EFFECTS OF PROMALIN AND PACLOBUTRAZOL ON CRACKING AND QUALITY OF NEIPLING STAYMAN APPLES

C. Visai, O. Failla
Ist. di Coltivazioni Arboree
Università degli Studi
Milano - Italy

T. Eccher
Ist. di Coltivazioni Arboree
Università degli Studi
Torino - Italy

Abstract

To investigate the effect of GA availability on fruit cracking of Neipling Stayman apple, trees were sprayed in spring with Promalin (0, 20 and 40 ppm) and paclobutrazol (PBZ) at 250 ppm (repeated 0, 3 or 5 times).

PBZ increased soluble solids content of fruit but such effect was nullified by the presence of Promalin; fruit length was increased by Promalin and reduced by PBZ. Promalin, contrary to expectation, did not reduce cracking while PBZ significantly increased it. It is suggested that the ineffectiveness of Promalin may be due to unsuitable timing of treatments.

1. Introduction

Cracking of apple fruit, which often results in the down grading of a considerable proportion of the crop, is the most important obstacle limiting the cultivation of the Stayman group of apples. It is due to several causes such as genetic factors, growing environment, soil management, growth stresses, etc. (Proctor and Lougheed, 1980; Skene, 1982; Taylor and Knight, 1986).

A histological analogy exists between cracking and skin russeting, so cracking could be considered the last and the more serious stage of skin russet (Skene, 1982; Walter, 1967). In Golden Delicious fruits, skin russeting seems to be strictly related with hormonal levels: treatments with GA_{4+7} significantly reduced russeting of fruits (Eccher, 1978, 1983; Taylor and Knight, 1986); seeds of a russet clone proved to contain much less total GA-like substances than seeds of a normal clone (Eccher *et al.*, 1976), and higher GA content was found in fruitlets from orchards at higher altitude where smoother and more elongated fruits are produced (Eccher, 1986). Unpublished data of Visai, have shown that cracked Neipling Stayman fruits had less GA-like substances than intact ones. However, some authors (Cobianchi and Rivalta, 1974; Comai and Widman, 1979; Costa *et al.*, 1983) obtained a reduction of fruit cracking with Alar treatments.

The aim of the present work was to study the effects on cracking of increasing or decreasing the GA availability in trees and fruitlets in the first stage of development. Two commercial products were used: Promalin (GA_{4+7} and BA) and paclobutrazol (PBZ).

2. Material and methods

The trials were carried out in 1987, in the experimental orchard of the University of Milan at Montanaso Lombardo in the Po Valley.

Ninety twelve-year-old Neipling Stayman apple trees, grafted on M9 and "palmetta" trained, were selected.

PBZ and Promalin solutions were sprayed following a factorial 3 x 3 design: three concentrations of Promalin (0, 20 or 40 ppm GA_{4+7}) were crossed with 5, 3 or 0 times of application of PBZ at 250 ppm. Promalin was sprayed at balloon stage (April 23) and weekly from petal fall (May 8) to May 29. The dates of the five PBZ applications were the same as for Promalin; the three PBZ applications were carried out only on the first three dates. Each of the nine treatments was tested on ten trees, always spraying only one half of the canopy while the other half, unsprayed, was taken as control of the same tree, thus overcoming trees variability. Apples were picked on September 30 separately from treated and control branches of each tree. All apples were checked for cracking and transverse and longitudinal diameters of fruit were measured. On samples (5 fruits) of each treated and untreated half tree, soluble solids (S.S.) and titratable acidity were measured after 5 months' cold storage.

Statistical analysis of all collected data was carried out comparing the values of the treated half of the tree with the untreated control of the same tree.

3. Results

The incidence of fruit cracking was very high in this year, the mean percentage of cracked fruit being over 40%. Only PBZ significantly affected fruit cracking, the percentage of cracked fruits increasing with increasing number of PBZ treatments (Table 1). Unexpectedly, Promalin did not reduce cracking.

Both Promalin and PBZ alone remarkably increased S.S. content but such effect was nullified by the presence of Promalin. A similar trend was observed on titratable acidity of fruits, whose higher values corresponded to higher PBZ doses in absence of Promalin although the differences did not reach statistical significance.

Treatments did not significantly affect the diameter of fruits but dramatically affected fruit length which was reduced by PBZ and increased by Promalin. Also the interaction between PBZ and Promalin was significant: GA 40 ppm overcame the PBZ effect while 20 ppm GA counterbalanced five PBZ treatments (Table 3).

Differences in fruit shape are better shown by the percent variation of the length/width ratio induced by the treatments, that is obtained by the formula (R1-R0)/R0 x 100, where R1 is the ratio length/width of treated fruit and R0 is the mean ratio of control fruits of the untreated half of the same tree (Table 4).

4. Discussion and conclusions

Both PBZ and Promalin proved to induce significant and opposite effects on fruit elongation and S.S. content of Stayman apples. The same was not true for fruit cracking, which was only increased by PBZ, but was not affected by Promalin, contrary to what was observed for fruit russeting of Golden Delicious.

In this trial the treatments were applied in spring, in the period of maximum susceptibility to russeting that already in June is visible on fruitlets. It is known that a correct timing of treatments and repeated GA applications are essential to control russeting; actually fruit cracking becomes apparent later in July. The ineffectiveness of Promalin on cracking therefore could be due to a wrong timing or to a too early interruption of treatments, while PBZ, whose persistence is well-known, could have maintained its effect through the period of cracking.

The hypothesis that fruit cracking in Stayman is due to hormonal factors cannot be rejected, but is still to be verified with a different timing of GA treatments.

References

Cobianchi, D., Rivalta, L., 1974. L'impiego dell'Alar contro la "spaccatura" delle mele Stayman. L'Inf. Agr. 14729-14731.

Comai, M., Widmann, L., 1979. Esperienze per contenere la spaccatura dei frutti di "Stayman Red". Esperienze e ricerche. Staz. Sper. Agr. Forest. S. Michele a/A IX:55-59.

Costa, G., Giulivo, C., Ramina, A., 1983. Influence of growth regulators on apple fruit cracking (cv. "Stayman Red"). Acta Hort. 137: 367-373.

Eccher, T., Fontana De Gradi, C., Visai, C., 1976. Primi risultati de ricerche sul contenuto di gibberelline di cloni lisci e rugginosi di Golden Delicious. Riv. Ortoflorofrutt. It. 60:337-341.

Eccher, T., 1978. Russeting of Golden Delicious apples as related to endogenous and exogenous gibberellins. Acta Hort. 80:381-385.

Eccher, T., 1983. Control of russeting of Golden Delivious apples by growth regulators treatments. Acta Hort. 137:375-381.

Eccher, T., 1986. Russeting and shape of Golden Delicious apples as related to endogenous GA content of fruitlets. Acta Hort. 179: 767-770.

Proctor, J.T.A., Lougheed, E.C., 1980. Cracking of Golden russet apples. Canadian Plant Disease Survey 60:55-58.

Skene, D.S., 1982. The development of russet rough and cracks on the fruit of the Cox's Orange Pippin during the course of the season. J. Hort. Sci. 57:165-174.

Taylor, D.R., Knight, Y.N., 1986. Russeting and cracking of apple fruit and their control with plant growth regulators. Acta Hort. 179:819-820.

Walter, T.E., 1967. Russeting and cracking in apple: a review of world literature. Rep. East Mall. Res. St for 1966: 83-95.

Table 1 - Per cent cracking

Times of PBZ application	0	3	5
% cracking :			
in treated half trees	38.1 a	42.8 b	48.3 c
ratio treated/untreat. half trees	0.99 a	1.08 a	1.25 b

Table 2 - Ratio between S.S. content in treated and control fruits of the same tree. In brackets mean values of treated fruits.

Times of PBZ application	Promalin ppm			
	0	20	40	mean
0	0.99a (12.0)	0.97a (11.8)	0.99a (12.1)	0.98A (12.0)
3	1.11b (13.3)	0.98a (11.9)	0.97a (12.0)	1.02B (12.4)
5	1.12b (13.4)	1.00a (12.2)	1.02a (12.5)	1.05B (12.7)
mean	1.09B (12.8)	0.98A (12.0)	0.99A (12.2)	

Table 3 - Ratio between fruit length in treated and control fruits of the same tree. In brackets mean values of treated fruits.

Times of PBZ application	Promalin ppm			
	0	20	40	mean
0	1.00b (55.9)	1.07c (59.6)	1.06c (59.9)	1.04A (58.5)
3	0.97ab (54.2)	1.04c (58.4)	1.06c (61.6)	1.03A (58.1)
5	0.94a (53.4)	0.99b (55.3)	1.06c (63.1)	0.99B (57.5)
mean	0.97A (54.8)	1.03B (58.2)	1.06C (61.3)	

Table 4 - Per cent variation of the ratio fruit length/width induced by the treatments .

Times of PBZ application	Promalin ppm			
	0	20	40	mean
0	0.6 b	5.5 f	7.2 g	4.3 B
3	-4.4 a	1.7 bc	4.2 cf	0.4 A
5	-4.8 a	2.3 cd	3.3 de	0.7 A
mean	-2.1 A	3.5 B	5.2 C	