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Effect of foliar application of humic acid, salicylic acid and novel liquid on fruit drop and yield of mango (*Mangifera indica* L.) cv. Amrapali

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Abstract
An experiment was carried out to study the "Effect of foliar application of humic acid, salicylic acid and novel liquid on fruit yield and quality of mango (*Mangifera indica* L.) cv. Amrapali" at Horticultural Research Farm, and P.G. Laboratory, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, during March to June, 2018. Treatments comprised foliar application (At 50% flower opening stage, pea stage and marble stage) of humic acid @ 1, 1.5 and 2%, salicylic acid @ 1000, 1500 and 2000 mg/l and novel liquid @ 1, 1.5 and 2% along with control. The experiment was carried out in completely randomized design with three repetitions. Among all the treatments T_2 (Humic acid @ 1.5%) treatment was found most effective treatment and recorded significantly minimum fruit drop (at marble and harvest stage), While maximum in number of fruits/tree, fruit weight, fruit diameter, fruit volume and fruit yield.

Keywords: Humic acid, salicylic acid, novel liquid, fruit drop and yield

Introduction
Mango (*Mangifera indica* L.) fruit is having excellent adaptability and regarded as "King of Fruits" (Radha and Mathew, 2007) [14]. Moreover, Mango has been cultivated in Indian sub-continent for well over 4000 years and favorite of the kings and common people as well, because of its nutritive value, taste, attractive fragrance and health promoting qualities. India is proud of having the largest available germplasm wealth of mango with about 1,000 cultivars (Bose, 1999) [4]. Mango is one of the major fruit crop of Asia and has developed its own importance all over the world (Bose *et al*. 2001) [5]. Mango is a national fruit of India because of its excellent flavour, delicious taste, delicate fragrance and attractive colour. In India thousands of varieties of mango are grown in a wide range of agro climatic conditions from tropical to sub-tropical and humid tropic to semi humid tropics. The important cultivars commercially grown under Gujarat conditions are Kesar, Alphanso, Rajapuri, Totapuri, Jamadar, Dashehari, Langra, and Neelum.
Amrapali is a mango variety introduced in 1971.The tree is dwarf, regular bearer, cluster bearing, small sized fruits, and good keeping quality. Fruits are green, apricot yellow, medium sized, sweet in taste with high TSS and pulp content (75%), while flesh is fibreless and deep orange red. Humic acid stimulate plant enzymes and increase their production. It is known to thicken the cell wall in fruit and prolong the storage as well as shelf life. Humic acid also stimulate plant growth (higher biomass production) by accelerating cell division, increasing the rate of development in root systems and increasing the yield of dry matter. Therefore, use of humic acid improve nutrient availability especially microelement in calcarious soil since it promotes nutrient uptake as chelating agent.

Material and Methods
An experiment was framed with ten treatments *viz,* humic acid @ 1, 1.5 and 2%, salicylic acid @ 1000, 1500 and 2000 mg/l and novel liquid @ 1, 1.5 and 2% along with control. A completely randomized design was used with three repetitions. An experiment was carried out during March to June, 2018 at Horticultural Research Farm, and P.G. Laboratory, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Thirty uniform size tree sprayed three time i.e at 50% flower opening stage, pea stage and marble stage. The mature fruits were harvested and sum up to record yield/plant.

Result and Discussion

Significantly minimum fruit dropped at marble stage (88.89%) and harvest stage (92.87%) was observed in the treatment T_2 (humic acid @ 1.5%) which was at par with treatment T_9, T_8, T_1, T_3 and T_4 . While, the highest fruit drop at marble stage (95.51%) was recorded in control in case of marble stage. While in case of harvest stage treatments T_9, T_3 and T_1 which was at par with treatment T_2. While, the highest fruit drop at harvest stage (98.30%) was recorded in control (Table 1.). Minimum fruit drop at marble and harvest stage might be due to the 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) [6] which cause a delay in abscission, chelates metal ions under alkaline soil conditions and improves the availability of nutrients to plants (Zhang *et al.*, 2010) [18]. Similar results were also observed by Fathy *et al.*, (2010) [8] in apricot, Abbas *et al.*, (2013) [1] in kinnow and Khattab *et al.*, (2012) [10] in pomegranate.

Maximum number of fruits per tree (368) was observed in the treatment T_2 (humic acid 1.5%) which remained at par with treatment T_9. While, minimum number fruits per tree (286) was recorded in control (Table 1.). Increase in number of fruits/tree might be due to humic acid which increases the number of flowers per plant and the highest flower bud differentiation rate which ultimately boost up the average number of fruit per plant (Abbas *et al.*, 2013) [1]. Similar type of results was also reported by Arancon *et al.* (2003) [2] in strawberries, Yildrim *et al.* (2007) [17] in tomato.

Maximum fruit volume (150.17 cc) was observed in the treatment T_2 (humic acid 1.5%) which was at par with treatment T_9. While, minimum fruit volume (126.50 cc) was recorded in control. In fruit diameter significantly, maximum fruit diameter (6.27 cm) was observed in the treatment T_2 (humic acid 1.5%) which was found at par with treatments T_6, T_1, T_9, T_3, T_5, T_4 and T_7. On the other hand, minimum fruit diameter (5.16 cm) was recorded in control (Table 1.). Increase in fruit volume and diameter might be due to enhancement of the cell division and cell enlargement by humic acid resulted development of fruit (Mahmoudi *et al.*, 2013) [12] in kiwi. Similar findings were also reported by Gadallah (1999) [9] in bean and Salman *et al.* (2005) [15] in watermelon.

Table 1: Effect of foliar application of humic acid, salicylic acid and novel liquid on fruit drop, no. of fruit per tree, fruit volume and diameter

Sr. No	Treatments	Fruit drop (%)		Number of fruits/tree	Fruit volume (cc)	Fruit diameter (cm)
		Marble stage	Harvest stage			
T_1	Humic acid 1%	90.34	95.75	138.13	6.07	323
T_2	Humic acid 1.5%	88.89	92.87	150.17	6.27	368
T_3	Humic acid 2%	90.84	95.46	134.87	6.02	321
T_4	Salicylic acid 1000 mg/l	91.65	98.54	134.10	5.88	319
T_5	Salicylic acid 1500 mg/l	92.77	97.95	133.87	5.89	309
T_6	Salicylic acid 2000 mg/l	93.67	97.55	134.17	6.12	300
T_7	NOVEL liquid 1%	92.32	96.88	135.97	5.80	316
T_8	NOVEL liquid 1.5%	90.28	96.34	136.23	5.75	305
T_9	NOVEL liquid 2%	89.78	95.35	143.40	6.05	350
T_{10}	Control	95.51	98.30	126.50	5.16	286
	S.Em. ±	1.09	1.01	3.33	0.17	13.87
	C.D. at 5%	3.24	2.98	9.83	0.49	40.93
	C.V.%	2.07	1.81	4.22	4.91	7.52

Maximum fruit weight (170.28 g) was observed in the treatment T_2 (humic acid 1.5%) which was at par with treatment T_9, T_1, T_8, T_7, T_3 and T_6. While, minimum fruit weight (140.37 g) was recorded in control (Table 2.). Increase in fruit weight might be due to humic acid which enhance uptake of mineral nutrient and activation of hormone like auxin and cytokinine which leads to cell division and elongation (Mahmoudi *et al.*, 2013) [12]. Similar results were also reported by Ngullie *et al.* (2014) [13] in mango, Laila (2013) [11] in olive and El-Razek *et al.* (2012) [7] in peach.

Table 2: Effect of foliar application of humic acid, salicylic acid and novel liquid on fruit weight and fruit yield

Sr. No	Treatments	Fruit weight (g)	Grade A (kg/tree)	Grade B (kg/tree)	Grade C (kg/tree)	Fruit yield (kg/tree)
T_1	Humic acid 1%	165.97	22.57	20.32	10.93	53.82
T_2	Humic acid 1.5%	170.28	28.13	21.51	13.10	62.74
T_3	Humic acid 2%	155.50	26.76	13.55	9.63	49.88
T_4	Salicylic acid 1000 mg/l	150.27	21.89	16.82	9.02	47.92
T_5	Salicylic acid 1500 mg/l	148.13	22.97	12.46	10.20	45.63
T_6	Salicylic acid 2000 mg/l	154.29	23.38	14.63	8.23	46.33
T_7	NOVEL liquid 1%	156.23	25.69	13.50	10.74	49.53
T_8	NOVEL liquid 1.5%	157.21	24.23	12.87	11.39	48.50
T_9	NOVEL liquid 2%	168.25	27.41	19.25	12.79	59.41
T_{10}	Control	140.37	20.65	11.86	7.74	40.23
	S.Em. ±	5.45	0.94	0.67	0.59	2.45
	C.D. at 5%	16.09	2.76	1.97	1.73	7.23
	C.V.%	6.03	6.65	7.38	9.78	8.42

Maximum fruit yield (62.74 kg/tree) was observed in the treatment T_2 (humic acid 1.5%) which was at par with treatment T_9. While, the lowest fruit yield (40.23 kg) was recorded in control. In case of A grade fruit, treatment humic acid 1.5% gave higher fruit yield (28.13 kg/tree) which was found at par with T_9 (27.41 kg/tree), T_7 (25.69 kg/tree) and T_3 (26.76 kg/tree) as compared to T_{10} (20.65 kg/tree). The treatment humic acid 1.5% (T_2) recorded maximum B grade

fruit yield (21.51 kg/tree) which was at par with T_1 (20.32 kg/tree). However in case of C grade fruit treatment T_2 *i.e.* humic acid 1.5% gave maximum fruit yield (13.10 kg/tree) which was at par with treatments T_9 (12.79 kg/tree) and T_8 (11.39 kg/tree). While minimum Grade A, B and C (20.65, 11.86 and 7.74 respectively) observed Increase in fruit yield might be due to humic acid which enhanced uptake of mineral nutrients and increased cation exchange in soil and plant hormone like activity of humic substances responsible for increased yield in custard apple (Serenella *et al.,* 2002) [16]. Similar results were also reported by El-Razek *et al*. (2012) [7] in peach, Asgharzade *et al.* (2012) [3] in grape, Laila *et al.* (2013) [s] in olive, Khattab *et al.* (2012) [10] in pomegranate and Ngullie *et al.* (2014) [13] in mango.

Conclusion

The result obtained from research experiment, it can be concluded that humic acid 1.5% was found beneficial to increases number of fruits/tree, fruit volume, fruit diameter, fruit weight, fruit yield and minimize the fruit drop at marble and harvest stage in mango cv. Amrapali.

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