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Effect of putrescine sprays at anthesis on 'Comice' pear yield components

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Abstract: Putrescine at 10^{-3}M applied at anthesis on 'Comice' pear increased yield efficiency by 220% and 47% during 1985 and 1986 respectively, and also improved fruit set, crop density, fruit size, and seed content. Putrescine did not affect fruit maturity or return bloom during the two seasons of this study.

1. Introduction

'Comice' pear trees develop sufficient flower buds but usually set few fruit due to heavy post-bloom and preharvest drop (*Callan* and *Lombard*, 1978; *Jaumien*, 1968; *Lombard* and *Richardson*, 1982). Lack of 'Comice' set and production may be due to a short effective pollination period (EPP) as reported by *Williams* (1965). Therefore, extension of the EPP could improve fruit set and productivity. The EPP can be extended in two ways: increase of the pollen tube growth rate (PTGR) and/or prolonging the period of ovule longevity (OL). Chemical methods for prolonging OL and PTGR in flowers of fruit trees have also had undesirable effects. Gibberellic acid promoted early senescence of sweet cherry ovules and benzyladenine and kinetin, which delayed senescence of external flower parts, also accelerated aging of cherry ovules (*Stosser* and *Anvari*, 1982).

Polyamines, low molecular weight aliphatic proteins, have been described as growth promoters in cell division and elongation in higher plants (*Galston* and *Kaur-Sawhney*, 1980). Polyamines and ethylene are derived from S-adenosylmethionine, suggesting substrate competition which has been shown in ripening fruits and leaves (*Altman* and *Bachrach,* 1981).

Increases in fruit set and yield have been obtained with aminoethoxyvinylglycine (AVG) in apple and pear (*Greene*, 1980; *Lombard* and *Richardson*, l.c.) and with polyamines (putrescine, spermidine, spermine) in apple (*Costa* and *Bagni*, 1983).

Crisosto et al. (1986) reported greater ovule longevity in 'Comice' flowers treated with aminoethoxyacetic acid (AOA) or putrescine compared to those untreated or treated with spermidine or spermine. However, the effect of putrescine on pear yield components is unknown.

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2. Materials and Methods

In 1985 10^{-3}M putrescine (160 ppm) was applied 2 days before anthesis on six replicates of 5 year old 'Comice' pear trees, planted 1 x 5m at the L. B. Research Farm, OSU, Corvallis, OR. The following year putrescine at 10^{-5}M, 10^{-4}M, 10^{-3}M, and 10^{-2}M (1.6, 16, 160, 1600 ppm, respectively) was applied to 12 year old 'Comice' pear trees at the Southern Oregon Experiment Station in Medford. Ten single tree replicates were used for each concentration. Control trees were sprayed until runoff with 0.01% Tween 80 and treated trees had a mixture of Tween 80 and putrescine in pH 6.7 aqueous solution.

During 1985 and 1986, four limb units per tree were used for evaluation of fruit set. Yield was expressed as yield efficiency (yield per trunk cross-sectional area, kg/cm^2).

In both seasons, fruit weight, fruit diameter, flesh firmness and seed number were determined at harvest. Return bloom was determined in all trees the year following treatment and measured as the number of flower clusters relative to the flower clusters of the previous year. The data were subjected to an analysis of variance and further analyzed using means separation and/or regression analysis.

3. Results and Discussion

In 1985, fruit set and yield efficiency were increased by 140% and 220% respecitvely by 10^{-3}M putrescine (Table 1). In 1986 'Comice' yield components in Medford also showed a significant response to putrescine at

10^{-3}M and 10^{-2}M (Table 2). Fruit set, crop density and yield efficiency were increased 44%, 46% and 47%, respectively, by 10^{-3}M putrescine treatment. Yield efficiency was not affected significantly by 10^{-4}M and 10^{-5}M putrescine. These yield increases could be explained by the longer EPP induced by putrescine treatment as was reported earlier (*Crisosto et al.*, 1986). EPP was at least 3 days longer under Medford orchard conditions than Corvallis orchard conditions (*Crisosto et al.*, l.c.).

In spite of the greater fruit set, crop density and yield efficiency, 10^{-3}M and 10^{-2}M treatments did not reduce fruit size. In fact, putrescine at 10^{-3}M increased fruit weight and diameter (Table 3). Seed content was increased at the various putrescine treatments. A relationship between high number of seed per fruit and high fruit size in pear was established by *Callan* and *Lombard* (l.c.). Thus, higher seed number per fruit could explain the trend toward increase in fruit size from putrescine. However, the variation in seed number accounted for 61% of the fruit diameter variation in the regression equation $Y = 6.16 + 1.27 \log X$ indicating only partial effect from seed content. Other factors such as environmental and exogenous conditions could stimulate initial fruit growth. Polyamines have been found to enhance cell division in vitro by several researchers (*Altman* and *Bachrach,* l.c.; *Galston* and *Kaur-Sawhney,* l.c.). Post bloom polyamine sprays in apple (*Bagni et al.,* 1983; *Costa* and *Bagni*, l.c.) and olive (*Rugini* and *Mencuccini*, 1985) resulted in increased fruit size during the early period of fruit growth.

Fruit firmness two months after storage was not influenced by putrescine in 1986. No russeting was observed on 'Comice' fruits from putrescine.

No significant difference in relative number of flower clusters as compared to the previous year was found in the treated trees (Table 4). However, there was a trend toward an increased flower number, indicating an increase in flower initiation and development. *Costa* and *Bagni* (l.c.) reported a similar effect after polyamine treatments on the apple cultivar Delicious, strain Ruby Spur.

Our results indicate that putrescine applied at anthesis could improve fruit set, crop density, fruit weight and yield efficiency on pear, especially under low fruit set conditions. These data point out the possible action of putrescine as an exogenous plant growth regulator in increasing fruit set and yield efficiency on 'Comice' pear.

Table 1 – Effect of putrescine bloom spray on 'Comice' pear performance. Corvallis 1985.

Treatments	Final fruit set (No. fruit/100 clusters)	Yield efficiency (Kg/cm)
Control	5.4	0.090
Putrescine (10^{-3}M)	13.1	0.290
LSD, 5%	4.2	0.060

Table 2 – Effect of putrescine sprays on 'Comice' yield components. Medford 1986.

Putrescine concentration (M)	Fruit set[z]	Crop density[y]	Yield efficiency[x]
0	35	3.9	0.170
10^{-5}	47	5.0	0.200
10^{-4}	49	5.4	0.210
10^{-3}	50	5.7	0.250
10^{-2}	51	6.1	0.240
LSD, 5%	12	1.4	0.050

[z] No. fruit/100 clusters
[y] No. fruit/cm^2
[x] Kg/cm^2

Table 3 – Effect of putrescine sprays on 'Comice' fruit characteristics. Medford 1986.

Putrescine Concentration (M)	Seed per fruit (No.)	Fruit size: Weight (g)	Fruit size: Diameter (cm)
0	3.4	182	6.8
10^{-5}	4.5	200	7.0
10^{-4}	4.8	200	7.1
10^{-3}	5.5	210	7.2
10^{-2}	4.3	185	6.9
LSD, 5%	0.8	18	0.25

Table 4 – Effect of putrescine anthesis spray on seed content and return bloom on 'Comice' trees (applied in 1985 and 1986).

Putrescine Concentration	Seed content (No. seed per fruit) Year of response		Return bloom (Relative No. flower clusters between years) Year of response	
	1985	1986	1986	1987
Control	4.4	3.4	95	85
Putrescine (10^{-3}M)	5.6	5.5	144	128
Significant at	5%	5%	N.S.	N.S.

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