

Chemical regulation of fruit loosening as an aid to mechanical harvesting in fruit crops

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With rising wage rates and a rapidly dwindling supply of harvest labour, strong interest is now focussed on research and development of mass shake-removal systems of fruit harvesting as an alternative to hand-picking. To achieve acceptable harvest efficiency, machine-harvesting systems require chemical aids to promote fruit loosening. Many different combinations of machine-harvesting systems for fruit removal and chemicals to assist fruit removal devices have been tried.

Research since 1973 at Yanco has shown that chemicals which promote ethylene production by the fruit have proven successful in inducing fruit abscission, although their modes of action for particular crops were vastly different, as in citrus and sweet cherry.

Citrus

The morphology of citrus fruit allowed effective use of abscissants whose principal mode of action was through superficial peel injury-induced ethylene production. Such chemicals have induced effective fruit loosening in Valencia oranges through the promotion of "hyperethyleneism" in the fruit. Using known time-course events for the chemicals Release[?] (5 chloro-3 methyl -4 nitro-1Hpyrazole) and Pik-Off[?] (Ethanedial dioxime), manipulation of application timing during the pre-harvest period produced significantly higher levels of fruit ethylene production ($P < 0.05$) and improved fruit loosening at harvest time. These abscissants were applied as two separate sprays using Pik-Off[?] at 100ppm (active ingredient) followed two days later by an application of Release[?] at 150 ppm. Significant improvement in machine harvester performance ($P < 0.05$) resulted from this improved abscission response.

Sweet Cherry

To achieve adequate levels of fruit removal by mechanical means in sweet cherries, use of growth regulating chemicals was found necessary to reduce the fruit bonding strength (FRF) at the pedicel:fruit separation layer. Increased fruit abscission in cherries appeared closely related to advanced maturity. This was promoted through the action of the chemicals Alar[?] (Succinic acid-2-2-dimethylhydrazide) applied at 1000ppm (active ingredient) two weeks post-bloom and 150ppm Ethrel[?] ((2 chloroethyl) Phosphonic acid) applied 7 to 10 days before harvest. Accelerated maturity (advanced growth rate, anthocyanin pigmentation and total soluble solids) resulted principally from the Alar application. It also pre-conditioned this non-climacteric fruit to ethylene-stimulated fruit loosening by increasing ethylene generation during the final-swell (Stage III) growth phase. Ethrel, which is degraded in fruit tissue to release ethylene, acted synergistically to promote colour development, fruit size and reduction of FRF. Complete abscission layer formation was promoted using these chemicals and FRF values were reduced to less than 0.5kg. Final detachment of fruit required only a mechanical separation of the vascular elements, which was successfully achieved using a mass-removal shake/catch harvesting system to recover fresh market-quality fruit. Low levels of pre-detachment fruit injury resulted from the improved chemical/machine performance and 70 percent of the crop was recovered.