are explained

Effect of Urea

The data revealed that application of different treatments significantly influenced the number of flowers per shoot. The maximum number of flowers per shoot (5.33) was observed in 1.5% urea (U_2). The flower number per shoot increased with increasing concentrations of urea, which is due to significant increase in shoot number that ultimately ended in an individual flower. Increased number of flowers in present study is in agreement with the results obtained by Singh *et al.* (1971). The minimum flower drop (58.89%) was observed in the treatment U_2 (1.5% urea). The urea has helped in flower retention since the nitrogen is an important component of protoplasm and is helpful in chlorophyll synthesis, the increase in photosynthetic and consequently urea stimulates the synthesis of endogenous hormones which prevents the abscission and facilitated the ovary to remain attached with the shoot, resulting in lower flower drop. Similar results were found by Doraipandian and Shahmugavelu (1972). The result revealed that the percentage of fruit set was significantly increased due to different level of urea. The maximum percentage of fruit set

(70.80%) was observed in the treatment U_2 (1.5% urea) (Table 3). More fruit set due to urea spray was due to profuse flowering. It seems to have helped to increase the fruit set either by improving pollen germination or by helping the growth of pollen tubes and thus facilitate in timely fertilization before the stigma loses its receptivity or the style becomes non-functional. These findings are in agreement with Doraipandian and Shahmugavelu (1972). The maximum percentage of fruit retention (63.17%) was observed in the treatment U_2 (1.5% urea). More fruit retention due to urea spray was due to more fruit setting. It seems to have helped to increase the fruit retention either by improving pollen germination or by helping the fruit set. These findings are in agreement with Doraipandian and Shahmugavelu (1972). Minimum fruit drop (36.83%) was observed in the treatment U_2 (1.5% urea). The urea has helped in fruit retention because urea stimulates the synthesis of chlorophyll which results in synthesis of endogenous auxins and auxin prevents the abscission and facilitated the ovary to remain attached with the shoot, resulting in lower fruit drop. Similar results were found by Doraipandian and Shahmugavelu (1972). The results indicated that the fruit weight (155.47g) increased less than 1.5% urea. An increase in fruit weight was due to accumulation of sugars and high pulp percentage in urea sprayed fruits. Similar results were also obtained by Singh and Rajput (1977). The results showed that the volume of fruit (127.12ml) increased with 1.5% urea. This is due to that the urea stimulates the synthesis of chlorophyll and increased photosynthetic activity which results in increased stored food material in the tissue. This caused increase in volume of fruit. Similar results were also obtained by Singh and Rajput (1977). Results indicated that the length of fruit (7.98 cm) increased under 1.5% urea. The increase in length of fruit may be due to increase in either flesh or seeds or in both. This is primarily due to the stimulation in the growth of flesh. This is in agreement with the results of Singh and Rajput (1977). Maximum girth of fruit (7.75 cm) was recorded with treatment U_2 (1.5% urea. It might be due to cumulative effect of nitrogen on photosynthetic and metabolic activities. The enlargement of fruit size is caused by drawing of photosynthates to the fruit as a consequence of intensification of the sink. It is in conformity with the observations of Singh and Rajput (1977). The TSS was significantly increased (11.85 ^{O}Brix) (Table 4) with treatment U_2 (1.5% urea). This is due to its action on converting complex substances into simple ones, which enhances the metabolic activity in fruits and it results in increased TSS of fruit. The present result on Total Soluble Solid is in conformity with the results achieved by Singh and Rajput (1977). Acidity was significantly affected by various treatments. It was noted that foliar spray of urea decreased the acidity. The minimum acidity of 0.48% was observed where 1.5% urea was sprayed (Table 4). It is in conformity with the observations of Singh and Rajput (1977).The ascorbic acid was significantly increased (220.79 mg/100g) with treatment U_2 (1.5% urea). The present result on ascorbic acid is in conformity with the results achieved by Singh and Rajput (1977). The pectin content was significantly affected by various levels of urea. Significantly the highest pectin content (0.67%) was observed with treatment U_2 (1.5% urea). The present result on pectin content is in conformity with the results achieved by Singh and Rajput (1977). The reducing sugar was significantly increased with urea 1.5%. This might be due to that the nitrogen promotes hydrolysis of starch into sugars. These results are in close conformity with the findings of Singh and Rajput (1977). The treatment U_2 (urea 1.5%) recorded significantly the maximum non-reducing sugar (4.66%). This is due to either speedily converted into sugars and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration or both. Similar result was also reported by Singh (1975) and Singh and Rajput (1977). The total sugar was significantly increased (7.03%) with treatment U_2 (1.5% urea) (Table 4). This is due to its action on converting complex substances into simple ones, which enhances the metabolic activity in fruits and it results in increasing total sugar of fruit. The present result on total sugar is in conformity with the results achieved by Singh (1975) and Singh and Rajput (1977). The result indicates that the number of fruits per plant was significantly increased due to different levels of urea. The highest number of fruits per plant (511.07) was observed in the treatment U_2 (1.5% urea). The urea has helped in more fruit retention per shoot, which resulted in increasing number of fruits per plant. Similar results were found by Labanauskas *et al.* (1963). The results revealed that different levels of urea significantly influenced the yield. The application of U_2 (1.5% urea) treatment gave higher yield (22095 kg/ha) as compared to other treatments. The cumulative effect of nitrogen on photosynthetic as well metabolic activities has helped to increase the fruit size and fruit weight and thereby increase the fruit yield. Similar

results are also found by Labanauskas *et al.* (1963).

Effect of Zinc

The data revealed that application of different treatments significantly influenced the number of flowers per shoot. The maximum number of flowers per shoot (5.30) was observed in 0.6% zinc (Z_3). The flower number per shoot increased with increasing concentrations of zinc, which is due to significant increase in shoot number that ultimately ended in an individual flower. Increased number of flowers in present study is in agreement with the results obtained by Sharma and Bhattacharyya (1994). The highest percentage of fruit retention (62.86%) was observed in the treatment Z_3 (0.6% zinc). More fruit retention due to zinc spray was due to more fruit setting. It seems to have helped to increase the fruit retention either by improving pollen germination or by helping the fruit set. These findings are in agreement with Bhambota *et al.* (1962). The lowest fruit drop (37.14%) was observed in the treatment Z_3 (0.6% zinc). The zinc has helped in fruit retention because zinc stimulates the synthesis of endogenous auxins and auxin prevents the abscission and facilitated the ovary to remain attached with the shoot, resulting in

Table 3 : Influence of foliar application of urea and zinc sulphate on flowering and fruiting characteristics of guava cv. Bhavnagar Red.

Treatment	Number of flowers per shoot	Flower drop (%)	Fruit set (%)	Fruit retention (%)	Fruit drop (%)	Fruit weight (g)	Fruit volume (ml)	Fruit length (cm)	Fruit girth (cm)
A-Urea									
U_1 – 1.0%	4.67	67.74	61.03	53.24	46.76	140.86	112.40	7.18	6.95
U_2 – 1.5%	5.33	58.89	70.80	63.17	36.83	155.47	127.12	7.98	7.75
U_3 – 2.0%	5.08	62.88	67.48	59.85	40.15	150.41	122.06	7.78	7.55
S.Em.±	0.09	1.13	1.39	1.43	1.44	2.52	2.49	0.13	0.14
LSD 0.05	0.27	3.40	4.17	4.30	4.31	7.54	7.48	0.40	0.41
B-Zinc sulphate									
Z_1 – 0.2%	4.70	67.46	61.35	53.57	46.43	141.93	113.58	7.22	6.98
Z_2 – 0.4%	5.08	63.46	67.46	59.83	40.17	150.90	122.55	7.77	7.54
Z_3 – 0.6%	5.30	58.18	70.49	62.86	37.14	153.89	125.44	7.95	7.72
S.Em.±	0.09	1.13	1.39	1.43	1.44	2.52	2.49	0.13	0.14
LSD 0.05	0.27	3.40	4.17	4.30	4.31	7.54	7.48	0.40	0.41
C.V. %	5.45	5.40	6.28	7.33	10.46	5.07	6.21	5.26	5.59

Balakrishnan (2001). The minimum flower drop (58.18%) was observed in the treatment Z_3 (0.6% zinc) (Table 3). The zinc has helped in flower retention because zinc stimulates the synthesis of endogenous auxins and auxin prevents the abscission and facilitated the ovary to remain attached with the shoot, resulting in lower flower drop. Similar results were found by Yadav *et al.* (2011). Maximum percentage of fruit set (70.49%) was observed in the treatment Z_3 (0.6% zinc). More fruit set due to zinc spray was due to profuse flowering. It seems to have helped to increase the fruit set either by improving pollen germination or by helping the growth of pollen tubes and thus facilitate in timely fertilization before the stigma loses its receptivity or the style becomes non-functional. These findings are in agreement with lower fruit drop. Similar results were found by Bhambota *et al.* (1962). The results indicated that the fruit weight (153.89g) increased under 0.6% zinc. An increase in fruit weight was due to accumulation of sugars and high pulp percentage in zinc sprayed fruits. Similar results were also obtained by Haque *et al.* (2000). The results indicated that the volume of fruit (125.44ml) increased under 0.6% zinc (Table 3). This is due to that the zinc regulates metabolic activities, which increased stored food material in the tissue. This caused increase in volume of fruit. Similar results were also obtained by Haque *et al.* (2000).Results indicated that the length of fruit (7.95 cm) increased under 0.6% zinc. The increase in length of fruit may be due to increase in either flesh or seeds or in both. This is primarily due to

the stimulation in the growth of flesh. This is in agreement with the results of Haque *et al.* (2000). The results showed that the girth of fruit was significantly increased by foliar application of zinc. Maximum girth of fruit was recorded under treatment Z_3 (0.6% zinc). It might be due to cumulative effect of micronutrient. The enlargement of fruit size is caused by drawing of photosynthates to the fruit as a consequence of intensification of the sink. It is in conformity with the observations of Haque *et al.* (2000). The TSS was significantly increased (11.85 ^{O}Brix) with treatment Z_3 (0.6% zinc) (Table 4). This is due to its action on converting complex substances into simple ones, which enhances the metabolic activity in fruits and it results in increased TSS of fruit. The present result on Total Soluble Solid is in conformity with the results achieved by Singh and Brahmachari (1999). Acidity was significantly affected by various treatments. It was noted that foliar spray of zinc decreased the acidity. The minimum acidity of 0.47% was observed where 0.6% zinc was sprayed. It is in conformity with the observations of Singh and Maurya (2003). The ascorbic acid was significantly increased (219.21 mg/100ml) with treatment Z_3 (0.6% zinc). The present result on ascorbic acid is in conformity with the results achieved by Jeyabaskaran and Pandey (2008). The pectin content was significantly affected by various levels of zinc. Significantly the highest pectin content (0.67%) was observed with treatment Z_3 (0.6% zinc). The present result on pectin content is in conformity with the results achieved by Pandey *et al.* (1998). The reducing sugars were significantly increased with zinc 0.6%. This might be due to that the zinc promotes hydrolysis of starch into sugars. These results are in close conformity with the findings of Singh and Brahmachari, 1999). The treatment Z_3 (zinc 0.6%) recorded significantly the maximum non-reducing sugars (4.61%). This is due to either speedily converted into sugars and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration or both. Similar result was also reported by Singh *et al.* (2003). The total sugars was significantly increased (6.95%) with treatment Z_3 (0.6% zinc) (Table 4). This is due to its action on converting complex substances into simple ones, which enhances the metabolic activity in fruits and it results in increased total sugar of fruit. The present result on total sugar is in conformity with the results achieved by Singh *et al.* (2003). The result indicates that the number of fruits per plant was significantly increased due to different levels of zinc. The highest number of fruits per plant (489.69) was observed in the treatment Z_3 (0.6% zinc). The zinc has helped in more fruit retention per shoot, which results in increased number of fruits per plant. Similar results were found by Sharma and Bhattacharyya (1994). The results revealed that different levels of zinc significantly influenced the yield. The application of Z_3 (0.6% zinc) treatment gave higher yield (20984 kg/ha) as compared to other treatments. The cumulative effect of zinc has

Table 4 : Influence of foliar application of urea and zinc sulphate on yield and quality parameters of guava cv. Bhavnagar Red.

Treatments	Numbar of fruits per plant	Yield fruits (kg/ha)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	Pectin content (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugars (%)
A-Urea									
U_1 – 1.0%	370.25	14563	10.83	0.58	205.58	0.57	2.09	4.13	6.23
U_2 – 1.5%	511.07	22095	11.85	0.48	220.79	0.67	2.37	4.66	7.03
U_3 – 2.0%	464.50	19401	11.68	0.52	215.73	0.65	2.30	4.53	6.83
S.Em.±	9.20	646	0.16	0.01	2.72	0.01	0.04	0.08	0.12
LSD 0.05	27.57	1938	0.48	0.04	8.15	0.04	0.12	0.23	0.35
B-Zinc sulphate									
Z_1 – 0.2%	411.68	16368	10.87	0.59	206.66	0.58	2.14	4.21	6.35
Z_2 – 0.4%	444.45	18707	11.63	0.52	216.22	0.64	2.28	4.51	6.79
Z_3 – 0.6%	489.69	20984	11.85	0.47	219.21	0.67	2.34	4.61	6.95
S.Em.±	9.20	646	0.16	0.01	2.72	0.01	0.04	0.08	0.12
LSD 0.05	27.57	1938	0.48	0.04	8.15	0.04	0.12	0.23	0.35

helped to increase the fruit size and fruit weight and thereby increase the fruit yield. Similar results are also found by Sarolia *et al.* (2007).

CONCLUSION

Experiment on effects of foliar application of urea and zinc with nine treatments combination on guava was carried out during 2012-13 at Fruit Research Station at Junagadh. The results showed that the 1.5% urea treatment gave significantly the maximum number of flowers per shoot (5.33), fruit set (70.80%), fruit retention (63.17%), fruit weight (155.47g), fruit volume (127.12ml), fruit length (7.98cm) and fruit girth (7.75cm) with minimum flower drop (58.89%) and fruit drop (36.83%). Similarly the highest number of fruits per plant (511.07) and yield of fruits (22095kg/ha) and TSS (11.85^{O}Brix), ascorbic acid (220.79mg/100g), pectin content (0.67%), reducing (2.37%), non-reducing (4.66%) and total sugars (7.03%) were noted in treatment U_2 (1.5% Urea), the lowest acidity (0.48%) was also observed in treatment U_2 (1.5 % Urea). With respect to effect of zinc sulphate the data indicated that the maximum number of flowers per shoot (5.30), fruit set (70.49%), fruit retention (62.86%), fruit weight (153.89g), fruit volume (125.44ml), fruit length (7.95cm) and fruit girth (7.72cm) and minimum flower drop (58.18%) and fruit drop (37.14%) were recorded in treatment Z_3 (0.6% $ZnSO_4$). Similarly the highest number of fruits per plant (489.69) and yield of fruits (20984kg/ha) and TSS (11.85^{O}Brix), ascorbic acid (219.21mg/100g), pectin content (0.67%), reducing (2.34%), non-reducing (4.61%) and total sugars (6.95%) were noted in treatment Z_3 (0.6% $ZnSO_4$) and the lowest acidity (0.47%) was also observed in treatment Z_3 (0.6% $ZnSO_4$). It was concluded that application of 1.5% urea and Z3 (0.6% ZnSO4) prove superior among tested dose of both the urea and zinc under Junagadh conditions.

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