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Use of Ethrel to Stimulate Coloring and Ripening of Minnesota Apple Cultivars[1]

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Increased red color and early maturation of preharvest 2-chloroethylphosphonic acid (Ethrel) treated apples has been reported frequently (3, 4, 5, 7). However, this early fruit maturity and accelerated red color development has been associated with a hastening of abscission of mature apple fruits (3) and a decrease in firmness of the apple flesh (3, 5, 7). Edgerton (3) and Unrath (7) reported that 2,4,5 trichlorophenoxypropionic acid (2,4,5-TP) effectively counteracts the promotion of abscission by Ethrel. They also stated that even though a mid-summer application of succinic acid 2,2-dimethyl hydrazide (Alar), 60 to 70 days before harvest, delayed apple abscission, preharvest application of Ethrel effectively overcame this delay. Alar does, however, improve apple flesh firmness (1, 2) and delay the appearance of the physiological discolor watercore (2).

This study was designed to evaluate mid-summer applications of Alar followed by preharvest applications of Ethrel and 2,4,5-TP on four Minnesota grown apple cultivars, Beacon, McIntosh, Haralson, and Fireside. The value of these treatments alone and in combination were studied by following fruit drop, red color development, fruit firmness, and watercore development.

Materials and Methods

Ethrel alone and in combination with Alar and 2,4,5-TP (for abscission control) were applied in 1976 to 20 year old, entire trees of 4 apple cultivars (Beacon, McIntosh, Haralson, and Fireside) before the fruit reached maturity. All treatments were replicated 3 times. Sprays were applied at 200 psi, dilute, and to run-off using a hand gun.

Alar was applied to Beacon June 25, and the Ethrel and 2,4,5-TP combina-

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tion on August 5. On McIntosh, Alar was applied July 16, and the Ethrel and 2,4,5-TP combinations on September 7. Haralson received an application of Alar July 29, and Ethrel and 2,4,5-TP combination on September 16. Alar was applied to Fireside August 5, and Ethrel and 2,4,5-TP were applied September 23. Fruit drop data in all treatments were obtained, and the remaining fruit harvested and stored at 1°C. The fruit were later evaluated for red color, firmness (using a Magness-Taylor fruit pressure tester), and the physiological disorder watercore.

Apple harvest dates were: Beacon, August 12 and 17; McIntosh, September 15; Haralson, September 23; and Fireside October 4.

Results and Discussion

Beacon

Preharvest foliar application of Ethrel stimulated development of red color and uniform ripening of Beacon apples (Table 1). It also increased the amount and severity of watercore. The addition of 2,4,5-TP increased coloring and uniform ripening, but did not provide adequate drop control. Although the mid-summer Alar application did not provide adequate drop control when used in combination with Ethrel, it did increase fruit firmness at harvest.

McIntosh

Ethrel, in combination with a mid-summer Alar application, enhanced red color and increased harvest drop of McIntosh apples (Table 2). The addition of 2,4,5-TP counteracted the abscission-promoting effect of the Ethrel and also aided red color development. At harvest, fruit firmness of Ethrel treated fruit was less than the control, but these differences had disappeared at the end of the 90 day storage period.

Haralson

An Ethrel application to Haralson stimulated red color and increased

Table 1. Effect of Ethrel in combination with Alar and 2,4,5-Tp on drop, color, firmness, and watercore of Beacon apples.

Treatment[a]	Fruit drop (%)	Red color (%)	Fruit firmness at harvest[b] (lb)	Watercore (%)
Alar + Ethrel	33	78	20.6	6
Alar + Ethrel + 2,4,5-TP	20	85	20.6	20
Ethrel + 2,4,5-TP	38	95	—	50
Control				
1st pick (Aug. 12)	56	44	17.4	0
2nd pick (Aug. 17)	18	91	—	25

[a]Alar applied June 25 at 1000 ppm. Ethrel and 2,4,5-TP applied August 5 at 225 ppm and 20 ppm.
[b]Harvest date, August 12, 1976.

Table 2. Effect of Ethrel in combination with Alar and 2,4,5-TP on drop, color, and firmness of McIntosh apples.

Treatment[a]	Fruit drop (%)	Red color (%)	Fruit firmness[b] (lb) 9/17	11/8	12/20
Alar + Ethrel	45	84	18.3	16.9	14.0
Alar + Ethrel + 2,4,5-TP	2	91	18.2	17.0	14.6
Control	5	57	19.9	18.7	13.6

[a]Alar applied July 16 at 1000 ppm. Ethrel and 2,4,5-TP applied September 7 at 300 ppm and 20 ppm.
[b]Harvest date, September 15, 1976.

both fruit drop and fruit softness (Table 3). The addition of a stop-drop, 2,4,5-TP, reduced fruit drop and increased red fruit color. When Alar was added to Ethrel and 2,4,5-TP fruit firmness was equal to those fruits receiving Alar alone and firmer than the control and other non-Alar treatments. Alar stimulated red color development.

Fireside

Red color development in Fireside apples was slightly increased by a preharvest spray of Ethrel and 2,4,5-TP (Table 4). The addition of a midsummer spray of Alar gave only a slight increase in red color. Although 2,4,5-TP alone is known to increase red color development in apples (6), it had no effect on Fireside when used in combination with Ethrel. 2,4,5-TP reduced harvest drop, but Alar was not effective. None of the treatments affected fruit firmness.

The data indicate that red color development can be greatly enhanced by preharvest applications of Ethrel and 2,4,5-TP to the apple cultivars Beacon, McIntosh, and Haralson. The later maturing cultivar Fireside did not respond greatly to the Ethrel treatment.

The fruit firmness response to Ethrel, although less consistent than fruit coloration, did result in both McIntosh and Haralson being softer at harvest. Their condition at maturity must be examined critically if the fruit is to be marketed at harvest or early in its storage period.

When using Ethrel for stimulation of coloring and uniform ripening of Beacon and McIntosh, a drop control material must be used since these cultivars drop fruit excessively. 2,4,5-TP, although not recommended for the early maturing Beacons, is usually more effective as a stop-drop than α-naphthalenoacetic acid (NAA).

The addition of Alar retarded watercore development, a problem of the

Table 3. Effect of Ethrel alone and in combination with Alar and 2,4,5-TP on drop, color, and firmness of Haralson apples.

Treatment[a]	Fruit drop (%)	Red co'or (%)	Fruit firmness at harvest[b] (lb)
Alar + Ethrel	13	79	20.4
Alar + Ethrel + 2,4,5-TP	4	91	20.8
Ethrel + 2,4,5-TP	2	83	19.6
Ethrel	11	76	19.5
Alar	3	76	21.0
Control	4	66	20.2

[a]Alar applied July 29 at 1000 ppm. Ethrel and 2,4,5-TP applied September 16 at 300 ppm and 20 ppm.
[b]Harvest date, September 23, 1976.

Table 4. Effect of Ethrel in combination with Alar and 2,4,5-TP on drop, color, and firmness of Fireside apples.

Treatment[a]	Fruit drop (%)	Red color (%)	Fruit firmness at harvest[b] (lb)
Alar + Ethrel	62	71	22.3
Alar + Ethrel + 2,4,5-TP	13	72	23.5
Ethrel + 2,4,5-TP	14	67	22.0
Control	7	58	23.2

[a]Alar applied August 5 at 1000 ppm. Ethrel and 2,4,5-TP applied September 23 at 300 ppm and 20 ppm.
[b]Harvest date, October 4, 1976.

Beacon cultivar, increased fruit firmness and reduced fruit drop.

The studies suggested that Alar treated Haralson apples can successfully be treated with Ethrel for increased color development and earlier harvest and 2,4,5-TP for drop control. Also, that cultivars with different genetic backgrounds show no diverse responses to the addition of growth regulators for fruit maturity control. It appears, however, that exacting practices and recommendations must be established for their use on individual cultivars.

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Abscission Development in the Floral Tube of Peach (*Prunus persica* L.)

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Abstract

Abscission of the floral tube progresses in successive stages that encompass large areas from the distal to the proximal portion of the break. Carbohydrates accumulate in the phloem at the basal portion where the fruit is attached to the pedicel. Carbohydrate depletion was found distally to the abscission zone. Xylem tissues were the last to abscise and the point of origin of abscission was the adaxial surface of the floral cup. Understanding these stages of development should assist fruit growers in regulating their cultural practices for economic production of fruit.

Abscission of peach floral parts has been investigated (6, 7) in an effort to characterize stages of development.

The morphological stages of abscission have been listed as: 1) differentiation for an abscission zone, 2) abscission zone in Stage I, 3) abscission zone in Stage II, 4) separation, and 5) healing (6). Separation of the cells in abscission is not a senescence process, but some cellular progress toward the senescent state is apparently prerequisite for abscission (2). Abscission of maturing sweet cherry fruit (*Prunus avium* L. cv. Windsor) occurred at 2 different locations, depending on the stage of fruit development (9).

A study on leaf abscission in *Phaseolus* (8) found 4 sequential stages which culminate in separation and that are distinct in the laminar abscission region. These include: 1) pith-cell breakdown, which may not be related to abscission; 2) cell division; 3) cellular differentiation; and, 4) cortical and vascular cell breakdown.

Shedding always occurs in the same general abscission zone in the cotton plant, although the actual pathway of separation may vary within this zone and seldom can be predicted (3).

This research report describes the progress of abscission in the floral-cup of peach. Also, sequential abscission development is characterized in the floral organ.

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