International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 589-592

Received: 04-11-2018
Accepted: 08-12-2018

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Response of time of foliar application of nutrients on yield and quality of guava (*Psidium guajava* L.) cv. Hisar Safeda

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Abstract
The present investigation was conducted to see the effect of time of foliar application of nutrients on growth, yield and quality of guava. The macro and micro nutrients combination along with basal RDF application were sprayed at vegetative, flowering and fruiting stage of guava cv. Hisar Safeda. The yield characters in terms of average fruit weight and fruit yield were significantly enhanced by foliar applications at vegetative, flowering and fruiting stage, except number of fruits per tree. Quality parameters *viz.* TSS, acidity and ascorbic acid were improved by different foliar applications at vegetative, flowering and fruiting stage.

Keywords: Foliar, guava, Hisar Safeda, nutrients

Introduction

The present investigation was carried out at experimental orchard, Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2017 and 2018. Eighteen years old Hisar Safeda trees were selected and treated with RDF + combination of macro and micro nutrients at vegetative, flowering and fruiting stages and control trees were treated with RDF only. The treatments were replicated thrice with three plants per replication. The average weight was calculated by dividing the total fruit weight by a total number of fruits and total number of fruits per tree was recorded by counting the harvested fruits in different pickings. The total fruit yield per tree was calculated by multiplying a total number of fruits per tree with average fruit weight and expressed in kg per tree. TSS of the guava fruit juice was determined by using a Digital Refractometer. The ascorbic acid and acidity was estimated by using the procedure given in A.O.A.C. (1990) [1].

Results and Discussion

Yield parameters

Average fruit weight

Data presented in table 1 depicted that average fruit weight was significantly affected by different macro and micro nutrients foliar application, irrespective of season. The highest average weight (135.26 g) was obtained in fruits harvested from trees sprayed with T_7 treatment, which was statistically at par with T_5, T_6 and T_3, while the lowest average weight (116.55 g) was recorded in fruits harvested from control trees, which was closely followed by T_1 and T_2. The increase in fruit weight may perhaps be due to rapid expansion in size of cells and more accumulation of sugars in sprayed fruits (Singh and Vashishtha, 1997) [11]. The increase in fruit weight of 'Hisar Safeda' guava might be explained with the role of zinc in the synthesis of tryptophan, a precursor for indole acetic acid synthesis (Cakmak *et al.*, 1989) [3], which is involved in the growth and development of the fruit. The increase in fruit weight by various macro and micro nutrients were recorded by Chauhan and Gupta (1985) [4] in ber and Sharma *et al.* (1991) [9] in guava. The fruits harvested in winter season had highest average weight (135.61 g) as compared to those harvested in rainy season (116.74 g) when considered irrespective of different foliar sprays. The interaction between different foliar sprays and seasons was found non significant in affecting the average fruit weight.

Table 1: Effect of foliar application of macro and micro nutrients on average fruit weight (g) of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	110.95	128.95	119.95
T2	112.78	130.88	121.83
T3	118.17	139.27	128.72
T4	115.78	134.32	125.05
T5	121.78	141.69	131.74
T6	120.60	139.99	130.30
T7	124.77	145.75	135.26
T8	109.10	124.00	116.55
Mean	116.74	135.61	
CD at 5%	T = 8.11, S = 5.05, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)
T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)
T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + T_3 T_7: T1 + T_2 + T_3 T_8: Control (RDF)

Number of fruits per tree

The results depicted in table 2 revealed that number of fruits per tree was not affected significantly by different macro and micro nutrients foliar sprays when considered irrespective of seasons. Numerically, highest number of fruits per tree (432.37) was recorded from the trees treated with T_7 treatment, while the control trees had lowest number of fruits (408.32) per tree. Regardless of different foliar sprays, the maximum number of fruits per tree (434.33) was observed in winter season as compared to rainy season (404.01). The interaction effect of different foliar sprays and seasons was found non significant with respect to number of fruits per tree.

Table 2: Effect of foliar application of macro and micro nutrients on number of fruits per tree of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	397.33	424.97	411.15
T2	401.43	425.4	413.42
T3	406.37	432.67	419.52
T4	401.8	425.43	413.62
T5	409.13	450.5	429.82
T6	407.67	442.67	425.17
T7	413.83	450.9	432.37
T8	394.53	422.1	408.32
Mean	404.01	434.33	
CD at 5%	T = NS, S = 16.12, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)
T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)
T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + T_3 T_7: T1 + T_2 + T_3 T_8: Control (RDF)

Data on yield was recorded and presented in table 3. Irrespective of seasons, different foliar sprays were found significant with respect to yield. The maximum yield (58.68 kg/tree) was obtained from the trees sprayed with T_7 treatment which was statistically at par with T_5 and T_6 foliar spray, while the minimum yield (47.69 kg/tree) was recorded in control trees which was closely followed by T_1, T_2 and T_3 treatments. Potassium application at higher rate might have improved the translocation of photosynthates from source to sink and ultimately yield (Verma and Chauhan, 2013) [13]. Iron has important function in enzymatic systems and chlorophyll formation and consequently increased photosynthesis which finally increased the yield (Smith, 1957) [12]. In addition manganese is a minor constituent of plant chlorophyll which is responsible for photosynthesis (Mengel and Krikby, 1987) [7]. Similar, findings have been reported by Shawky *et al.* (1990) [10] and Ismail (1994) [5] in Navel and Valencia oranges, respectively The winter season yield (58.97 kg/tree) was more in comparison to rainy season (47.20 kg/tree), irrespective of different foliar sprays. The yield was not affected significantly by the interaction of different foliar sprays and seasons.
The yield attributes were significantly higher in winter season because the nutrients had cumulative effect.

Table 3: Effect of foliar application of macro and micro nutrients on yield (kg/tree) of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	44.08	54.80	49.44
T2	45.27	55.68	50.47
T3	48.02	60.26	54.14
T4	46.52	57.14	51.83
T5	49.82	63.83	56.83
T6	49.17	61.97	55.57
T7	51.63	65.72	58.68
T8	43.04	52.34	47.69
Mean	47.20	58.97	
CD at 5%	T = 4.27, S = 2.14, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)
T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + $T_3$$T_7$: T1 + T_2 + T_3 T_8: Control (RDF)

Quality characters

TSS

Observations pertaining to TSS were recorded and the results are presented in table 4. The different macro and micro nutrients foliar spray significantly altered the fruit TSS when considered irrespective of seasons. The highest TSS (11.16 °Brix) was found in the fruits harvested from trees sprayed with T_7 foliar treatment which was statistically at par with T_5, T_6 and T_3 foliar treatments. However, the lowest TSS (10.00 °Brix) was recorded in the fruits harvested from control trees, which was found at par with T_1, T_2 and T_4 foliar treatments.

Table 4: Effect of foliar application of macro and micro nutrients on Total soluble solids (°Brix) of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	9.78	10.31	10.05
T2	9.94	10.55	10.25
T3	10.50	10.89	10.69
T4	10.33	10.68	10.51
T5	10.70	11.12	10.91
T6	10.61	11.00	10.81
T7	10.94	11.38	11.16
T8	9.28	10.07	10.00
Mean	10.26	10.75	
CD at 5%	T = 0.49, S = 0.20, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)
T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)
T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + T_3 T_7: T1 + T_2 + T_3 T_8: Control (RDF)

Irrespective of different foliar spray treatments, the fruits harvested in winter season had higher TSS (10.75 °Brix) as in comparison to fruits (10.26 °Brix) harvested in rainy season. Interaction effect of foliar treatments and seasons was found non-significant in terms of fruit TSS.

Table 5: Effect of foliar application of macro and micro nutrients on acidity (%) of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	0.58	0.55	0.57
T2	0.58	0.51	0.55
T3	0.57	0.47	0.52
T4	0.56	0.49	0.53
T5	0.54	0.44	0.49
T6	0.55	0.46	0.51
T7	0.53	0.44	0.49
T8	0.59	0.57	0.58
Mean	0.56	0.49	
CD at 5%	T = 0.04, S = 0.02, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)
T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)
T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + T_3 T_7: T1 + T_2 + T_3 T_8: Control (RDF)

Table 5 showed that different foliar sprays significantly affected the fruit acidity, irrespective of seasons. The minimum acidity (0.49%) was observed in the fruits harvested from trees treated with T_7 foliar treatment which was closely followed by T_5, T_6 and T_3 foliar sprays. However, the maximum acidity (0.58%) was recorded in the fruits harvested from control trees, which was statistically at par with T_1 and T_2 treatments. The winter season fruits had lower acidity (0.49%) when compared to rainy season fruits (0.56%), irrespective of different macro and micro nutrients foliar treatments. The fruit acidity was not affected significantly by the interaction effect of different foliar sprays and seasons.

Table 6: Effect of foliar application of macro and micro nutrients on ascorbic acid (mg/100g) of guava cv. Hisar Safeda

Treatment	Rainy (S1)	Winter (S2)	Mean
T1	142.27	144.47	143.37
T2	145.44	149.03	147.24
T3	150.23	156.61	153.42
T4	147.35	151.96	149.66
T5	157.47	159.00	158.24
T6	153.14	157.71	155.43
T7	158.83	160.13	159.48
T8	139.98	141.26	140.62
Mean	149.34	152.52	
CD at 5%	T = 9.48, S = NS, TxS = NS		

T_1: RDF + Foliar spray of NPK (19:19:19) at 2% and micronutrients Fe (1300ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at vegetative stage (April and October)

T_2: RDF + Foliar spray of NPK (12:32:16) at 2% and micronutrients Fe (500ppm), Mn (800ppm), Zn (800ppm), Cu (1000ppm), B (2000ppm) at flowering stage (May and November)
T_3: RDF + Foliar spray of NPK (16:8:34) at 2% and micronutrients Fe (1200ppm), Mn (1600ppm), Zn (1600ppm), Cu (1000ppm), B (1000ppm) at fruiting stage (July and February)
T_4: T1 + T_2 T_5: T_2 + T_3 T_6: T1 + T_3 T_7: T1 + T_2 + T_3 T_8: Control (RDF)

The ascorbic acid content in the guava fruits was affected significantly with the various foliar treatments of nutrients, irrespective of seasons (Table 6). The fruits harvested from trees sprayed with T_7 treatment showed highest ascorbic acid content (159.48 mg/100g) which was found at par with T_5, T_6 and T_3 treatments. The lowest ascorbic acid content (140.62 mg/100g) was recorded in the fruits harvested from control trees, which was closely followed by T_1, T_2 and T_4 treatments. The ascorbic acid content was not affected significantly with the seasons and the interaction effect of various foliar treatments and seasons. Higher TSS in guava fruits might be due to nitrogen role in stimulating functioning of enzymes in the physiological processes. Increased Total soluble solids in guava fruit might be due to more uptake of nitrogen and potassium in plant system (Verma and Chauhan, 2013) [13]. Various nutrients triggered the catalytic activity of several enzymes, which participates in the biosynthesis of ascorbic acid (Sharma *et al.*, 2013) [8]. Lower acidity in guava fruits might be due to higher accumulation of sugars, better translocation of sugars into fruit tissues and conversion of organic acids into sugars (Kumar *et al.*, 2015) [6]. Similar, results have also been reported by Beniwal *et al.* (1992) [2] in grapes.
The chemical attributes were significantly higher in winter season because the nutrients spray had cumulative effect.

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