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Effect of micronutrients and banana pseudostem sap at different ph levels of foliar spray solution on fruit quality of mango (*Mangifera indica* L.) cv. Kesar

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Abstract
The present experiment was conducted during 2015-16 and 2016-17 at RHRS, ACHF, NAU, Navsari, (Gujarat). The experiment was laid out in Randomized Block Design with Factorial Concept comprising two factors *viz.*, different pH levels of foliar spray solution (4.5, 5.5 pH and best available water) and banana pseudostem sap (5%), novel organic liquid fertilizer (1 and 2%), mixture Grade IV (1%), boric acid (0.2%). The treatments were replicated thrice. The individual effects of foliar applications at induction of flowering and full bloom stage and their interactions on fruit quality characters of mango cv. Kesar were recorded. The results revealed that individual effects of different pH levels of spray solution and micronutrients and banana pseudostem sap found significant. The foliar spray solution at pH 4.5 level and foliar application of 2% novel organic liquid fertilizer gave maximum organoleptic evaluation score, TSS, total sugars, reducing sugars, non-reducing sugars, ascorbic acid content, shelf life and lower acidity.

Keywords: pH level, banana pseudostem sap, novel organic liquid fertilizer, micronutrients and shelf life

Introduction
Flowering in mango is preceded by the differentiation of the flower bud in the shoots. The period of differentiation is reported to be October – December in Gujarat conditions, depending upon the local climatic conditions. In mango, heavy fruit drop is an important factor contributing to low fruit yield and sometimes only 0.1% of fruits reached up to maturity. The maintenance of fruit quality is critical while, employing any new technology for increasing production and shelf life. Thus, fruit set in mango is crucial event which greatly influence the ultimate fruit yield. Foliar absorption is pH dependent. This is attributed to the effect on the cuticle of complex electrostatic repulsion and attraction phenomena, which are regulated by pH. Micronutrients play an active role in the plant metabolism process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymatic activity, hormone synthesis, nitrogen fixation and reduction. Apart from direct use of banana pseudostem sap as liquid fertilizer, an enrichment process was developed (patented) for preparing Novel Organic Liquid Fertilizer (NOLF) suitable for foliar and soil application by Navsari Agricultural University, Navsari. Novel organic liquid fertilizer is good source of plant nutrient along with growth promoting substances like cytokine, GA_3, *etc*.

Material and Methods
The present was conducted during 2015-16 and 2016-17 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, (Gujarat). The experiment was laid out in Randomized Block Design with Factorial Concept comprising two factors *viz.*, different pH levels of foliar spray solution (4.5, 5.5 pH and best available water) and banana pseudostem sap (5%), novel organic liquid fertilizer (1 and 2%), mixture Grade IV (1%), boric acid (0.2%). The treatments were replicated thrice. The individual effects of foliar applications at induction of flowering and full bloom stage of different pH levels of spray solutions and banana pseudostem sap and micronutrients treatment as well as their interactions on fruit quality characters of mango cv. Kesar were recorded.

Result and discussion

Effect of pH levels of spray solution

The data presented in Table 1 clearly indicated that foliar application at pH 4.5 level (A_1) recorded significantly the maximum organoleptic evaluation in terms of colour, taste, odour, flavor and overall acceptability. It might be due to acidic pH increases the availability of Cations (H^+) in the spray solution and on the leaf surface. This creates a Cation diffusion gradient along which essential nutrients like Ca^+, K^+, Zn^+, Mg^+, Mn^+, B^+, Mo^+ can move across and through plant cell walls which ultimately improves organoleptic scores.

During the course of investigation (Table 1 and 2), there were significant increased in TSS, total sugars, reducing sugars non-reducing sugars, ascorbic acid content, shelf life and lower acidity in the treatment of pH 4.5 level (A_1). It might be due to pH affects the ionic status of some nutrients and also that of the cuticle because it contains some free (unesterified) carboxylic acids (Holloway, 1982) [6] and incorporates embedded waxes which are principally fatty acids (Baker, 1982) [3].

Effect of micronutrients and banana pseudostem sap

A perusal of data presented in Table 1 clearly indicated that there were significant increased in organoleptic evaluation in terms of colour, taste, odour, flavor and overall acceptability which increased significantly due to foliar application of 2% novel organic liquid fertilizer. The increased in the colour, taste, odour, flavor and overall acceptability might be due to respirational demand and adequate supply of nutrients, synthesis of invertase and starch splitting enzymes (Ram and Prasad, 1988) [9]. Similar results were obtained in relation to fruit quality by Anon. (2014) [2] in banana and Anon. (2013) [1] in papaya.

The maximum taste, odour, flavor and overall acceptability were also recorded in foliar application of micronutrient 1% Grade- IV application. It might be due to the Fe is associated with the development of flavor-proteins and the adequate amount of zinc which improved the auxin content and it also acts as a catalyst in oxidation-reduction processes in plants. Besides, zinc helped in other enzymatic reactions like transformation of carbohydrates, activity of hexokinase and formation of cellulose and change in sugar are considered due to its action on zymohexose (Dutta and Dhua, 2002) [5].

The presented in Table 1 and 2 indicated that fruit quality in terms of lower acidity and maximum TSS, total sugars, reducing sugars, non-reducing sugars, ascorbic acid content and shelf life increased significantly in the treatment of novel organic liquid fertilizer @ 2%. The increased in the sugars, TSS, ascorbic acid content and lower acidity might be due to respirational demand and adequate supply of nutrients, synthesis of invertase and starch splitting enzymes (Ram and Prasad, 1988) [9]. Similar results were obtained in relation to fruit quality by Anon. (2014) [2] in banana and Anon. (2013) [1] in papaya. The maximum percentage of total sugars was recorded in foliar application of micronutrient 1% Grade- IV application. The higher TSS was due to the increased total sugar content owing to the efficient translocation of available photosynthates to fruit pulp rather than to other parts. As an alternative proposal, it is suggested that borate ion may be associated with the cell membrane where it could be complex with sugar molecules and facilitates its passage across the membrane that might be the reason of increased total soluble solid (Meena *et al*., 2006) [8].

Shelf life of the fruits was affected significantly due to foliar spray of 2% novel organic liquid fertilizer. In present investigation, chemical compositions like TSS and total sugar were more in same treatment which helps to increased the shelf life of fruit because it contains more carbohydrates and This might be due to the fact that, shelf life is not control by nutritional factors. The increased in shelf life of mango fruits were also recorded in foliar application of 0.2% boric acid. It might be due to increased in concentration of boron of middle lamella of cell wall which provide physical strength to cell wall and improved fruit colour development and appearance. The present study also corroborated with the findings of Banik and Sen (1997) [4] and Tulsi Gurjar *et al.* (2015) [10] in mango.

Table 1: Effect of different pH levels, micronutrients and banana pseudostem sap on fruit quality characters of mango cv. Kesar **(mean of two years)**

Treatments	Colour	Taste	Odour	Flavo ur	Overall accepta bility	TSS (^{0}Brix)
pH levels of spray solution						
A_1 : pH 4.5	8.75	8.59	8.71	8.59	8.61	19.01
A_2 : pH 5.5	6.76	6.61	6.76	7.00	6.77	18.38
A_3 : Best available water	5.62	5.68	5.50	5.65	5.57	17.70
S.Em. ±	0.08	0.08	0.08	0.07	0.07	0.17
C.D. at 5%	0.24	0.24	0.24	0.21	0.20	0.49
Micronutrient and banana pseudoste m sap						
S_1 : Banana pseudo stem sap 5%	6.83	6.83	6.82	6.91	6.78	17.75
S_2 : Novel organic liquid fertilizer 1%	6.72	6.65	6.74	6.64	6.68	17.58
S_3 : Novel organic liquid fertilizer 2%	7.56	7.28	7.27	7.46	7.28	20.44
S_4 : Mixture Grade IV 1%	6.95	6.92	6.90	7.17	6.94	17.94
S_5 : Boric acid 0.2%	7.15	7.12	7.23	7.21	7.23	18.11
S.Em. ±	0.11	0.11	0.11	0.10	0.09	0.22
C.D. at 5%	0.30	0.31	0.31	0.27	0.26	0.63
Interaction effect (A×S)						
S.Em. ±	0.19	0.19	0.19	0.16	0.16	0.38
C.D. at 5%	NS	NS	NS	NS	NS	NS
CV%	6.45	6.65	6.64	5.70	5.51	5.11

Table 2: Effect of different pH levels, micronutrients and banana pseudostem sap on fruit quality characters of mango cv. Kesar (mean of two years)

Treatments	Acidity (%)	Ascorbi c acid Content (mg/100 g)	Total sugar (%)	Reducing sugar (%)	Non reducing Sugar (%)	Shelf life (days)
pH levels of spray solution						
A_1 : pH 4.5	0.27	52.35	13.62	5.60	8.02	17.52
A_2 : pH 5.5	0.26	50.44	13.30	5.05	8.25	15.28
A_3 : Best available water	0.27	49.23	12.58	4.08	8.50	13.05
S.Em. ±	0.003	0.34	0.10	0.05	0.06	0.29
C.D. at 5%	0.01	0.96	0.29	0.14	0.16	0.82
Micronutrient and banana pseudoste m sap						
S_1 : Banana pseudo stem sap 5%	0.28	49.68	12.86	4.65	8.21	14.28
S_2 : Novel organic liquid fertilizer 1%	0.31	48.84	12.67	4.52	8.15	13.79
S_3 : Novel organic liquid fertilizer 2%	0.23	52.86	13.73	5.38	8.35	18.24
S_4 : Mixture Grade IV 1%	0.26	50.56	13.15	4.90	8.26	14.80
S_5 : Boric acid 0.2%	0.25	51.45	13.44	5.14	8.30	15.32
S.Em. ±	0.003	0.44	0.13	0.06	0.07	0.37
C.D. at 5%	0.01	1.24	0.38	0.18	NS	1.05
Interaction effect (A×S)						
S.Em. ±	0.006	0.76	0.23	0.11	0.13	0.64
C.D. at 5%	NS	NS	NS	NS	NS	NS
CV%	5.53	3.66	4.27	5.36	3.76	10.31

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