HortScience 13(2):161. 1978

Physiology of Plum Fruit Abscission Induced by Larvae of the Plum Curculio[1]

Eli Levine and Franklin R. Hall[2]

Department of Entomology, Ohio Agricultural Research and Development Center, Wooster, OH 44691

Additional index words. cellulase, *Conotrachelus nenuphar,* pectinase, *Prunus domestica*

Abstract. **The physiological basis for plum (*Prunus domestica* L. cv. Fellenberg) fruit abscission induced by larvae of the plum curculio, *Conotrachelus nenuphar* (Herbst), appear to be pectinases and cellulase released into fruits by feeding larvae. About 45% more plums receiving active commercial pectinase and cellulase abscised than fruits receiving inactivated enzymes.**

Fruit abscission involves the synthesis and activity of enzymes such as pectinase and cellulase within the separation zone (2, 5, 6). In a previous paper (3), we showed that plum curculio-induced abscission of apples and plums was due solely to feeding activity by larvae. Larvae produce an array of pectinases and a cellulase. Enzymes are released into fruits as larvae feed (4). The purpose of this study was to determine whether pectinases and cellulase introduced into plums are capable of initiating fruit abscission.

To determine if plum fruit abscission may be caused by pectinases and cellulases, 10 g *Aspergillus niger* pectinase (U.S. Biochemical Corp., Cleveland, Ohio; product no. 19960) were mixed in 10 ml 0.05 M citrate buffer, pH 3.1 (pH of plums varied from 3.1 to 3.3 throughout the season). The mixture was sterilized by passing it through a membrane filter, pore diam 0.2 μm. Pectinase and cellulase activity of the filtrate were assayed viscometrically (4). On May 26, 1977, 90 'Fellenberg' plums, averaging 19 mm diam were randomly selected and tagged on 1 tree. One-half of the plums received 10 μl of active filtrate (equivalent to 7.3, 21.1, and 12.9 mature plum curculio larvae in the viscosity reduction of pectin, sodium polypectate, and carboxymethyl cellulose ether, respectively) which was placed in cavities made either at the distal end (tip) of 25 plums or proximal end (base) of 20 plums. The remaining plums received, in cavities made either at the tip (25 plums) or base of fruits (20 plums), 10 μl of filtrate that had been boiled for 3 min (inactive). Treatments to tips and bases of plums were replicated 5 and 4 times, respectively with 5 fruits in each replicate. Cavities were sealed with paraffin and fruits sprayed with azinphosmethyl and captan to control insects and brown rot, respectively. The ground beneath the tree was examined daily for fallen fruits.

Significantly more plums receiving active fungal pectinase than fruits receiving boiled enzyme abscised (Table 1). Introduction of pectinase into bases vs. tips of fruits did not significantly affect total fruit abscission. However, plums receiving active pectinase at the base fell significantly sooner than fruits receiving active pectinase at the tip (Table 1).

A. niger is reported (1, 7) to produce pectin methylesterase (PME), exo- and endo-polygalacturonase (PG), endo-polymethylgalacturonase (PMG), and endopectin methyl-*trans*-eliminase (PMTE). The fungal pectinase used in this study possessed significant activity against pectin and sodium polypectate. PMTE activity was confirmed and a contaminating cellulase was detected. Plums in the size range we studied typically fall 3-18 days after implantation of newly hatched larvae (3). During the first 12 days of development, 1 larva releases as much pectinase as that contained in 6 mature 12-day-old larvae (4).

Pectinases and/or cellulase released into fruits by plum curculio larvae may induce fruit abscission by slowly diffusing (these enzymes are very large molecules) to the abscission zone and acting directly on pectic and cellulolytic substances of the separation layer. This may explain why plums receiving fungal pectinase at the base fell earlier than fruits receiving the enzyme at the tip.

Table 1. Effect of active and inactive *Aspergillus niger* pectinase, introduced into distal or proximal ends of 'Fellenberg' plums, on fruit abscission.

Treatment	Abscission[z] (%)	Days to fall[y]
Active		
Distal	68.0 a	17.8
Proximal	70.0 a	12.9
Inactive		
Distal	26.7 b	–
Proximal	20.0 b	–

[z]Mean, 21 days post-treatment; mean separation by LSD, 1% level.

[y]Mean; means significantly different at the 1% level (t-test).

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[1]Received for publication October 27, 1977. Approved for publication as Journal Article No. 158-77 of the Ohio Agricultural Research and Development Center, Wooster, OH. 44691. Portion of a thesis submitted to the faculty of Ohio State University by the 1st author in partial fulfillment of the Ph.D. degree.

[2]We thank David C. Ferree, David J. Horn, Roy W. Rings, and George F. Shambaugh for their constructive review of the manuscript.