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Patel RJ
Department of Fruit Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Patil SJ
Department of Fruit Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Bhanderi DR
Department of Vegetable Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Tandel BM
Department of Fruit Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Patel AH
Department of Fruit Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Correspondence
Patel RJ
Department of Fruit Science
ASPEE College of Horticulture and Forestry Navsari Agricultural University, Navsari, Gujarat, India

Effect of different pH levels, micronutrients and banana pseudostem sap on flowering of mango (*Mangifera indica* L.) cv. Kesar

Patel RJ, Patil SJ, Bhanderi DR, Tandel BM and Patel AH

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 flowering characters of mango cv. Kesar were recorded. The results revealed that the foliar spray solution at pH 4.5 level and foliar application of 2 % novel organic liquid fertilizer gave maximum flowering characters of mango *i.e.* number of fruits at pea stage, fruit set (%) at marble stage, fruit set (%) at harvest stage, fruit retention and number of fruits per panicle. Interaction of different pH levels with banana pseudostem sap and micronutrients was found significant in case of fruit set (%) at marble stage, fruit set (%) at harvest stage, fruit retention and number of fruits per panicle of mango during investigation, which were the maximum when mango cv. Kesar tree treated at induction of flowering and full bloom stage with 2 % novel organic liquid fertilizer at 4. 5 pH level.

Keywords: pH level, banana pseudostem sap, novel organic liquid fertilizer, micronutrients and flowering characters

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 (patended) 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 flowering characters of mango cv. Kesar were recorded.

Result and Discussion

Effect of pH levels of spray solution

A perusal of data presented in Table 1 clearly revealed that, the maximum number of fruits at pea stage, fruit set (%) at marble stage, fruit set (%) at harvest stage, fruit retention (%) at harvest stage and number of fruits per panicle were observed in A_1 treatment (pH 4.5). This might be due to that the optimal pH values of spray solution for the maximum uptake of most mineral nutrients are available within the range of pH 3.0 to 5.5 (Kannan, 1 980) [4]. Similar results were recorded by Jacyna *et al.* (2011) [2] in cherry.

Effect of micronutrients and banana pseudostem sap

The data presented in Table 1 clearly revealed that foliar application of novel organic liquid fertilizer 2 % at induction of flowering and full bloom stage recorded maximum number of fruits at pea stage, fruit set (%) at marble stage, fruit set (%) at harvest stage, fruit retention (%) at harvest and number of fruits per panicle. It might be due to the macro and micronutrients present in novel organic liquid fertilizer which helpful to increased fruit set at different stages. The micronutrients at higher rate exerted a significant positive influenced on fruit set. The present study also corroborated with the findings of Anon. (2012) in mango.

In the present investigation, foliar application of 1 % Grade – IV micronutrients also gave the better number of fruit at pea stage, fruit set (%) at marble stage, fruit retention and number of fruits per panicle. Foliar application of micronutrients involved directly in various physiological processes and enzymatic activity. This might have resulted into better photosynthesis, greater accumulation of starch in fruits and involvement of Zn in auxin synthesis and B in translocation of starch to fruits. The balance of auxin in plant increased the number of fruit at pea stage, fruit set (%) at marble stage and fruit retention. Similar results were observed by Stino *et al.* (2011) [6] and Tulsi Gurjar *et al*. (2015) in mango.

Better number of fruits at pea stage, fruit set (%) at marble stage and fruit retention at harvest also observed in foliar application of boron. This might be due to boron play important role in pollen germination and pollen tube growth which is associated with better pollination, fertilization and fruit setting (Thompson and Batjer, 1950) [7]. The present study also corroborated with the findings of Jutamanee *et al.* (2002) [3], Vashistha *et al*. (2010) [9], Sankar *et al*. (2013) [5] and Tulsi Gurjar *et al*. (2015) in mango.

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

Treatments	No. of fruits at pea stage	Fruit set (%) at marble stage	Fruit set (%) at harvest stage	Fruit retention (%) at harvest stage	No. of fruits/ panicle
pH levels of spray solution					
A_1 : pH 4.5	23.81	24.14	7.17	29.52	1.73
A_2 : pH 5.5	22.04	24.07	6.75	27.98	1.50
A_3 : Best available water	20.78	22.34	5.99	26.83	1.25
S.Em. ±	0.32	0.27	0.05	0.19	0.03
C.D. at 5%	0.92	0.77	0.15	0.53	0.08
Micronutrient and banana pseudostem sap					
S_1 : Banana pseudo stem sap 5%	21.02	22.10	5.91	26.79	1.25
S_2 : Novel organic liquid fertilizer 1%	19.53	21.91	5.67	25.89	1.11
S_3 : Novel organic liquid fertilizer 2%	24.48	25.93	8.03	30.92	1.98
S_4 : Mixture Grade IV 1%	22.70	23.09	6.20	26.94	1.42
S_5 : Boric acid 0.2%	23.32	24.54	7.37	30.00	1.73
S.Em. ±	0.42	0.35	0.07	0.24	0.04
C.D. at 5%	1.18	0.99	0.19	0.68	0.11
Interaction effect (A×S)					
S.Em. ±	0.72	0.60	0.12	0.42	0.07
C.D. at 5%	NS	1.71	0.34	1.18	0.19
CV%	7.98	6.30	4.38	3.62	10.94

Interaction effect

Data illustrated in Table 2 clearly indicated that the mango cv. Kesar plants treated with 2 % novel organic liquid fertilizer at 4.5 pH level recorded significantly maximum fruit set (%) at marble stage, fruit set (%) at harvest stage, fruit retention (%) at harvest stage and number of fruits per panicle.

Table 2: Interaction between of different pH levels with micronutrients and banana pseudostem sap on flowering characters of mango cv. Kesar (mean of two years)

Treatment combinations	Fruit set (%) at marble stage	Fruit set (%) at harvest stage	Fruit retention (%) at harvest stage	No. of fruits/ panicle
A1S1	23.03	6.12	26.58	1.39
A1S2	21.53	5.83	27.08	1.20
A1S3	27.14	9.02	33.24	2.38
A1S4	23.32	6.70	28.75	1.66
A1S5	25.68	8.19	31.94	2.05
A2S1	21.74	5.98	27.56	1.26
A2S2	22.35	5.73	25.65	1.13
A2S3	26.06	8.17	31.39	2.01
A2S4	25.32	6.39	25.37	1.41
A2S5	24.95	7.45	29.91	1.72
A3S1	21.4	5.63	26.22	1.11

A3S2	21.85	5.44	24.95	1.01
A3S3	24.60	6.90	28.11	1.56
A3S4	20.72	5.52	26.71	1.18
A3S5	22.99	6.47	28.15	1.42
S.Em. ±	0.60	0.12	0.42	0.07
C.D. at 5%	1.71	0.34	1.18	0.19
CV%	6.30	4.38	3.62	10.94

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