

Effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (*Mangifera indica* L.) cv. KESAR

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ABSTRACT : An experiment was conducted at Regional Horticultural Research Station, Navsari Agricultural University, Navsari (Gujarat) during 2012-2013 to assess the effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (*Mangifera indica* L.) cv. Kesar. The experiment consisted of seven treatments viz., T₁ (control, water spray), T₂ (1500 ppm salicylic acid), T₃ (2000 ppm salicylic acid), T₄ (2500 ppm salicylic acid), T₅ (0.1% humic acid), T₆ (0.2% humic acid) and T₇ (0.3% humic acid). Results revealed that foliar application of 2000 ppm salicylic acid (T₃) was found better with respect to number of male and hermaphrodite flowers per panicle, hermaphrodite flower to male flower ratio (0.32), fruit retention per panicle (1.40), number of fruits per tree and quality parameters like TSS, titrable acidity and sugar. However, foliar application of 0.1 per cent humic acid (T₅) was beneficial for improving the fruit weight and yield.

Key Words : Salicylic acid, Humic acid, Hermaphrodite flower, TSS

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Flowering is the first of several events that set the stage for mango (*Mangifera indica* L.) production each year. With the availability of favorable growth conditions, the timing and intensity of flowering greatly determines when and how much fruit will be produced during a given season. The initial fruit set will depend much on the number of hermaphrodite flowers in a panicle. Fruit set percentage is a varietal character, depending upon several factors such as time of flowering, sex ratio, efficient cross pollination and intensity of flower drop. Salicylic acid is a diverse group of phenolics. Salicylic acid was shown to influence a number of physiological processes including flowering, ion uptake and transport, photosynthesis rate and stomatal conductance (Raskin, 1992). Moreover, in a number of species salicylic acid promoted flowering in combination with other plant growth regulators such as kinetin, indole acetic acid and gibberellins. It is considered as a growth regulators due to its stimulatory effect on growth and flowering. Humic acid is the active constituent of organic humus, which

can play a very important role in soil conditioning and plant growth. Physically, it promotes good soil structure and increases the water holding capacity of the soil; biologically it enhances the growth of useful soil organisms, while chemically it serves as an adsorption and retention complex for inorganic plant nutrients.

RESEARCH PROCEDURE

The present investigation was conducted during 2012-13 on 'Kesar' mango planted at 5m × 5m at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat. The experiment was laid out in Randomized Block Design with three replications and seven treatments namely salicylic acid 1500 ppm, salicylic acid 2000 ppm, salicylic acid 2500 ppm, humic acid 0.1 per cent, humic acid 0.2 per cent, humic acid 0.3 per cent and a control. Foliar application of both

salicylic and humic acid was carried out at flower bud initiation stage during the third week of October.

Fifteen years old trees of mango cv. Kesar were selected for the study. Five panicles per tree from each direction were tagged for studying the flowering and fruiting characters. Fruit retention per panicle was recorded just before harvest from each tagged panicle. The number of fruits was estimated from each treated trees at time of harvest. The yield of fruits per tree was recorded on the basis of fruit weight. Five uniformly matured fruits were handpicked from each treatment and were stored at room temperature for ripening. For chemical analysis the fruits from each treatment were used at full ripening stage (12th day) and analyzed. The data collected for all the characters involved under study were subjected to statistical analysis.

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Flowering parameters :

The highest number of both male (1035) and hermaphrodite flowers (335) per panicle were observed in plants treated with salicylic acid 2000 ppm (T_3). Similarly the highest hermaphrodite to male flower ratio (0.32) was obtained with treatment T_3 (Table 1). The increase in male and hermaphrodite flowers per panicle in the present investigation might be due to that salicylic acid increased the synthesis of floral stimulus in an inductive cycle due to its florigenic activity or more plausible affecting the ratio between flower-promoting and flower-inhibiting factors (Singh *et al.*, 2001). The hormonal concept of flowering in mango implies that cyclic synthesis of floral stimulus in leaves and the gap between such two cycles would decide flowering behaviour of mango (Kulkarni, 1986). Similar findings were also reported by Singh *et al.* (2001) and Kumar and Reddy (2008) in mango.

Fruiting attributes :

Among all the treatments, maximum fruit retention per panicle at harvest was recorded in trees treated with 2000 ppm salicylic acid (T_3) which remained at par with treatments T_4 , T_5 and T_7 (Table 1). Nunez-Elisea and Davenport (1986) demonstrated that ethylene production by fruit pericarp was involved in premature fruitlet abscission and the maximum abscissions of fruitlets occur during the first 30 days after fertilization. This offered the opportunity to explore the possibility of enhancing fruit retention by interfering ethylene production/action with the application of salicylic acid. Therefore, it is highly probable that aqueous spraying with salicylic acid may have interfered with the biosynthesis/action of ethylene, which in turn reduced fruitlet abscission and enhanced harvestable mango fruits. Another probable reason

for increased fruit retention might be due to better photosynthetic activity (Singh and Usha, 2003) leading to proper supply of carbohydrates to the fruits. Similar finding was also observed by Singh *et al.* (2001) in mango. Humic acid 0.1 per cent was found best next to salicylic acid 2000 ppm with regard to fruit retention per panicle at harvest. This positive influence can be attributed to the strength provided by the humic acid as it has been reported to behave like auxins (Canellas *et al.*, 2002).

The fruit length was also found to be significantly influenced by different concentrations of salicylic acid and humic acid and it was found higher in treatments T_5 (0.1 % humic acid) and T_6 (0.2 % humic acid). The enhanced fruit length due to application of humic acid may be due to increase in nutrient uptake. The increase in fruit length due to application of humic acid was also reported by El-Razek *et al.* (2013) in peach.

Yield parameters :

The fruit weight, number of fruits per tree and yield of mango were significantly influenced due to the application of different concentrations of salicylic acid and humic acid (Table 2). The data showed that mango trees sprayed with humic acid 0.1 per cent (T_5) yielded fruits with maximum weight. The trees which received the treatment of 2000 ppm salicylic acid (T_3) had higher number of fruits per tree (236.67). Further, treatment T_5 (0.1 % humic acid) significantly registered the highest fruit yield per tree which was statistically at par with treatment T_3 .

Humic acid has been reported to promote the quantitative properties of fruit such as fruit weight and yield (Mahmoudi *et al.*, 2013). Humic acid is especially beneficial in freeing up nutrients in the soil so that they are made available to the plants. It can convert elements into forms suitable for assimilation by plants due to its ability to form complexes by acting as chelating agents and increasing and free major nutrient like phosphorus and other micro nutrients (Vaughan and McDonald, 1976). The positive effect of humic acid in the present investigation with regard to fruit weight, number of fruits per tree and yield of mango may be attributed to enhanced uptake of mineral nutrients and increased cation exchange in soil. Furthermore, the plant hormone-like activity of humic substances may be responsible for increased yield in mango. The findings of El Razak *et al.* (2012) in peach and Laila *et al.* (2013) in olive are in conformity with the present investigation.

The increase in yield parameters due to salicylic acid observed in the present investigation can be attributed to increased photosynthetic activity in leaves and translocation of more photoassimilates to fruits. The findings of Singh *et al.* (2001) in mango and El-Razek *et al.* (2013) in olive are in agreement with the present study.

Table 1 : Effect of salicylic acid and humic acid on flowering and fruiting in mango cv. KESAR

Treatments	No. of hermaphrodite flowers	No. of male flowers	Hermaphrodite to male flower ratio	No. of fruits retained per panicle at harvest	Fruit length (cm)
T ₁ : Control	190.33	792.33	0.24	0.87	9.76
T ₂ : 1500 ppm SA	249.67	914.00	0.27	1.00	10.27
T ₃ : 2000 ppm SA	335.00	1035.00	0.32	1.40	10.40
T ₄ : 2500 ppm SA	196.33	744.00	0.26	1.13	10.87
T ₅ : 0.1% HA	240.00	837.33	0.28	1.33	12.66
T ₆ : 0.2% HA	193.67	746.33	0.26	1.07	11.56
T ₇ : 0.3% HA	242.67	893.33	0.27	1.20	11.01
S.E. ±	19.67	48.57	0.01	0.09	0.52
C.D. (P=0.05)	60.62	149.66	0.03	0.28	1.59
C.V. (%)	14.48	9.88	6.90	13.86	8.20

Table 2 : Effect of salicylic acid and humic acid on yield and quality parameters in mango cv. Kesar

Treatments	Fruit weight (g)	No. of fruits per tree	Yield (kg/tree)	TSS (°B)	Acidity (%)	Reducing sugar (%)
T ₁ : Control	248.64	179.00	44.55	15.39	0.30	3.29
T ₂ : 1500 ppm SA	240.19	222.00	53.32	18.13	0.27	3.38
T ₃ : 2000 ppm SA	280.26	236.67	66.46	18.59	0.23	3.95
T ₄ : 2500 ppm SA	251.50	195.00	48.79	17.49	0.25	3.87
T ₅ : 0.1% HA	322.24	227.33	73.59	16.78	0.29	3.66
T ₆ : 0.2% HA	284.61	213.33	60.46	17.25	0.27	3.57
T ₇ : 0.3% HA	294.55	192.00	56.20	17.37	0.25	3.42
S.E. ±	14.17	11.56	4.25	0.57	0.01	0.14
C.D. (P=0.05)	43.66	35.63	13.11	1.77	0.03	0.43
C.V. (%)	8.94	9.57	12.78	5.75	7.39	6.71

Quality parameters :

Fruit quality characters like total soluble solids (⁰Brix), reducing sugar (%) and titrable acidity (%) were significantly influenced by foliar spray of different concentrations of salicylic acid and humic acid in mango cv. Kesar. However, 2000 ppm salicylic acid was found to be the most effective and resulted in significantly highest total soluble solids (⁰Brix), reducing sugar (%) and minimum titrable acidity (%) (Table 2). The spray of salicylic acid regulated the carbohydrate metabolism in both source and sink tissue of the plants. The hydrolysis of sucrose by invertase regulates the levels of some plant hormones like indole-3acetic acid, salicylic acid and jasmonic acid (LeClere *et al.*, 2003). This information confirms the relationship between salicylic acid and invertase activity. Thus, the accumulation of reducing sugar might be due to increased translocation of more photosynthetic assimilates to the fruits and breakdown of starch during ripening. Similar results were also obtained by Singh *et al.* (2001) and Kumar and Reddy (2008) in mango.

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