International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 3564-3570

Received: 09-05-2020
Accepted: 12-06-2020

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Effect of foliar spray of silicon and boron on fruit quality and shelf life of rejuvenated mango (*Mangifera indica* L.) cv. Sonpari

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DOI: https://doi.org/10.22271/chemi.2020.v8.i4as.10202

Abstract
An experiment was conducted at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, during two continuous years 2017-18 and 2018-19 to examine the effect of different silicon and boron sources on fruit quality and shelf life of mango cv. Sonpari under South Gujarat conditions. The experiment was laid out in a Completely Randomized Design with factorial concept having ten treatment combinations comprising five levels of silicon and two levels of boron. The first foliar spray was given at full bloom stage and second at pea stage of mango fruits. Result from the study is revealed that use of foliar spray of potassium silicate @ 1.5% (S_3) improved fruit quality of mango with respect to higher value of total soluble solids (21.62 ºBrix), reducing sugars (5.70%), non-reducing sugars (9.99%), total sugars (15.69%) and maximum shelf life of fruits (17.33 days) with minimum acidity content (0.146%) in pooled analysis. Likewise, foliar spray of boric acid @ 1.2g L^{-1} (B_2) also gave significantly higher TSS, reducing sugars, non-reducing sugars, total sugars, ascorbic acid, total carotenoid content and enhancing shelf life with minimum acidity content of mango fruits cv. Sonpari. Combined spray of potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1} (S_3B_2) improved reducing sugars and total sugars with minimum acidity content of fruits.

Keywords: Mango, Sonpari, potassium silicate, silicic acid, boric acid

Introduction
Mango is considered to be the choicest fruit of all indigenous fruits grown in India due to high palatability, excellent flavour and taste, admirable medicinal value and nutritional richness. It is known as "King of tropical fruits". Geographical, climatic and genetic studies of mango indicate that it has originated in Indo-Burma region (Candolle, 1904) [8]. India is a major exporter of mango pulp in the world and exported 105873.21 MT of pulp worth ₹ 65766.98 lakhs. In India, the area under mango cultivation is 2258.1 thousand hectares with production and productivity of 21822.3 thousand MT and 9.7 MT/ha, respectively. While, Gujarat occupied 162.77 thousand hectares area with production and productivity of 1207.78 thousand MT and 7.42 MT/ha, respectively (Anon., 2018) [5].

Sonpari is a popular mango hybrid of South Gujarat region and also known as Gujarat Mango Hybrid-1 (GMH-1). It was released in the year 2000 from Agriculture Experimental Station, NAU, Paria (Gujarat). It was developed from Alphonso as female parent and Baneshan as the male parent. Fruit skin is smooth and becomes golden yellow in colour on ripening. The fruit has a good blend of sugars and acids which are desirable for consumer preference. The fruits are free from spongy tissue disorder and it has very good keeping quality.

Now-a-days, many attempts are established for improving yield and fruit quality of mango trees by using non-traditional methods. Silicon is beneficial on enhancing the tolerance of mango trees to biotic and abiotic stresses, water and nutrients uptake, photosynthesis and water transport. It is very important for reducing the severity of the trees to most disorders through forming a silicon cuticle double layers on the leaf epidermal tissues which is responsible for preventing the penetration of fungal hypha. Also, it is essential for ameliorating the adverse effects of heavy metal toxicity (Mengel *et al.*, 2001; Sauvas *et al.*, 2002; Iwaskai *et al.*, 2002; Melo *et al.*, 2003 and Tahr *et al.*, 2006) [17, 22, 13, 16, 24].

Boron has an announced impact on fruiting of fruit crops through its important roles in enhancing cell division, biosynthesis and translocation of sugars and hormones, root development, pollens germination, water and nutrients uptake and flower bud formation and decreasing dropping of flowers and fruit and the incidence of disorders (Fraguas and Silva, 1998) [10].

Realizing the importance of silicon and boron in different physiological processes, this study was formulated to examine the effect of single and combined applications of silicon and boron at the various concentrations on quality and shelf life of mango fruits cultivar 'Sonpari'.

Material and Methods

This study was carried out during the year 2017-18 and 2018-19 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat. Heading back of mango trees was done in February, 2012 and top worked with Sonpari cultivar in May, 2012. Trees are medium tall, rounded with moderately spreading twigs. In all 30 uniform tress of mango cv. Sonpari were selected for experimentation. All experimental trees were uniformly treated in respect with fertilization, irrigation and plant protection measures during the course of investigation, as recommended by NAU, Navsari.

Trees were planted at a distance of 6m x 6m. The experiment was laid out in a Completely Randomized Design with factorial concept having ten treatment combinations comprising five levels of silicon *viz*., S_1: no silicon, S_2: potassium silicate @ 1.0%, S_3: potassium silicate @ 1.5%, S_4: silicic acid @ 1.0%, S_5: silicic acid @ 1.5% and two levels of boron *viz*., B_1: no boric acid and B_2: boric acid @ 1.2g L^{-1}. Treatments were repeated thrice. The first foliar spray was given at full bloom stage and second at pea stage of mango fruits.

Treatment combinations

S_1B_1 : Absolute control (No silicon + No boric acid)
S_2B_1 : Potassium silicate (K_2SiO_3) @ 1.0% + No boric acid
S_3B_1 : Potassium silicate (K_2SiO_3) @ 1.5% + No boric acid
S_4B_1 : Silicic acid (H_4SiO_4) @ 1.0% + No boric acid
S_5B_1 : Silicic acid (H_4SiO_4) @ 1.5% + No boric acid
S_1B_2 : No silicon + Boric acid (H_3BO_3) @ 1.2g L^{-1}
S_2B_2 : Potassium silicate (K_2SiO_3) @ 1.0% + Boric acid (H_3BO_3) @ 1.2g L^{-1}
S_3B_2 : Potassium silicate (K_2SiO_3) @ 1.5% + Boric acid (H_3BO_3) @ 1.2g L^{-1}
S_4B_2 : Silicic acid (H_4SiO_4) @ 1.0% + Boric acid (H_3BO_3) @ 1.2g L^{-1}
S_5B_2 : Silicic acid (H_4SiO_4) @ 1.5% + Boric acid (H_3BO_3) @ 1.2g L^{-1}

Five mature fruits of uniform size and shape were selected for taking observations. Fruits were washed with tap water in the laboratory, dried and kept at ambient temperature (30±5 ºC and 50±5% RH) in Corrugated Fibre Board (CFB) boxes. Fruit quality parameters were recorded at eating stage after fruit ripen.

Total soluble solids were measured by using hand refractrometer (range 0 to 32 ºBrix). Reducing sugars (%), total sugars (%), acidity (%), ascorbic acid (mg/100g pulp) and total carotenoid (mg/100g pulp) content of ripen fruit were estimated as per method of Lane and Eynon described by Ranganna (1986) [20]. Non-reducing sugars (%) were estimated by subtracting reducing sugars from total sugars. The shelf life of the fruit was recorded by the number of days taken from harvesting to optimum eating stage.

The data obtained to all the characters studied under present research work were statistically analysed by the method of Completely Randomized Design (CRD) with factorial concept as described by Panse and Sukhatme (1985) [19]. The treatment means were compared by critical differences at five per cent level of probability.

Results and Discussion

Total Soluble Solids (TSS)

The data presented in Table-1 indicated that significantly higher value of TSS content of fruit (21.37 and 21.62 ºBrix) was recorded in S_3 (potassium silicate @ 1.5%) during first year and in pooled analysis, respectively. This treatment was statistically at par with S_2 (potassium silicate @ 1.0%). Boron also showed significant influenced on TSS content of fruit in the year 2018-19 and in pooled analysis but it was failed to produce significant effect during the year 2017-18. The highest TSS content of fruit (21.39 and 21.00 ºBrix) was recorded in fruits treated with boric acid @ 1.2g L^{-1} (B_2) during the year 2018-19 and in pooled analysis, respectively. Interaction effect of boron and silicon (B x S) was failed to change in TSS content of fruit and found non-significant during individual years as well as in pooled analysis. Silicon and boron interactions with year (B x Y, S x Y and B x S x Y) were also found non-significant in pooled analysis.

Acidity (%)

The data regarding acidity content of fruit (Table-2) was significantly affected by silicon sources in both the years as well as in pooled analysis. Lower value of acidity content of fruit (0.143%, 0.148% and 0.146%) was noted in S_3 (potassium silicate @ 1.5%) during individual years and in pooled analysis, respectively. It was statistically at par with S_2 (potassium silicate @ 1.0%) and S_5 (silicic acid @ 1.5%) in the year 2018-19 and S_2 (potassium silicate @ 1.0%), S_4 (silicic acid @ 1.0%) and S_5 (silicic acid @ 1.5%) in pooled analysis. Likewise, significantly minimum value of acidity of fruit (0.152, 0.153 and 0.152%) was recorded in B_2 (boric acid @ 1.2g L^{-1}) during first year, second year and pooled analysis, respectively. The interaction effect of boron and silicon (B x S) was found significant in individual years as well as in pooled analysis. Lower value of acidity of mango fruit (0.127%, 0.133% and 0.130%) was observed in combined spray of potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1} (S_3B_2) during first year, second year and in pooled analysis, respectively.

Reducing sugars (%)

The mean data (Table-3) revealed significant differences among different treatments of silicon sources on reducing sugars content of fruit. Higher value of reducing sugars content of fruit (5.69%, 5.71% and 5.70%) was found in S_3 (potassium silicate @ 1.5%) in the year 2017-18, 2018-19 and in pooled analysis, respectively, which was statistically at par with S_2 (potassium silicate @ 1.0%). Reducing sugars content of mango fruit was also significantly affected by foliar application of boric acid. Maximum value of reducing sugars of fruit (5.80%, 5.80% and 5.80%) was noted in B_2 (boric acid @ 1.2g L^{-1}). Interaction between boron and silicon gave significant effect on reducing sugars content of fruits in both the years as well as in pooled analysis. Higher content of reducing sugars (6.20% and 6.19%) of fruit was observed in treatment combinations of S_1B_2 (0% silicon + boric acid @ 1.2g L^{-1}) and S_3B_2 (potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1}) in 2017-18 and in pooled analysis, which was statistically at par with potassium silicate @ 1.0% + boric acid @ 1.2g L^{-1} (S_2B_2). In the year 2018-19, maximum value of reducing sugars content of fruit (6.17%) was recorded with treatment of no silicon plus boric acid @ 1.2g L^{-1} (S_1B_2), which was statistically at par with S_3B_2 (potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1}) and S_2B_2 (potassium silicate @ 1.0% + boric acid @ 1.2g L^{-1}).

Total sugars (%)
The data furnished in Table-4 showed significant effect of foliar spray of potassium silicate and silicic acid on total sugars content of fruit during the first year and in pooled analysis. Silicon sources were failed to produce significant effect on total sugars content of fruit in second year of experiment. Higher value of total sugars content of fruit was recorded in S_3 (potassium silicate @ 1.5%) *i.e*. 15.87% and 15.69% during first year and in pooled analysis, respectively. This treatment was statistically at par with S_2 (potassium silicate @ 1.0%). Boric acid also showed significant effect on total sugars content of fruit during both the years as well as in pooled analysis. Maximum total sugars content of fruit was observed with B_2 *i.e*. boric acid @ 1.2g L^{-1}, during both the years and in pooled analysis (15.23%, 15.77% and 15.50%, respectively). Interaction between boron and silicon on total sugars content of fruit was found non-significant during individual years. Significantly maximum value of total sugars content of fruit (16.04%) was recorded in S_3B_2 (potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1}) during pooled analysis, which was statistically at par with S_3B_1, S_1B_2, S_2B_2 and S_5B_2.

Non-reducing sugars (%)
From the data presented in Table-5, it is evident that silicon sources (potassium silicate and silicic acid) had non-significant effect on non-reducing sugars content of fruit during both the years. However, in pooled analysis, silicon sources gave significant effect on non-reducing sugars content of fruit. Higher value of non-reducing sugars content (9.99%) was noted in S_3 (potassium silicate @ 1.5%), which was statistically at par with S_2 (potassium silicate @ 1.0%) and S_5 (silicic acid @ 1.5%). Similarly, maximum value of non-reducing sugars content of fruit (9.97% and 9.70%) was recorded with boric acid @ 1.2g L^{-1} (B_2) during the year 2018-19 and in pooled analysis, respectively. All possible interactions *viz*., B x S, B x Y, S x Y and B x S x Y were found non-significant on non-reducing sugars content of fruit during both the years as well as in pooled analysis.

Ascorbic acid (mg/100g pulp)
It is evident from the data (Table-6) that ascorbic acid content of mango fruit (mg/100g pulp) was found non-significant with respect to silicon sources *i.e.* potassium silicate and silicic acid during individual years as well as in pooled analysis. Whereas, foliar spray of boric acid significantly affected on ascorbic acid content of mango fruit during both separate years and in pooled analysis also. Foliar application of boric acid @ 1.2g L^{-1} (B_2) gave higher value of ascorbic acid content of fruit during individual years as well as in pooled analysis (38.47, 38.71 and 38.59 mg/100g pulp, respectively). The data pertaining to the interaction effect between silicon and boron on ascorbic acid content of fruit was found non-significant during individual years, but it was significant during pooled analysis. Higher value of ascorbic acid content of fruit (40.00 mg/100g pulp) was recorded in S_1B_2 (No silicon + boric acid @ 1.2g L^{-1}), which was statistically at par with S_3B_2, S_4B_2 and S_5B_2.

Total carotenoids (mg/100g pulp)
There was non-significant result found on total carotenoids content of fruit (Table-7) with respect to foliar spray of potassium silicate and silicic acid during individual years as well as in pooled analysis. Total carotenoids content of fruit was significantly affected due to foliar application of boric acid during both the years and in pooled analysis. Significantly maximum total carotenoids content of fruit (1.86, 1.99 and 1.92 mg/100g pulp) was registered with boric acid @ 1.2g L^{-1} (B_2) during individual years as well as in pooled analysis, respectively as compared to without application of boric acid. In the first year, interaction between boron and silicon was found non-significant on total carotenoids content of fruit. Nevertheless, it was found significant during second year and in pooled analysed result. Maximum total carotenoids content of fruit (2.15 and 2.05 mg/100g pulp) was observed in S_1B_2 (No silicon + boric acid @ 1.2g L^{-1}) during 2018-19 and in pooled analysis, respectively. This treatment combination was statistically at par with S_3B_2 and S_5B_2. Other interactions *viz*., B x Y, S x Y and B x S x Y were showed non-significant effect on total carotenoids content of fruit (mg/100g pulp) in pooled analysis.

Shelf life (days)
Silicon sources *i.e*. potassium silicate and silicic acid were significantly affected on shelf life of fruit (Table-8) during both separate years as well as in pooled analysis. Maximum shelf life (17.83, 16.83 and 17.33 days) was observed in S_3 (potassium silicate @ 1.5%) during first year, second year and in pooled analysis, respectively, which was statistically at par with S_2 (potassium silicate @ 1.0%) and S_5 (silicic acid @ 1.5%). The data revealed that foliar application of boric acid also showed significant effect on shelf life of fruit during both the years and in pooled analysis. Foliar spray of boric acid @ 1.2g L^{-1} (B_2) had maximum days of shelf life of fruit (18.00, 17.07 and 17.53 days) during individual years as well as in pooled analysis, respectively. All the interactions between silicon, boron and year *viz*., B x S, B x Y, S x Y and B x S x Y were found non-significant on shelf life of fruit during separate years as well as in pooled analysis.
The beneficial effects of silicon on protecting the plants from unfavourable effects of environment during maturity might have improved fruit quality. Moreover, silicon and potassium may have stimulated the synthesis of more sugars in the fruit which helped in increasing total soluble solids and all sugars content of mango fruits. The decrease in acidity might be due to an increase in total soluble solids. The promoting effect of silicon on fruit quality was emphasized by Ahmed *et al*. (2013) [2], Abd-El-Rahman (2015) [3] in mango, Roshdy (2014) [21] in banana, Hanumanthaiah *et al*. (2015) [12] in banana and Ahmed *et al*. (2015) [3] in pomegranate. Potassium silicate also helped in suppression of respiration and reduction in ethylene evolution and thus, it increases the shelf life of the fruit (Babak and Majid, 2011) [7]. Silicon application decreased fruit rot by reducing the decay incidence, which is evidenced by Jayawardana *et al*. (2016) [14] who observed that the anthracnose disease of capsicum decreased by 83% due to silicon application in plant. Xu (2004) [27] found that application of different silicon compounds significantly reduced post-harvest fruit disease caused by *Penicillium sp*. and *Alternaria sp*. these indicate that applying silicate

fertilizers could prolong fruit shelf life during post-harvest storage.

Higher value of quality parameters *i.e*., TSS (ºBrix), reducing sugars (%), total sugars (%) and non-reducing sugars (%) might be attributed to the fact that boron directly affects the photosynthesis activity of plant and helps in sugar transport in fruit. These results are in agreement with the findings of Anees *et al*. (2011) [4] and Chauhan *et al*. (2014) [9] in mango, Awasthi and Lal (2009) [6] and Yadav *et al*. (2011) [28] in guava. Minimum value of acidity content with boric acid treatment might be due to fastly converted into sugars and their derivatives by the reaction involving the reversal of glycolytic path way or might have been used in respiration (Hada, 2013) [11] in guava. Higher value of ascorbic acid content in fruit might be due to the possible influence of boron on biosynthesis of ascorbic acid from sugars or inhibition of oxidative enzymes or both. These findings are in conformity with the results reported by Singh *et al.* (2004) [23] and Trivedi *et al*. (2012) [26] in guava, Khan *et al.* (2012) [15] in citrus and Tanuja *et al.* (2016) [25] in pomegranate.

Combined effect of silicon and boron also gave significant effect in some quality parameters *viz*., acidity, reducing and total sugars, ascorbic acid and carotenoids content of fruit. It might be due to it helps in sugar transportation in fruit and biosynthesis of ascorbic acid and total carotenoids (Moawad *et al.*, 2015 in mango) [18].

Conclusion

It can be concluded that the foliar application of potassium silicate @ 1.5% + boric acid @ 1.2g L^{-1} (S_3B_2) at full bloom stage and pea stage of mango fruit under South Gujarat conditions was found beneficial for improving fruit quality of mango cv. Sonpari with higher shelf life.

Table 1: Effect of silicon and boron on total soluble solids content of mango fruit cv. Sonpari

Total soluble solids (ºBrix)									
Treatments	2017-18			2018-19			Pooled		
	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)
S_1	19.23	19.71	19.47	18.77	21.41	20.09	19.00	20.56	19.78
S_2	20.58	20.98	20.78	21.00	21.51	21.25	20.78	21.25	21.01
S_3	21.00	21.73	21.37	21.67	22.07	21.87	21.33	21.90	21.62
S_4	19.48	20.30	19.89	20.32	21.14	20.73	19.90	20.72	20.31
S_5	20.27	20.29	20.28	20.57	20.82	20.70	20.42	20.56	20.49
Mean (B)	20.11	20.60	20.36	20.46	21.39	20.93	20.29	21.00	20.64
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.21	0.33	0.47	0.27	0.42	0.59	0.17	0.26	0.37
C. D. at 5%	NS	0.98	NS	0.78	NS	NS	0.49	0.77	NS
C.V. %			4.01			4.91			4.41

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.17	0.24	0.39	0.55
C. D. at 5%	NS	NS	NS	NS
C.V. %				4.58

Table 2: Effect of silicon and boron on acidity content of mango fruit cv. Sonpari

Acidity (%)									
Treatments	2017-18			2018-19			Pooled		
	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)
S_1	0.200	0.177	0.188	0.213	0.167	0.190	0.207	0.172	0.189
S_2	0.190	0.143	0.167	0.163	0.147	0.155	0.177	0.145	0.161
S_3	0.160	0.127	0.143	0.163	0.133	0.148	0.162	0.130	0.146
S_4	0.173	0.143	0.158	0.177	0.157	0.167	0.175	0.150	0.163
S_5	0.153	0.170	0.162	0.160	0.160	0.160	0.157	0.165	0.161
Mean (B)	0.175	0.152	0.164	0.175	0.153	0.164	0.175	0.152	0.164
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.003	0.004	0.006	0.003	0.005	0.007	0.001	0.002	0.003
C. D. at 5%	0.008	0.012	0.017	0.009	0.015	0.020	0.004	0.006	0.009
C.V. %			6.11			7.38			4.31

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.003	0.004	0.006	0.008
C. D. at 5%	NS	NS	NS	NS
C.V. %				8.49

Table 4: Effect of silicon and boron on total sugars content of mango fruit cv. Sonpari

Total sugars (%)									
Treatments	2017-18			2018-19			Pooled		
	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)
S_1	12.08	15.47	13.78	11.79	15.81	13.80	11.94	15.64	13.79
S_2	14.67	15.24	14.95	14.61	15.91	15.26	14.64	15.58	15.11
S_3	15.84	15.90	15.87	14.82	16.18	15.50	15.33	16.04	15.69
S_4	13.35	14.07	13.71	13.03	15.44	14.24	13.19	14.76	13.97
S_5	13.83	15.45	14.64	13.86	15.49	14.68	13.84	15.47	14.66
Mean (B)	13.95	15.23	14.59	13.62	15.77	14.70	13.79	15.50	14.64
	B	S	B x S	B	S	B x S	B	S	B x S

	2017-18 B	2017-18 S	2017-18 B x S	2018-19 B	2018-19 S	2018-19 B x S	Pooled B	Pooled S	Pooled B x S
S. Em. ±	0.26	0.41	0.58	0.26	0.42	0.59	0.15	0.23	0.32
C. D. at 5%	0.76	1.20	NS	0.78	NS	NS	0.43	0.68	0.96
C.V. %			6.85			6.95			5.42

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.22	0.31	0.48	0.69
C. D. at 5%	NS	NS	NS	NS
C.V. %				8.11

Table 3: Effect of silicon and boron on reducing sugars content of mango fruit cv. Sonpari

Reducing sugars (%)									
Treatments	**2017-18**			**2018-19**			**Pooled**		
	B_1	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**
S_1	3.82	6.20	5.00	3.84	6.17	5.00	3.83	6.19	5.00
S_2	5.09	5.66	5.38	5.20	5.67	5.44	5.15	5.67	5.41
S_3	5.18	6.20	5.69	5.25	6.16	5.71	5.22	6.19	5.70
S_4	4.75	5.56	5.15	4.76	5.60	5.18	4.75	5.58	5.17
S_5	4.83	5.36	5.10	4.85	5.39	5.12	4.84	5.38	5.11
Mean (B)	4.73	5.80	5.27	4.78	5.80	5.29	4.76	5.80	5.28
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.09	0.14	0.20	0.08	0.13	0.19	0.06	0.10	0.14
C. D. at 5%	0.27	0.42	0.60	0.25	0.39	0.55	0.18	0.29	0.41
C.V. %			6.64			6.11			6.48

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.06	0.09	0.14	0.19
C. D. at 5%	NS	NS	NS	NS
C.V. %				6.27

Table 5: Effect of silicon and boron on non-reducing sugars content of mango fruit cv. Sonpari

Non-reducing sugars (%)									
Treatments	**2017-18**			**2018-19**			**Pooled**		
	B_1	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**
S_1	8.26	9.27	8.77	7.96	9.64	8.80	8.11	9.46	8.78
S_2	9.58	9.58	9.58	9.41	10.24	9.83	9.50	9.91	9.70
S_3	10.66	9.69	10.18	9.57	10.02	9.79	10.12	9.86	9.99
S_4	8.60	8.51	8.56	8.28	9.84	9.06	8.44	9.18	8.81
S_5	8.99	10.09	9.54	9.01	10.10	9.56	9.00	10.10	9.55
Mean (B)	9.22	9.43	9.32	8.85	9.97	9.41	9.03	9.70	9.37
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.27	0.43	0.60	0.26	0.42	0.59	0.16	0.26	0.37
C. D. at 5%	NS	NS	NS	0.78	NS	NS	0.48	0.77	NS
C.V. %			11.24			10.89			9.61

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.21	0.30	0.47	0.67
C. D. at 5%	NS	NS	NS	NS
C.V. %				12.34

Table 6: Effect of silicon and boron on ascorbic acid content of mango fruit cv. Sonpari

Ascorbic acid (mg/100g pulp)									
Treatments	**2017-18**			**2018-19**			**Pooled**		
	B_1	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**	**B_1**	**B_2**	**Mean (S)**
S_1	34.64	40.07	37.36	34.28	39.93	37.11	34.46	40.00	37.23
S_2	37.71	37.92	37.81	37.26	37.82	37.54	37.48	37.87	37.68
S_3	37.84	37.75	37.80	37.70	39.16	38.43	37.77	38.46	38.11
S_4	35.41	38.10	36.75	35.01	37.97	36.49	35.21	38.03	36.62
S_5	36.07	38.53	37.30	35.55	38.64	37.10	35.81	38.58	37.20
Mean (B)	36.34	38.47	37.40	35.96	38.71	37.33	36.15	38.59	37.37
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.50	0.80	1.13	0.54	0.86	1.20	0.29	0.46	0.66
C. D. at 5%	1.49	NS	NS	1.60	NS	NS	0.87	NS	1.94
C.V. %			5.21			5.61			4.31

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.43	0.61	0.97	1.37
C. D. at 5%	NS	NS	NS	NS
C.V. %				6.33

Table 7: Effect of silicon and boron on total carotenoids content of mango fruit cv. Sonpari

Total carotenoids (mg/100 g pulp)									
Treatments	2017-18			2018-19			Pooled		
	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)
S_1	1.56	1.94	1.75	1.59	2.15	1.87	1.57	2.05	1.81
S_2	1.67	1.84	1.76	1.77	1.88	1.82	1.72	1.86	1.79
S_3	1.74	1.84	1.79	1.82	2.06	1.94	1.78	1.95	1.87
S_4	1.66	1.76	1.71	1.68	1.91	1.79	1.67	1.84	1.75
S_5	1.78	1.89	1.84	1.74	1.96	1.85	1.76	1.92	1.84
Mean (B)	1.68	1.86	1.77	1.72	1.99	1.86	1.70	1.92	1.81
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.03	0.04	0.06	0.03	0.05	0.07	0.02	0.03	0.05
C. D. at 5%	0.07	NS	NS	0.09	NS	0.20	0.06	NS	0.13
C.V. %			5.70			6.39			6.05

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.02	0.03	0.04	0.06
C. D. at 5%	NS	NS	NS	NS
C.V. %				6.04

Table 8: Effect of silicon and boron on shelf life of mango fruit cv. Sonpari

Shelf life (days)									
Treatments	2017-18			2018-19			Pooled		
	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)	B_1	B_2	Mean (S)
S_1	15.67	17.67	16.67	14.33	17.00	15.67	15.00	17.33	16.17
S_2	17.00	18.00	17.50	15.33	16.67	16.00	16.17	17.33	16.75
S_3	17.00	18.67	17.83	16.00	17.67	16.83	16.50	18.17	17.33
S_4	16.33	17.33	16.83	14.67	16.33	15.50	15.50	16.83	16.17
S_5	16.67	18.33	17.50	15.67	17.67	16.67	16.17	18.00	17.08
Mean (B)	16.53	18.00	17.27	15.20	17.07	16.13	15.87	17.53	16.70
	B	S	B x S	B	S	B x S	B	S	B x S
S. Em. ±	0.17	0.27	0.38	0.19	0.31	0.43	0.15	0.23	0.33
C. D. at 5%	0.50	0.79	NS	0.57	0.91	NS	0.43	0.69	NS
C.V. %			3.81			4.67			4.83

	Y	B x Y	S x Y	B x S x Y
S. Em. ±	0.11	0.15	0.24	0.34
C. D. at 5%	NS	NS	NS	NS
C.V. %				3.54

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