

FINAL PROJECT REPORT

WTFRC Project Number: PH-05-512 (WSU Project 13C-3655-4297)

Project Title: Effects of preharvest sprays of MCP on apple

PI: Don C. Elfving
Organization: WSU Tree Fruit Research and Extension Center
Address: 1100 N. Western Avenue
City: Wenatchee
State/Province: WA
Zip: 98801
Telephone: 509-663-8181 x252
Email: delfving@wsu.edu

Cooperators: Dr. S.R. Drake, USDA/ARS-TFRL, Wenatchee
Dwayne Visser, WSU-TFREC, Wenatchee

Budget History:

Item	Year 1: 2006
Salaries	1,000
Benefits	340
Wages	800
Benefits	80
Equipment	0
Supplies	200
Travel	400
Miscellaneous	0
Total	\$2,820

Objectives:

1. Test the new sprayable MCP formulation for efficacy on ‘Scarletspur Delicious’ and ‘Cameo’ apple fruit quality retention after storage.
2. Compare preharvest MCP treatments of the new formulation with the standard postharvest treatment approach and with AVG applied four weeks before first harvest.
3. Test preharvest MCP timing and concentration effects in relation to harvest date to identify relationships among MCP timing, concentrations and harvest date on fruit postharvest behavior.
4. Evaluate potential for AVG, ethephon, preharvest MCP or postharvest MCP as tools for adjusting fruit maturity in ‘Cripps Pink’ apples to permit earlier harvest with fruit quality and postharvest durability equivalent to untreated apples harvested at the normal time

Significant findings:

1. MCP applied to apple trees as a dilute spray with a handgun was much more effective in influencing ‘Scarletspur Delicious’ fruit behavior than a comparable spray applied with a Proptec airblast sprayer at 100 gallons per acre. Application technology is a critical factor in successful use of the current formulation of MCP.
2. Preharvest MCP applied one week before harvest (WBH) controlled fruit drop in ‘Scarletspur Delicious’ for one month regardless of MCP concentration, but drop in ‘Cameo’ was too small to show an effect.
3. Preharvest MCP delayed starch hydrolysis, reduced ethylene production and reduced red color measurably in both ‘Scarletspur Delicious’ and ‘Cameo’ apples at harvest one week after treatment. One set of applications was made one week before normal harvest (fruit sampled at normal harvest), while a second set of applications was made the week of normal harvest and sampled one week later.
4. For both cultivars, the principal differences among treatments after 60 days RA, 120 days CA or 210 days extended CA (ECA) were mainly in flesh firmness and internal ethylene concentration (IEC).
5. Patterns of flesh firmness and IEC were similar for fruit immediately out of storage and after seven days of stimulated ripening. For fruit treated only with preharvest MCP, flesh firmness was greater with higher concentrations of MCP, but the response was curvilinear as concentration increased.
6. Similarly, IEC was decreased with higher concentrations of MCP.
7. Where postharvest treatment of fruit with MCP was also carried out, the concentration-dependent responses of flesh firmness and IEC were entirely eliminated and all fruit showed the same level of control over firmness loss and IEC regardless of preharvest treatment.
8. ‘Cripps Pink’ apples treated six weeks before normal harvest (WBNH) with AVG (ReTain[®]) and 4 WBNH with ethephon showed an unusual amount of preharvest drop compared to untreated trees or trees sprayed with either AVG or ethephon alone. As much as half the crop was lost on these trees, even though starch hydrolysis and IEC were not different from other treatments receiving ethephon with or without MCP.
9. ‘Cripps Pink’ apples treated with either preharvest AVG or MCP showed a very marked reduction in development of red color, while preharvest ethephon stimulated red color development such that treated fruit harvested two weeks early had about the same red color as untreated fruit harvested on the normal date.
10. The optimum strategy for encouraging early fruit maturity (commercial harvest two weeks before the normal time) in ‘Cripps Pink’ while preserving good color development, internal condition and good storability appeared to be a preharvest application of ethephon (300 ppm) four weeks before normal harvest followed by a postharvest MCP fruit treatment.

11. Spraying MCP one week after ethephon resulted in comparable starch and IEC levels as ethephon alone but red color development was strongly inhibited, making this approach for promoting early fruit maturity unattractive.

Methods:

Trials were established in mature, cropping trees of ‘Scarletspur Delicious,’ ‘Cameo’ and ‘Cripps Pink’ apple to determine effects of various bioregulator products on fruit maturation, fruit quality and post-storage behavior. All trials employed single- or double-tree plots in randomized complete block designs.

Results and discussion:

Preharvest applications of MCP appear to work well in apple if appropriate application technology is employed. Preliminary results suggest that large droplet size and full coverage aid in producing effective tree and fruit responses. Because MCP is a gas when in aqueous solution at normal temperatures and pressures, the product is probably quite volatile and off-gasses quickly. This fact, combined with the limited wetting of concentrate spray applications, is consistent with observations that small droplets and limited spray volume per acre produce unfavorable results.

In ‘Scarletspur Delicious’ and ‘Cameo’ apples, preharvest dilute sprays of MCP applied one week before harvest produced results close or comparable to a standard postharvest application when MCP concentration (a.i.) in the spray solution was at least 45 ppm. The observed effects on retention of flesh firmness and control of IEC continued to be present up to 210 days in CA storage following harvest. This suggests that once ethylene receptors in apple are combined with MCP and control over ethylene effects in the fruit is established these sites are not reactivated or replaced and control is maintained. The level of control achievable with preharvest MCP represents as much as a 4-lb. benefit in flesh firmness under long-term storage, even after seven days of stimulated ripening, equal to what can be obtained with a postharvest application of MCP. This technology appears very promising and may offer other advantages as well, including the potential for extending the harvest season, which could help improve crop recovery in a limited labor situation.

‘Cripps Pink’ apples in Washington are subject to potentially significant crop loss from preharvest freezes, which have happened several times in the last decade. Bioregulators that can control fruit maturation might be able to play an important role in encouraging earlier fruit maturity while permitting the preservation of fruit quality. Ethephon can stimulate fruit maturation but is commonly associated with more rapid deterioration of fruit quality during storage. Ethylene production or action inhibitors (e.g., ReTain, MCP) retard fruit maturation and extend fruit storability. Various combinations of bioregulators that either stimulate or retard fruit maturation and ethylene production were tried to determine if fruit could be brought to the same maturity condition two weeks earlier than untreated fruit reach when harvested at the normal time. Because of the profound effect of maturation inhibitors (preharvest AVG or MCP) on red color development in this cultivar, the best treatment for accomplishing this goal was the combination of ethephon (300 ppm dilute) applied four weeks before normal harvest followed by postharvest treatment of fruit with MCP after harvest two weeks following the ethephon application. Further trials are warranted to confirm this result.

Summary:

MCP applied preharvest produces effects on apples that are the equivalent of postharvest treatment, but the sprayable technology allows application before harvest. One unanswered question that immediately surfaces is whether a preharvest application can control fruit ripening enough to permit a significant (1-3 week) delay in harvest without the normal loss of fruit storability and quality. If so, spraying MCP might also help smooth out peaks in harvest labor requirements, aiding the

maintenance of good fruit quality and facilitating harvest labor management in a limited labor environment. The stimulation of fruit drop observed in 'Cripps Pink' apples treated with AVG and later with ethephon is unusual since other factors thought to be associated with stimulation of drop, such as starch hydrolysis or ethylene production, were not accelerated in this treatment. A combination of preharvest ethephon plus postharvest MCP appears to offer the best opportunity for successful earlier harvest of 'Cripps Pink' apples.

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