

Short communication

Effect of hormonal treatment and mulching on fruit drop and quality in mango

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ABSTRACT

An experiment was laid out to assess the effect of hormonal treatment and mulching on fruit drop and quality in cvs. Mallika, Amrapali and Dashehari of mango at the experimental farm Bhota of IBES Neri, Hamirpur, during the years 2010-2012. Eight treatments, viz., T₁ & T₂: 2, 4-D (20 and 40ppm), T₃ & T₄: NAA (25 and 50ppm), T₅: 2, 4-D (20ppm) + Black polythene mulch, T₆: NAA (25ppm) + Black polythene mulch, T₇: Black polythene mulch, and T₈: Control, were applied during the last week of April at the pea stage of fruit development in the years 2011 and 2012. Observations were recorded on marked panicles at monthly intervals until harvest. All the hormonal treatments, mulching and combination thereof, showed significant reduction in fruit drop in all the three cultivars under study. Fruit retention at harvest in cvs. Amrapali, and Mallika and Dashehari was maximum (5.95, 9.5 and 8.3%, respectively) with T₅ (2, 4-D 20ppm + Black polythene mulch) which was statistically at par with T₁ (2, 4-D 20ppm), T₇ (Black polythene mulch) and T₂ (2, 4-D 40ppm). Effect of treatments on TSS content was non-significant. Highest TSS content (14.5°B) was noted in cv. Dashehari which was significantly higher than in Mallika (11.7°B) or Amrapali (11.4°B). Titratable acidity was significantly low in all the treatments than that in untreated plants. Highest acidity (0.53%) was recorded in Control. 'Dashehari' recorded the highest (0.63%) acidity, followed by Mallika (0.49%) and Amrapali (0.46%).

Key words: Mango, NAA, 2,4-D, mulch, fruit-drop, fruit quality

Mango is one of the most important tropical fruits worldwide in terms of production and consumer-acceptance (FAO, 2010). Mango (*Mangifera indica* L.) belongs to the order Sapindales and the family Anacardiaceae, and is cultivated primarily under tropical and subtropical climate. Foot hills of Himachal Pradesh present semi-arid type of a climate but, generally, the whole area around is characterized by a sub-tropical climate. Mango is one of the leading fruit crops grown in the low-hill and valley areas of Himachal Pradesh, with 28927 MT production from 39568 ha under mango cultivation (Anon., 2012). Despite adequate annual rainfall in the region, drought-like situation is fairly common due to a skewed distribution of rainfall. Owing to these sub-optimal growth conditions, establishing new plantations and attaining normal vegetative and reproductive growth is an uphill task. Fruit growth and fruit maturity in mango grown in these areas coincides with a period of heavy water-stress often resulting in low fruit-set, high fruit-drop, low fruit-size and poor fruit-quality.

Natural fruit-drop in mango is very high, especially during the initial four weeks of fruit-set. Chadha and Singh

(1964) reported fruit-drop of 98, 95 and 99% in cvs. Langra, Dashehari and Fazli, respectively, during the 'on year'. Incidence of fruit-drop is more severe during the 'on year' in biennial-bearing cultivars. Various factors are associated with fruit-drop, such as, lack of cross-pollination, deficient nutrition, self-incompatibility, formation of abscission layer, hormonal imbalance, position of the fruit, and prevalence of pests and diseases (Chadha, 1993). Various workers have reported that just 0.1% of perfect flowers reach maturity in mango. Extent of the fruit-drop varies among cultivars (Chadha and Singh, 1964). Higher fruit-drop is generally associated with low auxin concentration (Singh *et al*, 2005), gibberellins & cytokinins (Ram, 1983). The period of heavy fruit drop in mango corresponds with high concentration of growth inhibitors (Murti and Upreti, 1995).

Among the control measures, mulching, proper fertilization and hormonal treatments have been found promising by a number of workers. Swake *et al* (1990) reported an increase of 2% in the yield over Control using polythene mulch in mango. Singh and Singh (1976) reported that NAA at 10ppm and 2, 4-D at 10 or 15ppm gave the

highest retention of fruits. Therefore, the present study intended to assess the effect of plant hormonal treatments, in combination with mulching, on reducing fruit-drop in mango.

An experiment was laid out to assess the effect of hormonal treatments and mulching on fruit drop and quality of mango cultivars Mallika, Amrapali and Dashehari at the experimental farm Bhota of IBES Neri, Hamirpur during the years 2010-2012. The experimental site lies in Hamirpur district representing the sub-mountain region of Himachal Pradesh. Average mean maximum and minimum temperatures here are 31.3°C and 12.4°C, respectively, and relative humidity is 60.9%. Eight treatments, viz., T₁ & T₂: 2, 4-D (20 and 40ppm), T₃ & T₄: NAA (25 and 50ppm), T₅: 2, 4-D (20ppm) + Black polythene mulch, T₆: NAA (25ppm) + Black polythene mulch, T₇: Black polythene mulch, and T₈: Control, were applied during the last week of April at the pea-size stage of fruits. Each treatment was replicated on three mango trees. Randomized Block Design was set up for applying treatments and for data analysis. Each treatment was replicated thrice. To record observations on the effect of treatments on fruit-drop, four panicles from all around the tree were marked on each plant. Data on initial fruit-set per panicle was recorded in these marked panicles before commencing the experiment. Subsequently, fruit-

retention on the marked panicles was recorded at monthly intervals until harvest. Fruit samples, comprising ten fruits per tree, were used for determining physico-chemical characteristics like fruit-length, diameter, fruit-weight, TSS and titrable acidity.

Perusal of data (Table 1) revealed that the highest fruit-retention (22.2%) at 30 days after fruit set was found with T₄ (50ppm NAA) in cv. Amrapali, followed by that in the Control (21.6%), 2,4-D 40ppm (21.2%), and NAA 25ppm (20.6%). In cv. Mallika, highest fruit-retention (29.5%) at the same stage was recorded with T₁ (2,4-D 20ppm), followed by NAA 20ppm, and Control. Treatment T₁ (2,4-D 20ppm) had the highest fruit-retention (23.4%) 30 days after fruit-set in cv. Dashehari, which was at par with NAA 25ppm (22.5%) and Black polythene mulch (22.4%). At 60 days after fruit-set, maximum fruit-retention (13.3%) was noted with T₅ (2,4-D 20ppm + Black polythene mulch), which was statistically at par with NAA 50ppm (12.8%) and the Control (12.4%). Maximum fruit-retention in cv. Mallika at this stage was recorded with T₇ (Black polythene mulch), which was statistically at par with T₂ (2,4-D 40ppm), T₄ (50ppm NAA) and T₅ (2,4-D 20ppm + Black polythene mulch). In cv. Dashehari, T₅ (2,4-D 20ppm + Black polythene mulch) recorded the highest fruit-retention (17.5%), whereas, the lowest retention (8.1%) was found

Table 1. Effect of hormonal treatments and mulching on fruit-retention in three cultivars of mango

Treatment	Fruit-retention (%) days after fruit-set														
	Amrapali					Mallika					Dashehari				
	30	60	90	120	At harvest	30	60	90	120	At harvest	30	60	90	120	At harvest
2,4-D (20ppm)	19.6 (4.42)	10.5 (3.21)	8.2 (2.83)	5.7 (2.38)	5.73 (2.37)	29.5 (5.43)	14.8 (3.81)	9.4 (3.03)	6.7 (2.56)	6.51 (2.54)	23.4 (4.81)	8.1 (2.82)	6.1 (2.45)	5.2 (2.27)	4.41 (2.10)
2,4-D (40ppm)	21.2 (4.60)	11.6 (3.38)	8.2 (2.83)	5.7 (2.38)	5.28 (2.28)	26.8 (5.15)	16.4 (4.02)	11.3 (3.31)	7.6 (2.73)	6.77 (2.59)	21.3 (4.60)	14.7 (3.81)	9.5 (3.06)	6.3 (2.49)	4.31 (2.05)
NAA (25ppm)	20.6 (4.53)	12.3 (3.48)	9.2 (3.01)	5.6 (2.35)	4.05 (2.01)	27.3 (5.20)	14.9 (3.85)	9.5 (3.06)	6.8 (2.57)	5.19 (2.25)	22.5 (4.72)	13.7 (3.68)	9.5 (3.06)	7.3 (2.68)	4.27 (2.04)
NAA (50ppm)	22.2 (4.70)	12.8 (3.56)	7.9 (2.80)	4.9 (2.21)	4.54 (2.11)	25.6 (5.03)	16.1 (4.00)	10.2 (3.17)	8.3 (2.86)	5.09 (2.23)	20.8 (4.55)	11.77 (3.41)	8.6 (2.90)	6.4 (2.50)	4.54 (2.13)
2,4-D (20ppm) + Black polythene mulch	19.6 (4.42)	13.3 (3.61)	9.8 (3.11)	7.4 (2.70)	5.95 (2.43)	26.2 (5.10)	15.8 (3.97)	11.7 (3.40)	9.5 (3.06)	7.15 (2.65)	21.3 (4.60)	17.5 (4.15)	11.6 (3.38)	8.3 (2.86)	5.25 (2.27)
NAA (25ppm) + Black polythene mulch alone	20.4 (4.51)	11.9 (3.43)	8.3 (2.87)	5.6 (2.35)	5.23 (2.26)	23.9 (4.86)	13.3 (3.64)	8.2 (2.84)	5.7 (2.36)	4.68 (2.14)	18.9 (4.32)	11.6 (3.39)	9.3 (3.02)	8.1 (2.83)	4.89 (2.20)
Black polythene mulch	19.3 (4.39)	10.2 (3.18)	8.6 (2.91)	5.9 (2.40)	5.35 (2.30)	26.3 (5.10)	17.3 (4.12)	11.6 (3.38)	7.1 (2.65)	4.27 (2.04)	22.4 (4.70)	15.8 (3.95)	11.3 (3.35)	8.9 (2.95)	4.58 (2.12)
Control	21.6 (4.62)	12.4 (3.50)	9.2 (3.01)	6.5 (2.5)	3.28 (1.80)	27.2 (5.18)	16.3 (4.01)	11.4 (3.35)	8.4 (2.86)	4.15 (2.02)	20.8 (4.55)	14.5 (3.78)	9.5 (3.06)	7.4 (2.70)	4.12 (2.01)
CD 0.05	1.69	1.38	NS	1.41	1.27	3.25	2.95	1.71	1.28	1.07	3.13	4.90	4.21	2.39	0.43

*Figures in parentheses are square-root transformed values

Table 2. Effect of hormonal treatments and mulching on fruit quality in three cultivars of mango

Treatment	Fruit weight (g)			Fruit length (cm)			Fruit diameter (cm)			TSS (°B)			Acidity (%)							
	Amra- pali	Mean	Dashe- hari	Amra- pali	Mean	Dashe- hari	Amra- pali	Mean	Dashe- hari	Amra- pali	Mean	Dashe- hari	Amra- pali	Mean	Dashe- hari					
	2,4-D (20ppm)	135.21	329.25	240.34	234.20	8.41	12.95	10.43	10.59	5.98	7.11	5.32	6.14	11.4	11.5	13.8	12.2	0.44	0.37	0.52
2,4-D (40ppm)	124.53	328.46	238.35	230.45	8.39	12.99	10.59	10.66	5.87	7.22	5.36	6.15	11.6	11.9	13.7	12.4	0.39	0.40	0.55	0.45
NAA (25ppm)	130.63	323.78	234.13	229.51	8.31	12.74	10.45	10.50	5.84	7.06	5.69	6.20	11.3	12.6	13.9	12.6	0.42	0.53	0.44	0.46
NAA (50ppm)	121.27	324.52	241.25	229.01	8.41	12.75	10.41	10.52	5.81	7.15	5.55	6.17	11.8	12.8	13.3	12.6	0.35	0.57	0.56	0.49
2,4-D (20ppm) + Black polythene mulch	139.46	339.45	248.75	242.55	8.45	13.19	10.66	10.76	5.69	7.36	5.54	6.20	12.1	11.7	14.8	12.8	0.34	0.34	0.48	0.38
NAA (25ppm) + Black polythene mulch	137.58	337.75	245.48	240.77	8.40	13.32	10.74	10.82	6.19	7.55	5.77	6.50	11.6	12.3	14.6	12.8	0.37	0.46	0.47	0.43
Black polythene mulch	126.16	323.45	233.96	227.85	8.25	13.15	10.71	10.70	6.01	7.12	5.66	6.26	11.5	11.8	14.3	12.5	0.40	0.44	0.50	0.44
Control	123.17	321.28	206.74	217.06	8.22	12.81	10.01	10.34	5.35	6.95	5.29	5.86	11.4	11.7	14.5	12.5	0.46	0.49	0.63	0.53
CD _{0.05}				11.23				0.16				0.17				NS				0.09
Treatments				67.35				1.35				0.86				1.26				0.11
Variety TxV				93.58				1.68				1.04				1.94				0.21

with 2,4-D 20 ppm. Treatment T₅ (2,4-D 20ppm + Black polythene mulch) recorded highest fruit-retention in cv. Amrapali (9.8%), followed by Mallika (11.7%) and Dashehari (11.6%) at 90 days after fruit-set, and was statistically at par with T₄ (NAA 50ppm) and T₇ (Black polythene mulch). A similar trend was observed at 120 days after fruit-set where T₅ (2,4-D 20ppm + Black polythene mulch) had highest fruit-retention in all the three cultivars under study. Enhancement in (flowering 35 to 50%), fruit retention and minimum fruit-drop with enhanced yield in trees mulched with black polythene was also reported by Singh *et al* (2009) in cvs. Langra and Chausa of mango.

A perusal of data on fruit-retention at harvest revealed that maximum (5.95%) retention of fruits in cv. Amrapali was observed with T₅ (2,4-D 20ppm + Black polythene mulch), which was statistically at par with T₁ (2,4-D 20ppm), T₇ (Black polythene mulch) and T₂ (2,4-D 40ppm). In cvs. Mallika and Dashehari too, the same treatment, i.e., T₅ (2,4-D 20ppm + Black polythene mulch) resulted in the highest fruit-retention of 9.5% and 8.3%, respectively. Chattaha and Anjum (1999) also found 2,4-D @ 40ppm to be the most effective treatment in controlling fruit-drop in cv. Samar Behisht Chausa of mango, as compared to NAA or 2,4,5-T. During our investigation at harvest, it was noticed that all the hormonal treatments, mulching and combinations thereof, had significant effect on reduction in fruit-drop in all the three cultivars under study. Results obtained in the present study are in conformity with Ahmed *et al* (2012) who reported that treating plants with NAA, 2,4-D and 2,4,5-T significantly influenced the number of fruits retained at pea, marble, and harvest stages of fruit growth, compared to than in Control. Kulkarni (1983) also reported that application of 2,4-D @ 25ppm to half-grown fruits of mango cv. Alphonso reduced fruit-drop. 2,4-D reduced the fruit-drop by antagonizing adverse effects of growth inhibitors like ABA and ethylene.

All the treatments tested enhanced fruit-weight over the untreated Control (Table 2). Maximum fruit-weight (242.55g) was recorded with T₅ (2,4-D 20ppm + Black polythene mulch), which was statistically at par with the treatments NAA (25ppm) + Black polythene mulch, and 2,4-D 20ppm. Among the three cultivars, highest fruit-weight (321.28g) was recorded in cv. Mallika, followed by Dashehari (206.74g) and Amrapali (123.17g). Treatment T₅ (2,4-D 20ppm + Black polythene mulch) was found to give maximum fruit-length (10.82cm) and fruit-diameter (6.50cm), which was statistically at par with T₆ (NAA 25ppm

+ Black polythene mulch) and T₇ (Black polythene mulch alone). Lowest value for fruit-length (10.34cm) and fruit-diameter (5.29cm) was recorded in the untreated Control. Among the cultivars, Amrapali had the maximum (12.81cm) fruit-length, and Mallika had the largest (6.95cm) fruit-diameter. Effect of various treatments on Total Soluble Solids (TSS) content was non-significant. Highest TSS content (14.5°B) was noted in cv. Dashehari, which was significantly higher than that in Mallika (11.7°B) or Amrapali (11.4°B). Titratable acidity was significantly low in all the treatments, than in Control (untreated) plants. Highest acidity (0.53%) was recorded in the Control. 'Dashehari' recorded the highest (0.63%) acidity, followed by 'Mallika' (0.49%) and 'Amrapali' (0.46%).

Results obtained in the present experiment showed that T₅ (2,4-D 20ppm + Black polythene mulch) produced the best results in terms of enhanced fruit-retention and improved fruit-size and quality. Ahmed *et al* (2012) also reported similar results in cv. Dashehari, where, application of 2,4-D @ 15ppm enhanced fruit-size (in terms of fruit-weight) by 8.7% over the Control. 2,4-D (35ppm) recorded significantly higher TSS (19.5°B), and, TSS to titratable acidity ratio over the Control. This confirms the role of application of exogenous auxins in reducing fruit-drop in mango.

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