

INFLUENCE OF FULL BLOOM SPRAY APPLICATION OF PUTRESCINE, KNO₃ AND CPPU ON NUMBER OF FRUITS, FRUIT SET, FRUIT DROP AND FRUIT RETENTION OF ALPHONSO MANGOES

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ABSTRACT

This study was carried out during 1997 and 1998 seasons. Alphonso mango trees of 20 year old were used. The experiment was conducted in an orchard located in Giza governorate. Panicles were sprayed at full bloom with putrescine at 150, 300 or 450 PPM, KNO₃ at 0.5, 1 or 2% and CPPU at 5, 10 or 15 PPM. The highest fruit number per panicle was recorded with putrescine followed by CPPU and a direct relationship was detected in this respect with putrescine. The highest fruit set was scored with both of putrescine and CPPU. Whilst, the lowest one was detected with KNO₃. A direct relationship was found between putrescine concentration and fruit set, reversibly, fruit set decreased with the increase in CPPU and KNO₃ concentration. Fruit drop decreased with KNO₃ while it increased with putrescine and CPPU. Both of KNO₃ and putrescine increased fruit retention at harvest with a direct relationship with the used concentrations. The highest values in this regard were recorded with 2% KNO₃ and 450 PPM putrescine.

Key words: Mango, *Mangifera Indica*, Fruit Set, Putrescine, CPPU, KNO₃.

INTRODUCTION

The mango (*mangifera indica* L.) belongs to the family Anacardiaceae. Compared to citrus and bananas, mangoes, is the third most important crop in the tropics. Alphonso mango cv. is considered one of the most promising cvs for export. The tree is moderately large, with broadly rounded, dense canopy; the fruit is yellow, ovate-oblique, averaging 6 cm long by 5 cm broad, the skin is thin; the flesh is firm to soft, low in fiber, yellow in colour, sweet with characteristic aroma and has very pleasant taste preferred by many who knows this cultivar. Low productivity of mango due to very low fruit set and high fruit drop are considered big problems concerning mango production. Various attempts have been made to increase fruit set and decrease fruit drop. The use of chemical substances as foliar application proved to be effective in reducing fruit drop and increasing yield as, Zora and Singh (1995) found that putrescine increased fruit set and fruit retention in mango cv. Dashehari and Langra when applied at full bloom. Oosthuysen (1995) reported that CPPU enhanced fruit retention in mango cvs. Tommy Atkins and Heidi. Moreover Oosthuysen (1993) demonstrated that foliar spray application of KNO₃ at 4% increased fruit retention and yield of mango cv. Tommy Atkins.

The present study was carried out to investigate the effect of full bloom spray application of putrescine, potassium nitrate or sifofex (CPPU) on number of fruit, fruit set, fruit drop and fruit retention

MATERIALS AND METHODS

This study was conducted throughout 1997 and 1998 seasons on Alphonso mango (*Mangifera Indica* L.) grown on sandy soil at Giza Governorate. The selected trees, in the two seasons of the study, were in the on year and about 20 years old, grafted on seedling rootstocks and planted at 6 meter a part , similar in vigor, size and subjected to the same cultural practices. The trees under investigation were planted among several varieties to ensure an adequate pollination and fertilization. The farm contained Alphonso, Hindy khassa, Zebda, Mabrouka and Balady cvs.

The panicles were sprayed at full bloom (90% blooming) with Putrescine (tetra methylene-diamine (C₄ H₁₂ N₂-2HCl)) at 150, 300 and 450 PPM, Potassium nitrate (KNO₃) at 0.5%, 1% and 2%, or CPPU {(N-(2-chloro-4-pyridyl-N-phenyl-urea) C₁₂H₁₀ ClNO₃, (Sitofex)} at 5, 10 and 15 PPM.

The experiment was laid out in a complete randomized design with three single trees as replicates for each treatment. Twenty panicles per replicate (distributed among the four directions) were tagged. In the second season, another group of trees in the same farm and in the on year were chosen for study. The following parameters were studied: -

Number of fruits per panicle:

Number of fruit per panicle was counted at couple of weeks intervals from fruit set up to harvesting.

Fruit set:

Thirty panicles of different sizes were collected for total perfect flowers calculation. Fruit set percentage was calculated at couple of week's intervals from the petal fall stage up to harvesting according to the following equation:

$$\text{Fruit set percentage} = \frac{\text{No. of fruit set per panicle}}{\text{No. of total perfect flowers per panicle}} \times 100$$

Fruit drop:

Fruit drop percentage was calculated at two weeks intervals proportionally to those counted at set.

Fruit retention:

Fruit retention percentage was determined at harvest as follows:

$$\text{Fruit retention percentage} = \frac{\text{No. of mature fruits per panicle}}{\text{No. of setting fruits per panicle}} \times 100$$

Design of experiment and statistical analysis:

A complete randomize design was used, each treatment was replicated three times with one tree for each replicate. Data were tabulated and statistically analyzed according to (Snedecor and Cochran, 1980). Means were compared by L.S.D at 5% .

RESULTS AND DISCUSSION

Number of fruits per panicle: -

Data in Tables (1 & 2) show that Putrescine and CPPU increased significantly fruit number per panicle. These results are in agreement with the findings of Zora *et al.* (1995) and Oosthuysen (1995) they concluded that Putrescine and CPPU increased yield of mango cvs. Dashehari, Langra, Tommy Atkins and Heidi.

Putrescine proved superior in this regard, followed by CPPU. On the other hand, KNO_3 decreased this number, there is an adverse relationship between the used concentration of KNO_3 and the number of fruits attained per panicle. The findings of Oosthuysen (1996) with mango cv. Kent disagreed with the obtained results. Contrarily, number of fruit per panicle increased as Putrescine concentration increased. This result came in line with the findings of Costa and Bagni (1981), (1983); Eddo *et al.* (1985) and Rugini *et al.* (1986).

Data cleared that the lowest concentration of CPPU (5 PPM) resulted in the highest number, Conversely the lowest was recorded with the highest concentration (15 PPM) these results agreed with those of Greene (1989) on apple, moreover Mataa *et al.* (1997) supported these results in their trails on mandarin.

Regarding KNO_3 effect on fruit number per panicle, data indicated that number of fruit per panicle was reduced with the higher concentration of KNO_3 . The findings of Sharma *et al.* (1990) with mango cv. Dashehari and Oosthuysen (1993) with mango cv. Tommy Atkins, are in contrary of these results.

It is worth mentioning that, number of fruits per panicle decreased sharply and continuously after fruit set and up to maturity, nevertheless the striking decrease in fruit number occurred during the period of 15 to 30 day from set. The rate of decrease was significantly high throughout the 60 days from set, as during this period this number decreased from (23.37 and 21.42) to (2.11 and 1.96) in both seasons respectively, thereafter this rate was low and insignificant. These findings are in accordance with that obtained by Singh (1987) and Subhadrdaband *et al.* (1996).

Fruit set

Data in Tables (3 & 4) indicate that Putrescine and CPPU treatments significantly increased fruit set percentage. However, KNO_3 decreased it in both seasons. These findings are in harmony with those reported by Oosthuysen (1993) and Zora *et al.* (1995).

The highest percentage of fruit set was recorded with Putrescine in the first season, while, in the second one it was recorded with CPPU. Differences between them were significant only in the first season.

1+2

3+4

Fruit set percentage increased as the concentration of Putrescine increased, contrary it decreased with increasing the concentration of both KNO_3 and CPPU. These findings are in accordance with that obtained by Nunez (1986) and Zora *et al.* (1995) on mango Dashehari and Langra.

Fruit set decreased significantly 60 days from setting, however an insignificant continuous decrease was noted afterwards till maturity, it could be noticed from the data that fruit set decreased by 94.77% and 93.93% by age in both seasons respectively. The findings of Singh *et al.* (1987) and Subhadrabandhu *et al.* (1996) confirmed these results.

Fruit drop:

It is evident from Tables (5&6) that spraying panicles of Alphonso mango at full bloom with KNO_3 reduced significantly fruit drop percentage in the two seasons of study. These results were supported by those obtained by Sharma *et al.* (1990).

Regarding the other tested treatments, data indicated that no significant difference was noted between the control and CPPU in the first season while it was significant in the second one. Concerning putrescine this difference was significant in both seasons. The highest percentage of fruit drop was recorded with Putrescine, followed by control and CPPU. The finding of Tiburico *et al.* (1993) and Paksasorn *et al.* (1995) disagree with the obtained results.

It is also indicated from the results, that differences between the three concentrations within CPPU and Putrescine were insignificant during the two seasons of study. These results are supported by Antognozzi *et al.* (1993) and Joublan *et al.* (1995) on kiwi fruit and grape.

It is obvious that increasing the concentration of KNO_3 significantly reduced the percentage of fruit drop. The results of Sharma *et al.* (1990) are in agreement with these findings. Data revealed a significant increase in fruit drop during the 75 days from setting, thereafter it increased insignificantly up to maturity. These results were supported by the results obtained by Singh (1978).

Fruit retention:

Data in Tables (7 & 8) revealed that spraying panicles of Alphonso mango with KNO_3 at full bloom, resulted in the highest fruit retention percentage, data also indicated that, KNO_3 at 2% gave better results than 1% or 0.5%. In this regard; Putrescine came after KNO_3 , as the recorded retention percentages were (5.07 and 7.41%) the two seasons consequently. Using Putrescine at 450 PPM was more effective than 300 or 150 PPM. These results are in agreement with those reported by Oosthuysse (1996) as spraying KNO_3 at 2% increased fruit retention of mango cv. Kent. Zora *et al.* (1995) demonstrated that spraying Putrescine at full bloom resulted in increasing the final fruit retention of mango cvs. Dashehari and Langra.

5+6

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7+8

CPPU significantly decreased fruit retention than the other treatments, as a reverse relationship between the concentration of CPPU and percentage of fruit retention was observed. As spraying CPPU at 5 PPM maximized this percentage, Meanwhile this percentage was decreased with the concentrations 10 or 15 PPM. The control showed the lowest percentage in this regard (3.71 and 2.75) in the two seasons respectively without significant difference with the CPPU treatment. The findings of Oosthuysse (1993 and 1995) confirmed these results.

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تأثير الرش بالببتروسين ، نترات البوتاسيوم والسيتوفكس عند التزهير الكامل على عدد الثمار، نسبة العقد ، نسبة التساقط ونسبة الثمار المتبقية للمانجو الفونس. ماجدة محمود خطاب، جمال محمد حسيب ، أيمن السيد شعبان. قسم الفاكهة. كلية الزراعة - جامعة القاهرة

أجريت هذه الدراسة خلال موسمي 1997، 1998 على أشجار مانجو صنف الفونس، أعمارها 20 عام متجانسة في النمو ونامية في مزرعة خاصة تحت ظروف محافظة الجيزة. تم الرش عند التزهير الكامل بكل من الببتروسين بتركيز 150، 300، 450 جزء في المليون، نترات البوتاسيوم بتركيز 5، 1، 2% والسيتوفكس بتركيز 5، 10، 15 جزء في المليون. معاملات الببتروسين سجلت أعلى عدد من الثمار لكل نورة يليها السيتوفكس ونترات البوتاسيوم. وجدت علاقة عكسية بين عدد الثمار وتركيز كل من نترات البوتاسيوم والسيتوفكس. بينما أظهرت معاملات الببتروسين علاقة طردية بين التركيز وعدد الثمار. معاملات الببتروسين والسيتوفكس سجلت نسبة عقد أعلى من الكنترول بينما انخفضت هذه النسبة مع نترات البوتاسيوم. أيضاً وجدت علاقة طردية بين تركيز الببتروسين ونسبة العقد في حين قلت نسبة العقد بزيادة تركيز السيتوفكس ونترات البوتاسيوم. انخفضت نسبة التساقط مع نترات البوتاسيوم بينما زادت هذه النسبة مع الببتروسين والسيتوفكس. نترات البوتاسيوم والببتروسين أظهرت زيادة واضحة في نسبة الثمار المتبقية عند الحصاد وكانت هناك علاقة طردية بين التركيز وهذه النسبة، حيث سجلت أعلى قيم مع تركيز 2% نترات بوتاسيوم، 450 جزء في المليون من الببتروسين.

Table (1): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on number of fruits/panicle (season 1997).

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150 PPM	300 PPM	450 PPM	.50 %	1 %	2 %	5 PPM	10PPM	15PPM		
15	27.43	31.70	38.80	16.80	11.66	8.33	30.53	24.70	23.13	20.66	23.37
30	4.20	4.66	5.26	8.10	7.40	6.33	6.46	5.16	4.70	3.93	5.62
45	3.00	3.70	4.16	3.40	3.00	2.93	4.33	3.53	3.26	3.00	3.43
60	1.93	1.93	2.50	2.23	1.60	1.46	2.73	2.53	2.20	2.03	2.11
75	1.60	1.80	2.20	1.96	1.50	1.30	2.10	1.53	1.33	1.00	1.63
90	1.53	1.70	2.13	1.90	1.40	1.00	1.63	1.30	1.232	0.96	1.47
105	1.43	1.66	2.06	1.73	1.33	0.96	1.43	1.10	1.00	0.83	1.35
120	1.36	1.60	2.00	1.66	1.26	0.93	1.23	0.90	0.83	0.76	1.25
MEAN (A)	5.31	6.09	7.38	4.72	3.64	2.90	6.30	5.09	4.71	1.147	
MEAN (B)	6.24			3.75			5.36			4.14	

LSD at 5% for : Concentrations (A)= 0.7895 Substances (B)= 0.4558 Age of fruit (C)= 0.6446 A x B x C = 2.233

Table (2): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on number of fruits/panicle (season 1998).

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150 PPM	300 PPM	450 PPM	.50 %	1 %	2 %	5 PPM	10PPM	15PPM		
15	23.50	23.80	27.13	16.06	11.10	8.40	33.60	26.06	22.30	22.30	21.42
30	4.60	5.30	6.36	8.70	4.20	4.40	6.30	6.50	5.20	3.30	5.51
45	3.30	3.90	4.16	3.86	2.40	2.80	4.30	3.80	4.10	1.70	3.43
60	1.70	2.20	2.80	2.60	1.90	1.70	2.20	1.60	1.60	1.30	1.96
75	1.50	1.90	2.30	1.80	1.60	1.33	1.90	1.36	.096	1.00	1.56
90	1.46	1.96	2.30	1.66	1.56	1.30	1.86	1.33	0.83	0.73	1.48
105	1.40	1.83	2.23	1.60	1.46	1.26	1.76	1.03	0.76	0.66	1.39
120	1.36	1.80	2.16	1.50	1.40	1.16	1.73	0.90	0.70	.060	1.33
MEAN (A)	4.85	5.32	6.62	4.72	3.20	2.79	6.70	5.32	4.55	3.94	
MEAN (B)	5.59			3.57			5.52			3.94	

LSD at 5% for : Concentrations (A)= 1.511 Substances (B) = 0.8725 Age of fruit (C) = 1.234 A x B x C= 4.274

Table (3): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit set percentage (season 1997)

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150 PPM	300 PPM	450 PPM	.50 %	1 %	2 %	5 PPM	10 PPM	15 PPM		
15	9.88	11.42	14.0	6.05	4.20	3.00	11.0	8.89	8.33	7.44	8.42
30	1.50	1.62	1.89	2.91	2.66	2.28	2.32	1.86	1.68	1.41	2.01
45	1.08	1.20	1.50	1.22	1.08	1.05	1.44	1.26	1.17	1.08	1.20
60	0.69	0.69	0.90	0.80	0.63	0.52	0.98	0.90	0.69	0.73	0.76
75	0.57	0.69	0.79	0.70	0.53	0.48	0.75	0.54	0.47	0.36	0.58
90	0.55	0.61	0.76	0.68	0.50	0.36	0.58	0.46	0.44	0.34	0.52
105	0.51	0.60	0.74	0.62	0.47	0.34	0.51	0.39	0.35	0.29	0.48
120	0.48	0.57	0.71	0.59	0.45	0.33	0.44	0.32	0.29	0.27	0.44
MEAN(A)	1.90	2.17	2.65	1.69	1.31	1.04	2.25	1.82	1.69	1.49	
MEAN(B)		2.24			1.34			1.92		1.49	

LSD at 5% for : Concentrations (A) = 0.2697 Substances (B)= 0.1557 Age of fruit (C) = 0.2202 A x B x C= 0.7629

Table (4): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit set percentage (season 1998).

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150 PPM	300PPM	450 PPM	.50 %	1 %	2 %	5 PPM	10 PPM	15 PPM		
15	8.70	8.81	10.2	5.93	4.09	3.10	12.42	9.62	8.24	8.26	7.91
30	1.69	1.95	2.44	3.21	1.55	1.62	2.34	2.42	1.93	1.23	2.03
45	1.22	1.45	1.53	1.425	0.89	1.02	1.59	1.42	1.52	0.62	1.26
60	0.62	0.83	1.05	0.96	0.72	0.64	0.80	0.59	0.58	0.47	0.72
75	0.55	0.70	0.85	0.66	0.61	0.48	0.69	0.50	0.35	0.36	0.57
90	0.53	0.68	0.84	0.61	0.57	0.47	0.68	0.48	0.30	0.26	0.54
105	0.51	0.67	0.81	0.58	0.53	0.46	0.64	0.37	0.28	0.24	0.50
120	0.50	0.66	0.79	0.55	0.51	0.42	0.63	0.32	0.25	0.22	0.48
MEAN(A)	1.79	1.96	2.29	1.74	1.18	1.02	2.47	1.96	1.68	1.45	
MEAN(B)		2.01			1.31			2.03		1.45	

LSD at 5% for : Concentrations (A) = 0.5580 Substances (B) = 0.3222 Age of fruit (C) = 0.4557 A x B x C = 1.579

Table (5): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit drop percentage (season 1997).

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150PPM	300PPM	450PPM	.50 %	1 %	2 %	5 PPM	10PPM	15PPM		
30	86.47	85.26	84.37	50.36	36.51	23.24	78.78	79.22	79.73	80.86	68.48
45	89.56	89.41	88.97	78.84	74.11	64.81	85.78	85.65	85.91	85.45	82.84
60	93.51	94.01	93.04	86.68	86.15	82.12	91.04	89.75	90.48	90.13	89.69
75	94.24	94.41	94.22	88.08	87.04	83.79	93.12	93.74	94.21	95.15	91.79
90	94.40	94.71	94.45	88.49	87.95	87.96	94.63	94.67	94.68	95.31	92.72
105	94.54	94.81	94.79	89.48	88.53	88.37	95.29	95.52	95.67	95.96	93.29
120	94.67	95.01	95.02	89.92	89.14	88.75	95.96	96.34	96.39	96.28	93.74
MEAN (A)	92.48	92.51	92.12	81.69	78.49	74.14	90.65	90.69	91.01	91.30	
MEAN (B)	92.37			78.10			90.78			91.30	

LSD at 5% for : Concentrations (A)= 1.662 Substances (B) = 0.9593 Age of fruit (C) = 1.269 A x B x C= 4.396

Table (6): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit drop percentage (season 1998).

Age of Fruits (days)	Substances									CONTROL	MEAN (C)
	PUTRESCINE			POTASSIUM NITRATE			CPPU				
	150 PPM	300 PPM	450 PPM	.50 %	1 %	2 %	5 PPM	10 PPM	15 PPM		
30	75.02	76.92	80.10	45.26	62.18	46.25	78.49	74.66	74.99	85.64	69.95
45	84.54	82.75	85.09	74.92	77.76	66.41	85.96	85.20	80.20	92.57	81.54
60	89.09	90.40	92.28	83.07	82.00	78.65	92.54	93.68	92.29	94.26	88.82
75	91.16	91.51	93.27	88.66	84.66	84.19	93.35	94.60	95.24	95.45	91.20
90	91.30	91.75	93.43	89.46	85.61	84.60	93.41	94.72	95.85	96.70	91.68
105	91.58	91.89	93.74	89.90	86.54	84.95	93.67	95.94	96.21	96.97	92.13
120	91.82	92.00	93.90	90.59	87.16	86.07	93.81	96.49	96.57	97.23	92.56
MEAN (A)	87.78	88.17	90.25	80.26	80.84	75.87	90.17	90.75	90.19	94.11	
MEAN (B)	88.73			78.99			90.37			94.11	

LSD at 5% for : Concentrations (A) = 2.379 Substances (B) = 1.374 Age of fruit (C) = 1.817 A x B x C= 6.295

Table (7): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit retention percentage (season 1997).

Substances									
Putrescine			KNO ₃			CPPU			Control
150 ppm	300 ppm	450 ppm	0.5%	1%	2%	5 ppm	10 ppm	15 ppm	
4.96bcd	4.97bc	5.30b	10.07a	10.85a	11.25a	4.03cde	3.65e	3.59e	3.71de
5.07 B			10.72 A			3.75 C			3.71 C

Values followed by the same letter in row are not statistically different at 5 % level

Table (8): Effect of spraying putrescine, KNO₃ and CPPU at full bloom on fruit retention percentage (season 1998).

Substances									
Putrescine			KNO ₃			CPPU			control
150 ppm	300 ppm	450 ppm	0.5%	1%	2%	5 ppm	10 ppm	15 ppm	
6.09 cd	7.99 c	8.16 c	9.39 bc	12.83 ab	13.92 a	6.17 cd	3.49 d	3.42 d	2.75 d
7.41 B			12.04 A			4.36 C			2.75 C

Values followed by the same letter in row are not statistically different at 5 % level