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INVESTIGATIONS ON THE CONTROL OF FRUIT DROP IN ALPHONSO MANGO

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SUMMARY

Field experiments were conducted during 1998-2002 for identification of pollinizer varieties, control of recurring flowering and control of fruit drop by use of mineral nutrients and growth regulators in Alphonso mango at the Regional Fruit Research Station, Vengurle, Sindhudurg. The investigations revealed that variety Kesar, Ratna and Goamankur were the best pollinizer varieties for Alphonso mango as substantiated by synchrony in flowering with Alphonso, better fruit set and acceptable fruit quality of pollinizer. Alphonso x Alphonso cross combination showed only 4% fruit retention whereas, Alphonso x Kesar, Alphonso x Ratna and Alphonso x Goamankur revealed 10-12% fruit retention. Therefore, plantation of 10 to 15% trees of Kesar, Ratna or Goamankur in Alphonso orchards as pollinizers was recommended. The recurring flowering emerging at the base of old flowering panicle causes heavy fruit drop from adjacent old ones. The foliar spray of GA_3 (50 ppm) at full bloom stage significantly reduced the recurring flowering in Alphonso mango. For control of flower/fruit drop in Alphonso mango, foliar spray of nutrients (urea, KNO_3, micronutrient complex) and growth regulators (NAA, triacontanol) at different concentrations were tested separately and in combination. The three years data revealed that urea 2%, NAA 20 ppm and micronutrient mixture 50 ppm in combination produced significantly higher fruit yield followed by combined application of urea + triacontanol + micronutrient.

Key words **: Alphonso mango, fruit drop, growth regulator, mineral nutrients, pollinizer, recurring flowering**

INTRODUCTION

The demand for Alphonso mango in export market is ever increasing due to its typical sugar-acid blend, attractive tasty pulp without fibre and long keeping quality. However, it has serious draw backs of alternate bearing habit and poor productivity (2.5t/ha). Cross pollination is essential for fruit set and is usually entomophilous. In nature more than 50% flowers remain unpollinated. The number of pollen grains/pollinated flower is also low. Wagle (1929) found that 38.4% flowers drops before fertilization, 56.4% shed after fertilization and 3.6% drop before fruits attain marble size. The low fruit set in mango is ascribed to self incompatibility and numerous problems encountered in pollination, fertilization and low temperature during flowering (Singh 1978, Swamy *et al*. 1988). A significant advantage was found in hand pollination with foreign pollen over self pollination.

Recurring flowering is the emergence of new flowering panicle at the base of old flowering panicle due to prolonged cold climate. This results into fruit drop from old panicle. As GA inhibit the flowering in mango, use of GA_3 has been suggested to control recurring flowering (Shinde *et al*. 2001). The deficiency of nutrients and

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growth regulators also causes flower and fruit drop of varying degree at various stages. Auxin is known to play an important role in control of flower and fruit drop. Boron deficiency impairs the floral development, pollen germination, pollen tube growth (Rath *et al*. 1980). The fruitlet abscissions in mango also occur due to Zn deficiency (Daulta *et al*. 1981). The present study attempts to analyse these aspects so as to control the fruit drop in Alphonso mango.

MATERIALS AND METHODS

Field experiments were conducted during 1998 to 2002 mango seasons at the Regional Fruit Research Station, Vengurle for control of flower and fruit drop in Alphonso mango. In one of the experiments identification of pollinizer varieties for Alphonso mango was undertaken. Hand pollination was done with mango varieties viz, Alphonso, Kesar, Ratna, Goamankur, Vellai Kolumban, Sindhu, Tomy Atkins, Keitt on fifty panicle for each Alphonso tree. The anthers of the above genotypes were collected in petri dishes in early morning and dusted on emasculated Alphonso Stigma. The pollinated panicle were covered by muslin cloth bags. The procedure suggested by Swamy *et al*. (1988) was used. Fruit retention was recorded.

For the control of recurring flowering in Alphonso mango, foliar spray of GA_3 50,100,150 and 200 ppm (single spray only) was given at 50% flowering, full bloom and peanut stage. Experiment was conducted in RBD with 4 replications. The observation on per cent recurring flowering, per cent fruit drop and final fruit retention per panicle in each treatment was recorded.

In order to evaluate whether fruit drop can be controlled by foliar spray of nutrient and growth regulators, NAA (10 and 20 ppm), triacontanol (5 and 10 ppm), urea (2%), KNO_3 (2%), micronutrient mixture (50 ppm) alone and in combination were sprayed at different concentrations at peanut stage and 10 days after first spray. The experiment was laid out in RBD with 3 replications. Observations on fruit set and yield were recorded.

RESULTS AND DISCUSSION

Compatibility of pollinizers **:** Significant variation in per cent fruit retention was evident in pooled mean of 3 years (Table 1). Cross combination Alphonso x Kesar (11.33%), Alphonso x Goamankur (12.00%), Alphonso x Tomy Atkins (15.66%) and Alphonso x Ratna (11.66%) increased the per cent fruit retention significantly over control, i.e. Alphonso x Alphonso (4.66%). This indicated that the pollens of other varieties improved fruit set in Alphonso mango. There was no fruit set in completely bagged panicle of Alphonso intended for self pollination. This was due to lack of access to pollinators (insects or hand pollination) and non availability of pollens of other varieties. Similar results were demonstrated by Singh (1996) in Dasheri mango and Gunjate *et al.* (1983) in Alphonso mango. Based on fruit set the best and effective pollinizer for Alphonso was Tomy Atkins followed by Goamankur, Ratna and Kesar. Among the other pollinizers Sindhu (7.66%) and Keitt (7.66%) and Vellaikolumban (5.33%) did not increase the fruit retention appreciably over Alphonso x Alphonso (4.66%). Thus sindhu and keitt proved poor pollinizer for Alphonso. These results suggested mixed planting of Alphonso with Goamankur, Kesar, Ratna, for improved fruit retention in Alphonso and at the same time providing yield of pollinizer.

The flowering time of pollinizers is the most important for synchrony with Alphonso. The study revealed that Kesar, Ratna and Goamankur have synchrony in flowering with Alphonso. Even though Tomy Atkin recorded highest fruit retention, it did not synchronize its flowering with Alphonso. Therefore, it can not be considered as pollinizer for Alphonso. The fruit quality of pollinizer is also an important character to be considered while selecting the pollinizer. The selected pollinizers, viz. Kesar, Ratna and Goamankur have equally acceptable fruit qualities as mixed planted pollinizer varieties (Table 2). Thus by evaluating fruit retention, synchrony in flowering and fruit quality, Kesar, Ratna and Goamankur could be considered as most compatible pollinizers for Alphonso.

Table 1. Effect of pollinizer varieties on fruit retention of Alphonso mango

Cross combination	Per cent fruit retention			Pooled Mean (3 yrs)	Flowering time of male parent
	1998-99	1999-2000	2000-2001		
Alphonso panicle caged (only bag)	0	0	0	0	-
Alphonso x Alphonso	4 (11.48)	4 (11.48)	6 (14.15)	4.66 (12.37)	Dec.
Alphonso x Kesar	8 (16.37)	14 (21.96)	12 (20.26)	11.33 (19.53)	Dec.-Jan.
Alphonso x Goamankur	10 (18.38)	13 (21.05)	13 (21.67)	12 (20.36)	Dec.-Jan.
Alphonso x Vellaikolumban	6 (14.15)	5 (12.81)	5 (12.80)	5.33 (13.25)	Dec.
Alphonso x Sindhu	8 (16.37)	5 (15.32)	5 (16.41)	7.66 (16.03)	Dec.-Jan.
Alphonso x Tomy Atkins	17 (24.29)	16 (23.56)	14 (21.96)	15.66 (23.27)	Jan.
Alphonso x Kiett	10 (18.42)	5 (12.81)	8 (16.35)	7.66 (15.86)	Jan.
Alphonso x Ratna	10 (18.42)	13 (21.12)	12 (20.23)	11.66 (19.93)	Dec-Jan.
SE±	0.87	0.91	0.75	1.54	
CD at 5%	2.59	2.63	2.25	4.61	

* Figures in parenthesis are the Arc sin values.

Table 2. Physico-chemical characteristics of selected pollinizer varieties

Character	Alphonso	Kesar	Goamankur	Ratna	Tomy Atkins
Fruit weight (g)	250	270	210	315	620
Fruit colour	Yellow	Yellow	Yellow	Yellow	Red
Pulp recovery (%)	73	74	73	74	78
T.S.S. (^{0}Brix)	19.0	21.0	15.8	23.0	15.1
Acidity (%)	0.34	0.29	0.25	0.27	0.23

Control of recurring flowering **:** It could be observed from the data (Table 3) that all the concentrations of GA_3 tested irrespective of application time reduced the intensity (0.92 to 5.08%) of recurring flowering significantly, except GA_3 50 ppm at peanut stage (6.52%) compared to control (16.33%). The fruit retention per panicle increased with GA_3 (50 ppm) at full bloom treatment (0.38) than control (0.24) (Table 4). The problem of recurring flowering in mango results in severe fruit drop at various stages. There are evidences that gibberellin play an inhibitory role in mango flowering (Kacharu *et al*. 1971, Tomar 1984).

Table 3. Control of recurring flowering in Alphonso mango with GA_3 spray

Treatment	Intensity of recurring flowering (%)				Mean
	1996- 97	1997-98	1998-99	1999-2000	
Control	17.00 (24.16)	0	17.50 (24.70)	14.50 (23.28)	16.33 (24.04)
GA_3 50ppm at 50% flowering	4.50 (12.00)	0	2.50 (6.46)	3.13 (8.78)	3.38 (9.08)
GA_3 50ppm at full bloom	3.25 (9.56)	0	3.00 (8.61)	4.97 (12.83)	3.74 (10.33)
GA_3 50ppm at peanut stage	9.25 (17.62)	0	4.50 (11.45)	5.82 (13.90)	6.52 (14.32)
GA_3 100ppm at 50% flowering	2.00 (7.78)	0	0.00 (0.00)	1.75 (5.38)	1.25 (4.39)
GA_3 100ppm at full bloom	4.00 (9.79)	0	0.00 (0.00)	2.00 (5.72)	2.00 (5.17)
GA_3 100ppm at peanut stage	6.25 (14.31)	0	6.25 (14.09)	2.75 (8.15)	5.08 (12.18)
GA_3 150ppm at 50% flowering	1.25 (6.33)	0	0.00 (0.00)	1.75 (6.56)	1.00 (4.29)
GA_3 150ppm at full bloom	1.75 (7.39)	0	0.00 (0.00)	1.00 (4.06)	0.92 (3.81)
GA_3 150ppm at peanut stage	2.75 (9.44)	0	3.00 (8.61)	1.50 (4.99)	2.42 (7.68)
GA_3 200ppm at 50% flowering	2.00 (7.99)	0	0.00 (0.00)	1.00 (4.06)	1.00 (4.01)
GA_3 200ppm at full bloom	2.50 (8.84)	0	0.00 (0.00)	0.75 (3.47)	1.08 (4.10)
GA_3 200ppm at peanut stage	1.75 (7.39)	0	0.00 (0.00)	1.00 (4.06)	0.92 (3.81)
SE±	1.34	-	1.85	2.36	3.79
CD at 5%	3.85	-	5.37	6.76	10.50

* Figures in parenthesis are the Arc sin values.

Table 4. Per cent fruit drop of various sizes from main panicles due to recurrent flowering and control due to GA_3 application (Av. of 100 panicles)

Size	Initial fruit set/panicle	No. of fruit droped/panicle	Fruit retention per panicle
	(A) Without GA_3 application		
Peanut	3.5	3.0	
Marble	0.5	0.2	0.24
Egg	0.3	0	
	(B) With GA_3 (50 ppm at full bloom) application		
Peanut	2.8	2.1	
Marble	0.7	0.1	0.38
Egg	0.6	0	

Table 5. Effect of nutrient and growth regulators on flowering, panicle length and fruit set per panicle in Alphonso mango

Treatments	Per cent flowering				Panicle length (cm)				Fruit set/panicle			
	1999-2000	2000-01	2001-02	Pooled mean	1999-2000	2000-01	2001-02	Pooled mean	1999-2000	2000-01	2001-02	Pooled mean
NAA 10ppm	91.66 (80.00)	85.66 (69.24)	80.00 (63.85)	85.77 (71.03)	26.66	16.63	22.48	21.92	9.66	8.00	4.66	7.44
NAA 20ppm	91.66 (80.00)	85.60 (69.24)	81.66 (64.87)	86.31 (71.35)	26.33	16.30	18.08	20.23	10.33	7.00	5.07	7.46
Triacontanol 5 ppm	100.00 (90.00)	76.60 (61.92)	71.66 (59.54)	82.75 (70.48)	26.00	18.53	18.74	21.09	8.33	8.00	4.70	7.01
Triacontanol 10 ppm	95.00 (82.40)	83.30 (66.84)	63.33 (52.88)	80.54 (67.37)	26.33	20.20	16.02	20.85	9.00	7.33	4.67	7.00
Urea 2%	85.00 (71.76)	81.60 (66.47)	73.33 (59.33)	79.97 (65.85)	25.66	16.63	18.66	20.31	9.33	5.00	5.33	6.55
KNO_3 2%	100.00 (90.00)	83.30 (66.84)	88.33 (71.38)	90.54 (76.07)	26.66	17.63	19.96	21.41	9.66	8.33	5.17	7.72
Micronutrient 50 ppm	91.66 (76.26)	75.00 (60.77)	68.33 (55.82)	78.33 (64.28)	25.66	16.63	18.71	20.33	8.33	6.33	4.67	6.44
Urea 2% + NAA 20 ppm + Micronutrient 50 ppm	95.00 (82.40)	80.00 (63.55)	80.00 (63.74)	85.00 (69.89)	25.33	18.63	18.98	20.98	11.00	8.67	5.67	8.44
Urea 2% + Tria 5 ppm + Micronutrient 50 ppm	81.66 (65.00)	83.30 67.45)	80.00 (63.55)	81.65 (65.33)	25.00	16.30	19.88	20.39	10.66	8.33	5.33	8.09
Control	81.66 (68.93)	78.30 (63.18)	76.66 (61.92)	78.87 (64.67)	28.33	17.50	18.96	21.59	7.66	4.67	4.13	5.48
SE±	7.990	5.534	4.792	3.57	0.81	1.23	1.822	0.781	0.56	1.20	0.403	0.468
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	1.67	3.59	1.10	1.297

Table 6. Effect of nutrient and growth regulators on no. of fruits per tree and fruit yield in Alphonso mango

Treatments	No. of fruits/tree					Fruit yield kg/tree				
	1998-99	1999-2000	2000-01	2001-02	Pooled mean	1998-99	1999-2000	2000-01	2001-02	Pooled mean
NAA 10ppm	206.66	214.0	72.00	119.66	153.08	48.55	53.80	17.35	30.90	37.65
NAA 20ppm	209.33	156.0	61.00	148.33	143.66	49.77	37.00	14.85	37.80	34.86
Triacontanol 5 ppm	174.00	243.33	72.66	128.00	154.49	41.20	61.25	17.70	32.17	38.08
Triacontanol 10 ppm	180.00	232.0	76.66	111.00	149.92	41.56	58.00	18.65	28.90	36.78
Urea 2%	176.33	128.66	62.00	154.66	130.39	41.20	31.50	15.10	37.20	31.25
KNO_3 2%	171.66	236.33	64.33	152.00	156.08	40.40	59.08	15.63	39.30	38.60
Micronutrient 50 ppm	158.33	138.33	52.66	132.00	120.33	37.76	34.58	12.82	29.03	28.55
Urea 2% + NAA 20 ppm + Micronutrient 50 ppm	228.00	249.00	85.00	207.00	192.25	53.38	62.25	20.48	51.87	46.99
Urea 2% + Tria 5 ppm + Micronutrient 50 ppm	220.00	215.00	89.33	188.33	178.16	51.98	53.08	21.46	47.10	43.41
Control	137.33	111.67	46.00	98.00	98.25	32.41	27.92	11.25	28.0	28.89
SE±	15.60	31.49	7.237	24.84	12.59	3.52	7.98	1.73	5.15	2.97
CD at 5%	46.34	93.52	21.492	68.00	34.89	10.47	23.69	5.13	15.29	8.22

***Nutrient and PGR's for fruit retention* :** The fruit set/panicle significantly increased by nutrient and PGR's over control (Table 5 and 6). Combined use of urea (2%) + NAA (20 ppm) + micronutrient (50 ppm) was most effective for increasing fruit set per panicle (8.44) followed by urea (2%) + triacontanol (5 ppm) + micronutrient (50 ppm) (8.09) compared to control (5.48). Similarly, urea + NAA + micronutrient recorded significantly higher fruit yield (46.99 kg/tree) followed by urea + triacontanol + micronutrient (43.41 kg/tree), KNO_3 2% (38.60 kg/tree), tiacontanol 5 ppm (38.08 kg/tree) and NAA 10 ppm (37.65 kg/tree) over control (28.89 kg/tree). Potassium application increased fruit retention and yield in Tomy Atkins (Oosthuyse, 1993) and also known to improve quality of fruits. Therefore judicious combination of nutrient, PGR and micronutrient increased the fruit set and yield in Alphonso mango.

From the results of the above three studies it was clearly brought out that for sustainable production of Alphonso mango mixed planting of superior pollinizers (viz. Goamankur, Kesar, Ratna) in Alphonso gardens, arresting the recurrent flowering by GA_3 (50 ppm) and judicious combination of nutrients PGR and micronutrients could be suggested to alleviate low yield in Alphonso mango.

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