Bruising of Sweet Cherries Resulting in Internal Browning and Increased Susceptibility to Fungi

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The authors thank the San Joaquin Cherry Growers and Industries Foundation for financial support, and Al Gotelli, a grower and member of the Foundation, for his valuable personal assistance.

ABSTRACT

Impact bruising during harvest causes internal flesh discoloration followed by exudation of liquid droplets and formation of a slight depression. Bruised fruit were more susceptible to infection by *Rhizopus, Monilinia,* and *Botrytis,* whereas *Alternaria* developed on both bruised and nonbruised fruit. Initial stages of these fungal decay can be mistaken for bruised fruit. Temperatures before and after bruising did not influence the rate of internal discoloration.

Phytopathology 62:579-580.

Grade U.S. No. 1 sweet cherries for fresh market must meet inspection standards of less than 1% decay and less than 10% of any single defect. Decay is detected by signs of the pathogens as well as symptoms. Sporulation or mycelial characteristics typify advanced infections by *Rhizopus, Monilinia, Botrytis,* and *Alternaria,* but the initial symptoms of decay development are difficult to distinguish by sight. Rejections of shipments have been largely attributed to decay, internal browning, or "pitting" (1). This study shows the importance of bruising to the development of fungus decay as well as to increased amounts of internal browning of the fruit flesh which could be misidentified as fungus decay.

Infection of bruised fruit by fungus pathogens.—Formation of liquid drops, on bruised fruit surfaces dropped into unpadded buckets from a height of 24 inches, was observed on 10 of 20 fruit after 14 days in an environment of 21 C and 95% relative humidity (Fig. 1). After observing formation of the liquid droplets, the susceptibility of bruised areas to infection by fungus pathogens was tested. Fifteen bruised or nonbruised fruit inoculated with spores (20,000/ml) were incubated for 7 days at 21 C and over 95% relative humidity. Bruised fruit were more prone to infection by some fungi. *R. stolonifer, M. laxa,* and *B. cinerea* developed little to no decay on nonbruised fruit, whereas over 90% of the bruised fruit developed decay. With *A. tenuis,* however, both the bruised and nonbruised fruit were equally susceptible to decay.

Impact bruising and development of internal flesh browning.—The early morning presence of fruit pickers in the orchard is often noted by the constant sound of fruit being dropped into unpadded buckets, suggesting that impact from dropping may cause bruising and subsequent browning. To test this supposition, fruit picked by grasping the stem to prevent bruising were dropped 24 inches into unpadded or padded buckets. Black Tartarians dropped into unpadded buckets showed 25% internal browning, whereas those dropped into padded buckets showed only 2% browning. Comparable control fruits, picked and placed carefully into unpadded buckets, showed only 1% internal browning. Examination of fruit on the trees revealed no internal browning. Bing cherries dropped into unpadded buckets developed 33% internal browning, whereas those placed carefully into the unpadded buckets showed only 1% internal browning. Thus, the impact of dropping fruit into unpadded buckets can cause internal browning.

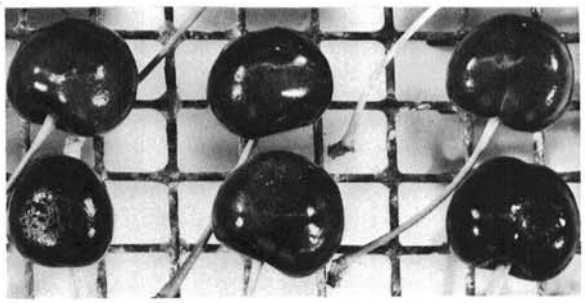

Fig. 1. Slightly sunken area with liquid droplets that developed on bruised fruit after storage for 14 days.

For additional evidence on bruising as the cause of internal browning, four lots of 200 rejected fruit from one packing shed and four lots of 25 fruit from another shed were sampled and examined. From the first shed, 450 fruits or 56% showed some stages of internal browning, with greatest incidence on the cheek of the fruit. Fruit from the second shed showed a similar pattern of internal browning on 40% of the fruit. The data showed that internal browning can occur on any portion of the fruit, but the highest percentage (49%) was on the cheek.

The time required for internal browning symptoms to develop was studied. Six samples of Bing cherries with pit temperatures of 21 C were dropped from a height of 24 inches into an unpadded bucket; immediately, five samples were stored at 1.5 C and one at 21 C. Samples stored at 1.5 C were removed at intervals and checked for water-soaked areas and internal browning. Within 4 hr, water-soaked areas appeared in the flesh on 70% of the fruit. Continued storage and examination at 24, 48, 72, and 144 hr revealed that reddish, water-soaked areas turned brown within 24 hr, but no other symptoms developed thereafter. The fruit stored at 21 C developed symptoms similar to those stored at 1.5 C, but also showed slight depressions (pitting) and exudation of liquid on the surface as pictured in Fig. 1.

We studied the effects of fruit temperature on bruising by holding samples of 20 fruit each for 24 hr at temperatures of 3-degree increments from 3 to 33 C before dropping them into unpadded buckets from the height of 24 inches. Discoloration of flesh as indicated by water-soaking or internal browning was determined after 4, 24, and 48 hr for each of the temperature increments. There were no differences in amount of water-soaking or internal browning among the temperature increments, but over 58% of the fruit developed internal browning during the first 4 hr of incubation.

Similar experiments in 1969, 1970, and 1971 showed that variable climatic conditions during the growing season did not influence the development of internal browning following impact bruising.

The possible presence of decay pathogens in bruised fruit.—Isolations from 170 cherries with internal browning or with water-soaked appearance from a lot of fruit rejected at terminal inspection because of decay failed to yield any fungal cultures on potato-dextrose medium, but did yield 23 cultures of *Erwinia* sp. on medium B, a substrate especially suitable for bacterial detection. Cherries inoculated with the isolated bacteria failed to develop symptoms, suggesting that internal browning was not caused by the bacteria.

Our results show that bruised sweet cherries will develop water-soaking and browning of the fruit flesh, and such bruised areas are more susceptible to infection by fungus pathogens. Further studies are needed to compare the internal browning described herein with that reported from the State of Washington as "cherry pitting". Because bruised fruit are more susceptible to decay, studies are needed to determine if currently used decay control measures consisting of Botran (2,6-Dichloro-4-nitroaniline) and captan or benomyl sprays will prevent infection of bruised fruit. In addition, techniques for distinguishing bruised fruit from decayed fruit are needed.

LITERATURE CITED

1. LUCE, B. 1970. Sweet cherry "Pitting", subject of Yakima meeting. The Good Fruit Grower. 20(21):10-11.