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Stone fruit injuries and damage at the wholesale market of São Paulo, Brazil

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Abstract

Mechanical injuries and diseases in stone fruit are important causes for market rejection. The objectives of this research were to quantify and characterize the mechanical injuries and diseases in peaches, nectarines and plums at São Paulo's wholesale market, the largest in Brazil. Incidence of injuries was assessed weekly in 1% of the marketed fruit (2973 fruit/week), from September to December in 2003 and 2004. Mechanical injuries were the most frequent injuries in both years, ranging from 8.73% (plum) to 44.5% (nectarine) of injured fruit. There was a significant positive correlation between the incidence of postharvest mechanical injuries and postharvest diseases. Incidence of postharvest diseases varied from 2.5% to 6.6%. *Cladosporium* rot (*Cladosporium* sp.) and brown rot (*Monilinia fructicola*) were the most frequent diseases, and were mostly detected in the apexes of nectarines and peaches. Aurora (peach), Sunraycer (nectarine) and Gulfblaze (plum) varieties were the most susceptible to injuries and diseases.
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Keywords: Postharvest diseases; *Prunus* spp.; Damage

1. Introduction

The area and quantity of production of peach (*Prunus persica*), nectarine (*P. persica* var. nucipersica) and plum (*Prunus salicina*) are increasing in the state of São Paulo, Brazil (Barbosa et al., 2003) with the introduction of low chill and early ripening varieties selected by Brazilian breeding programs. These precocious varieties are almost exclusively grown for fresh market. They are harvested from September to November, 2 months before the harvest in the south of Brazil, the traditional region of stone fruit production. Probably, because of the predominantly warm climate, postharvest disease incidence is high in fruit produced in the state of São Paulo (Gonçalves, 2005; Bassetto, 2006). The diseases soft rot (*Rhizopus* spp.) and brown rot (*Monilinia fructicola*) are frequently the main causes of fruit damage, losses and market rejection (Bassetto, 2006).

In general, phytopathological losses are the largest single cause of avoidable postharvest losses (Toma et al., 1990), but only when the losses are known with a reasonable degree of accuracy can crop protection be applied at the correct dosage (Zadoks and Schein, 1979).

São Paulo's wholesale market (CEAGESP) receives production of 1476 Brazilian municipalities (13% of total Brazilian fresh fruit and vegetables) and is an excellent place for monitoring fresh produce by its volume and diversity. On average, 44% of the peach production from the state of São Paulo is sold in the São Paulo wholesale market, most of it without refrigeration (Gutierrez, 2005). Although CEAGESP experiences high postharvest losses in stone fruits, no damage and loss quantification study has been done.

The objectives of this study are to characterize the biotic and abiotic injuries and to measure the damage caused by these injuries to peaches, nectarines and plums produced in São Paulo and sold at São Paulo's wholesale market.

2. Materials and methods

This study has adopted the crop loss terminology used by Zadoks (1985), in which any injury is visible and measurable symptom caused by a harmful organism, damage is any reduction in the quality and/or quantity of yield, and

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loss is the reduction in financial return due to a harmful organism.

Samples were collected every week, in 2003 from 24 September to 1 December and in 2004 from 8 September to 1 December at São Paulo's wholesale market (CEAGESP). Additional samples were taken in 17 December, 2003 and 21 December, 2004.

For each date of evaluation, incidence of injuries was assessed in 1% of the marketed fruits at the five biggest stone fruit wholesalers of CEAGESP with 39,607 fruits inspected in the first year and 28,774 in the second year (Table 1). The sampling was stratified by fruit variety, size and place of origin. The sampling unit was a cardboard box (45 cm × 30 cm × 15 cm) containing 6 kg of fruit. Each fruit in each sample was inspected visually and the injuries were described and measured. Fruit with incipient infection symptoms were sent to the laboratory, where they were held in a moist chamber for incubation for 24 h. After that they were visually inspected. The pathogen identification was, if necessary, aided by optical microscopic examination of spores and mycelia. Injuries were classified as postharvest mechanical injuries (bruises, cuts and punctures), pre-harvest mechanical injuries (healed lesions caused by rub injury or pest attacks), physiological disorders (badly misshapen fruit, growth cracks or cracking), pre-harvest diseases (rust and shot-hole) and postharvest diseases (rots, including brown rot). *M. fructicola* infection can occur before or after harvest, but it is considered as a postharvest disease because the symptoms developed in ripe fruit. The location of the injury in each fruit was also described: peduncle, apex (tip) or side.

Table 1
Assessment dates, number of boxes and number of fruit examined in each assessment at the wholesale market of São Paulo, Brazil in 2003 and 2004

Assessment date	Peach		Nectarine		Plum	
	Boxes	Fruit	Boxes	Fruit	Boxes	Fruit
2003						
24 September	22	2354	3	386	–	–
30 September	25	2407	5	427	–	–
8 October	24	2519	15	1692	–	–
15 October	26	2376	13	1376	–	–
22 October	35	3797	8	986	–	–
29 October	34	2939	8	691	3	324
5 November	37	2719	16	1395	3	258
12 November	30	2370	12	907	4	468
17 November	12	962	10	768	4	482
26 November	18	1107	7	578	2	356
1 December	14	1978	7	665	8	1032
17 December	–	–	4	267	8	1021
2004						
8 September	11	1034				
17 September	23	2124	4	252	–	–
22 September	26	2480	10	767	–	–
1 October	43	3342	10	968	–	–
6 October	23	1856	12	987	7	1263
22 October	31	2498	10	844	5	1002
29 October	27	2039	11	892	–	–
5 November	31	2386	10	736	2	254
19 November	4	243	5	331	3	495
1 December	–	–	–	–	6	680
21 December	–	–	–	–	9	1301

The incidence of injury in the different fruit species in these 2 years was characterized by two or multiple comparisons for proportion tests (dichotomous variables) ($p = 0.01$), according to Zar (1999). The same test was used to compare the susceptibility of the different varieties to postharvest mechanical injuries and to postharvest diseases during the 2 years. Postharvest mechanical injuries were correlated to postharvest diseases by linear regression. In the first regression analysis, the independent variable was the incidence of mechanically injured fruit and percentage of diseased fruit was the dependent variable. In the second regression analysis, the dependent variable was the incidence of diseased fruit excluding fruit with brown rot symptoms.

3. Results

Mechanical injuries were the most frequent injuries in peaches, nectarines and plums in both years. The incidences of peaches with postharvest and pre-harvest mechanical injuries were respectively, 12.6% and 14.5% (Fig. 1). The incidences of mechanical injuries in nectarines in pre-harvest and postharvest were 44.5% and 12.5% and in plums 23.1% and 8.7%, respectively (Fig. 1). Bruise (>50%) was the most common injury.

There was a positive correlation between postharvest mechanical injuries and disease incidence (Table 2). Despite the low coefficient of determination, due to scattered points, the regressions were highly significant, except for the plums in

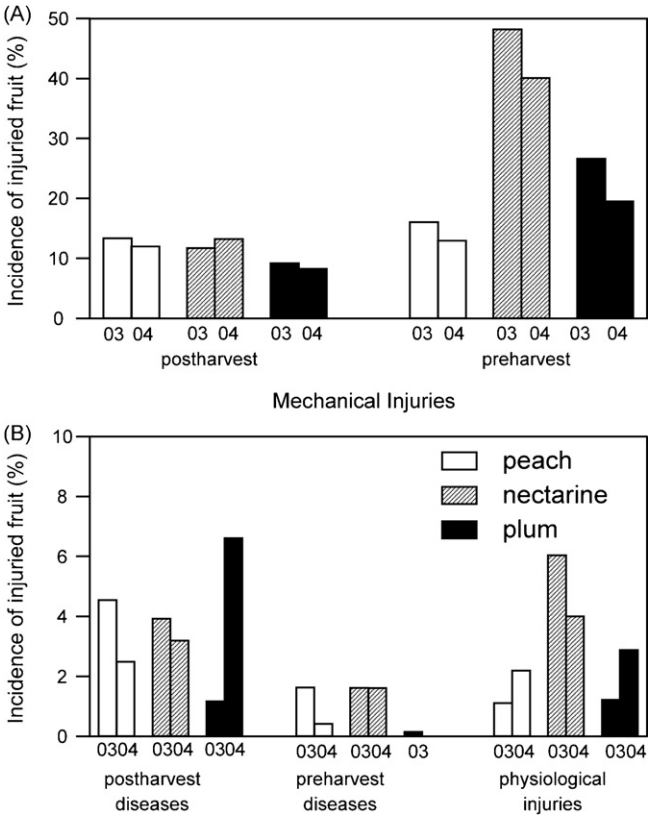

Fig. 1. Incidence (percentage of injured fruit) of postharvest and pre-harvest mechanical injuries (A) and postharvest diseases, pre-harvest diseases and physiological disturbances (B) in peaches, nectarines and plums at São Paulo wholesale market, Brazil in 2003 and 2004.

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