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EFFECT OF POLYAMINES, GIBBERELLINS AND OTHER GROWTH REGULATORS ON THE FRUIT-SET OF AVOCADO

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Abstract

The polyamines Spermidine at 10^{-4}M, Putrescine at 10^{-3}M and 10^{-4}M, Spermine at 10^{-4}M and aminoxyacetic acid at 500 ppm were applied, at full bloom to whole trees or branches of Fuerte, in a young six year-old avocado orchard in the area of Chania Crete to increase fruit-set. In other trials Fuerte trees were sprayed with GA_3 at 50, 100, 200, 400 ppm and 100 ppm applied four times at regular 10-day intervals. Further a mixture of 200 ppm GA_3 25 ppm BAP (benzylaminopurine) and 10 ppm NAA (naphthaleneacetic acid) was applied to young trees of the cvs Hass and Fuerte.

As it was found gibberellic acid (50-400) ppm applied on Fuerte at full bloom increased parthenocarpic fruits 40 to 80 times while four repeated, at weekly intervals, sprays of 100 ppm of gibberellic acid increased parthenocarpic fruits more than 200 times. A mixture of 25 ppm BAP plus 10 ppm of NAA and 200 ppm GA sprayed at bloom induced the setting of parthenocarpic fruits in both Hass and Fuerte. Sper- midine or Spermine at 10^{-4}M or 10^{-3}M of Putrescine sprayed at bloom increased fruit- set in Fuerte.

Additional index words: hormones, fruit drop, parthenocarpic fruits

1. Introduction

Avocado (*Persea americana* Mill) is an established crop in many parts of the World but yields are often unreliable. Gibberellins, benzylaminopurine, napthaleneacetic acid, polyarnines and other growth regulators are reported to increase fruit set in apples (Longhlin *et al.*, 1984), olives (Androulakis 1987, Rugini *et al,* 1986), pears (Crisosto et al.1986), grapes (Shaltuunt et al.1986) and other crops. Stewart *et al.* (1951) reported that a 5% emulsion of kerosene containing either 25ppm of the isopropyl ester of 2,4-D or 2ppm of butyl ester of 2,4,5-T did not affect the yield of normal fruits of Fuerte but 2,4-D when applied in April, increased the number

of seedless fruits. Razeto *et al.*, (1983) found that one application of GA_3 at 50ppm on Fuerte at the end of blooming increased parthenocarpic fruits 100 times while in cv. Negra de la Cruz sprayed at the beginning of bloom, the seedless fruits increased as up to 14 times.

Avocado is a recent import in several areas of southern Greece and in Crete. All imported cultivars with the exception of Hass, however, suffer from less than adequate productivity. Thus the present work was carried out in order to study the effect of putrecine, spermidine and spermine and of GA and other growth regulators on the fruit set of the avocado.

2. Material and methods

In order to evaluate the effect of polyamines (spermidine spermine purtescine), aminoxyacetic acid, gibberellin and of a triple hormone mixture (NAA, BAP, and GA_3) on the fruit-set of avocado, three experiments were carried out on young 6 years old avocado orchards in the villages Alikianou and Nerocourou of the district of Chania, Crete. The first experiment comprised sprays with the polyamines spermidine, spermine at 10^{-4}M, putrescine at 10^{-4} and 10^{-3} *M* (prepared in a 0.01M buffer of tris- (hydroxymethyl) amino methane adjusted to pH 7.1), Aminoxyacetic acid (AOA) at 500 ppm plus water sprayed and untreated controls.

The second experiment comprised four levels of GA_3 (50, 100, 200 and 400 ppm) plus water sprayed and untreated controls. The treatments were randomly allocated on tagged branches bearing more than one hundred inflorescences, of six uniform young trees of Fuerte on the 6th of April, using a small, hand-held sprayer. Besides an additional (seventh) treatment consisting of repeated four times (6, 15 and 29 of April and on 6th of May) application of 100 ppm GA_3 (on the same branches) was included. In another (third) experiment whole Fuerte and Hass trees were treated, at full bloom (6th of April) with a triple hormone mixture comprising 200 ppm GA_3 25 ppm BAP (benzylaminopurite), 10 ppm NAA (naphthalenacetic: acid) and giberellic acid at 200 ppm. Water sprayed controls were also included.

3. Results and discusion

The first counts (fruits per 100 inflorescences) on the branches of Fuerte treated with polyamines and aminoxyacetic acid (AOA) were inconsistent and no clear conclusion can be drawn about the effect of these treatments on initial fruit set. (Table 1). The counts of fruits, retained to the end of growing season, were more consistent.

Table 1. Number of fruits per 100 inflorescences in trees of Fuerte , treated with different concentations of spermidine, spermine, putrescine and aminoxyacetic acid or sprayed with water controls

Treatment	DATES						
	24May	3 June	14June	28 June	28 July	31 Aug	5 Oct
Spermidine 10^{-4}M	36.18	14.72	12.30	11.92	9.02	805	7.82
Spermine 10^{-4} M	52.62	13.30	9.50	9.07	8.65	7.56	7.56
Putrescince 10^{-3} M	53.18	15.29	12.45	10.18	9.71	802	8.02
Putrescince 10^{-4}M	39.49	5.41	4.67	5.8	3.95	3.82	3.82
A.O.A. 500 ppm	15.98	7.60	4.80	4.46	2.81	2.81	2.81
Water sprayed control	50.73	9.19	7.07	6.97	5.25	4.25	4.21
Untreated control	29.11	4.91	4.91	4.60	4.30	4.30	4.30

Thus with the exception of the lower concentration (10^{-4} M) of putrescine, polyarnines increased (final) fruit-set by 77.9 to 88.7% whereas aminoxyacetic acid showed a definite

thinning action (Table 1, count on 5 Oct.). Higher fruit-set rates by polyarnine sprays were also obtained in olives (Rugini *et al.* 1984), apple (Costa *et al.*, 1984) and in pear (Crisosto *et al.* 1984).

In the second experiment, initially, a sizable number of, mostly parthenocarpic fruits were set in all the treatments including the controls, the application of GA_3, however, greatly enhanced the setting of parthenocarpic fruits. As shown in Table 2a and 2b GA_3 applied at full bloom, increased 40 to 80 times the number of parthenocarpic: fruits of the Fuerte while it did not affect the number of normal fruits.

Table 2. Total number (a), and number of parthenocarpic fruits (b) fruits per 100 inlorescences

GA_3 (ppm)	DATES								MEAN
	19/5	1/6	10/6	20/6	12/7	4/8	5/9	4/10	
a. Total number of fruits									
0	53.60	3.96	1.46	0.99	0.99	0.71	0.71	0.71	7.89
50	29.21	22.68	10.59	6.81	6.81	6.73	6.73	5.40	11.87
100	53.89	51.46	29.27	13.57	8.90	7.89	7.36	5.86	22.28
200	104.48	105.28	45.98	13.98	11.23	10.56	10.57	9.70	38.97
400	84.85	118.87	73.68	23.52	13.51	12.96	12.71	11.22	43.92
4x100	135.54	192.36	136.09	53.26	31.36	31.22	30.52	29.37	79.97
Mean	76.93	82.44	49.51	18.69	13.99	11.68	11.43	10.38	34.15
b.Parthenocarpic fruits									
0				0.85	0.15	0.15	0.14	0.14	0.28
50				6.65	6.65	6.56	6.56	5.23	6.33
100				13.39	8.72	7.71	7.26	5.67	8.56
200				12.75	11.13	10.47	10.47	9.60	10.88
400				23.52	13.51	12.96	12.71	11.22	14.78
4x100				53.26	31.36	31.22	30.52	29.37	35.15
Mean				18.40	11.92	11.51	11.28	10.21	12.66

Similar results were reported by Stewart and Hield (1951) after spraying avocados with 25 ppm of 2,4 D in April while Razeto and Longueira (1983) reported that a single application of 50 ppm of GA_3 on the cvs Fuerte and Negra della Cruz resulted in 100 and 14 times more parthenocarpic fruits than in the control respectively. The concentration of the growth regulators and the timing of the sprays seem to be critical. The mixture of hormones (25 ppm BAP plus 10 ppm of NAA and 200 ppm GA_3) applied at full bloom to whole Fuerte and Hass trees (third experiment) induced the setting of parthenocarpic fruits in both (Table 3). The counts of fruits well after the intensive early fruit drop (28^{th} of September), i.e. when normal and parthenocarpic fruits were well developed, showed that parthenocarpic increased nearly 100 times in Fuerte. Besides Fuerte (known to give pathenocarpic fruits readily), in the cv Hass in which under normal conditions no parthenocarpic fruits are seen, on average 81.8, such fruits per tree were counted in response to the treatment with the triple hormone mixture. The parthenocarpic fruits obtained with the use of hormones in cv Fuerte had similar pattern of development with those in the controls. Kotob and Schwabe (1971), who applied a similar hormone mixture on apples however, obtained parthenocarpic apples similar in size with the seeded ones. This difference in the response to the hormone mixture might be due to the fact that a different proportion of the hormones - constituents might be needed for avocado.

Table 3 Average number of parthenocarpic and normal fruits per tree sprayed with a hormone mixture or with GA3 and in sprayed with water controls in the cvs Furte and Hass (Eeach figure is the average of 5 replications)

Treatment	Normal		Parthenocarpic		Total	
	Fuerte	Hass	Fuerte	Hass	Fuerte	Hass
Hormone mixture	30.6	381.4	177.8	81.8	208.4	463.2
GA_3	15.6	*	262.2	*	277.8	*
Water spray controls	36.2	471.2	2.0	0.0	38.2	471.2
Mean	27.46	426.2	147.3	40.9	174.8	467.2

*Treatment not applied

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