flower buds (5) in contrast with reduced resistance observed in this experiment. Therefore, there is an interaction of the paclobutrazol effect on cold resistance with other factors related to location or weather. Almost certainly there will be an interaction with species and maybe cultivar. Nevertheless, the risk of reduced cold resistance resulting from the use of paclobutrazol in the managment of peach, apricot, and sweet cherry must be considered in evaluating the potential benefits.

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Wholesale, Retail, and Consumer Level Losses of Nectarines in Metropolitan New York

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Abstract. **Quantitative and qualitative losses incurred in the marketing of nectarines (*Prunus persica* L. 'Nectarina' Ait) in metropolitan New York were studied at wholesale, retail, and consumer levels from 1981 to 1983. Examination of nectarines at the wholesale level indicated that losses to pathological, physiological, and physical deterioration were 3.3%. Losses of 6.6% were observed at retail store and consumer levels. Decay, mainly due to brown rot, was the leading cause of loss in wholesale and consumer level sampling, whereas mechanical damage caused most of the loss in retail.**

The volume of fresh nectarines delivered to metropolitan New York has been increasing steadily in recent years, and it presently averages about 11,000 MT annually (10). Aside from a small volume of winter imports from Chile (2–3%), California supplies practically all of the nectarines to this market. A study to determine the nature and extent of losses in wholesaling, retailing, and consumption of nectarines could provide guidelines for developing commercially feasible measures to reduce these losses. This report is one in a series of studies on marketing losses of fresh produce crops that began in 1966 (1, 2, 3, 4, 5, 6, 7, 12).

The evaluation of the wholesale condition of nectarines was conducted during the period from 1981 to 1983, beginning in June and ending in September of each year. Cartons containing 11.35 kg of fruit were obtained weekly from food-chain distribution centers and from wholesalers in New York City's Terminal Market at Hunts Point. The samples were brought to the Postharvest Research Center in New Brunswick, N. J., where they were examined. In 1983, the nectarines also were examined after they had ripened at 21°C for 3 days.

The criteria used for sorting nectarines at wholesale reflected the normal culling practice of retailers. The culls were placed into categories which included parasitic diseases, injuries from mechanical handling, and nonparasitic disorders such as internal breakdown, desiccation, overripeness and freezing.

Retail loss data for a 1- or 2-day sales period were obtained from 8 or 9 metropolitan New York supermarkets for each week California nectarines were in season. At least 2 stores each in representative low, middle, and high income locations were visited 1–3 days after the wholesale examinations. The loss data were derived from the number of culls removed from cartons of fruit sold or displayed in each store, and once weekly a consumer-size store sample (10–15 fruits) also was purchased. When the nature of the retail loss could not be determined immediately, the affected specimens were brought to the laboratory for a thorough examination. The consumer samples also were held in the laboratory at 21°C until the nectarines were eating ripe, usually in 1–3 days. Losses recorded for retail and consumer levels were based on the weight of the fruit. Retail losses consisted of whole fruits, whereas trimmings made up the bulk of losses in consumer samples.

The culls in wholesale cartons examined ranged from 3.2% to 3.3% per year (Table 1). Parasitic diseases accounted for approximately two-thirds of the culls. Brown rot [*Monilinia fructicola* (Wint.) Honey and *M. laxa* (Aderh. & Ruhl) Honey] was the most prevalent fruit rot observed, affecting about 60% of the diseased culls. An unidentified yeast rot that was usually localized at the distal end of the nectarine was the next most common rot. It was associated with a softening and advanced ripening of the tissue at that end. Other rots in wholesale samples were gray mold rot (*Botrytis cinerea* Pers. ex Fr.), cladosporium rot (*Cladosporium herbarum* Lk. ex Fr.), alternaria rot (*Alternaria* sp.), and sour rot (*Geotrichum candidum* Lk. ex Pers.).

Physical injuries accounted for approximately 25% of the fruit losses in wholesale samples. Mechanical damage, manifested as severe bruises, prominent cuts, and punctures, was chiefly responsible for the loss. Nonparasitic disorders affected only a few fruit that were culled because of excessive softness or a badly split pit. Another 2.4% of the fruit had defects such as split pits, cuts, punctures, and bruises that were not serious enough to warrant a cull designation and for which data are not presented.

When the 1983 wholesale samples were ripened by holding at 21°C for 3 days, a sharp increase in cullage occurred. Brown rot (4.8%), gray mold rot (0.5%), yeast rots (0.7%), and sour rot (0.1%) were responsible for spoilage of an additional 6.1% of the fruits, and another 0.3% was overly soft or overripe. While some rots, especially those caused by yeasts, developed in bruised tissue, brown and gray mold rots apparently developed from incipient and/or latent infections. These infections became active when the fruits were removed from cold storage or when they ripened. Ripening produces physiological changes in host tissue and cell walls that could activate latent infections (11).

Annual retail store losses ranged from 6.1% to 7.1% and averaged 6.6% of the 156,850 nectarines (17,100 kg) retailed during the 3-year study (Table 1). Mechanical injury was the leading cause of loss in retail stores and, with freezing and insect damage, wasted 4.2%. Parasitic diseases were responsible for spoilage of 1.9%. Shrivelling, internal breakdown and overripeness caused the remaining 0.5%. No significant differences in wholesale or retail losses were found between years of sampling, nor was there any significant yearly difference in parasitic disease loss.

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Table 1. Cull and trimming losses of nectarines marketed in metropolitan New York, 1981–1983.

Year and sampling level	Cartons (no.)	Fruit examined and estimated[z]		Cull and trimming losses							
		No.	Wt. (kg)	Brown rot (%)	Yeast rot (%)	All rots[y] (%)	Mechanical injury (%)	Desiccation (%)	Internal breakdown (%)	All others[x] (%)	Total (%)
1981											
Wholesale	24	2,281	272.4	1.1	0.4	1.9	1.2	0	0	0.3	3.3
Retail	631	67,050	7,150.0	1.4	0.1	1.9	4.4**	0.3	0.2	0.3	7.1**
Consumer		1,520	177.4	2.8	0.1	3.2	0.8	0	1.2	<0.1	5.2
1982											
Wholesale	19	1,820	215.6	1.7	0.4	2.5	0.4	0	0.2	0.1	3.2
Retail	507	52,200	5,750.0	0.9	0.4	1.5	3.9**	0.3	0.1	0.3	6.1*
Consumer		1,646	186.6	2.2	0.4	3.0	0.8	0	1.0	0.1	4.9
1983											
Wholesale	30	3,008	340.5	1.4	0.9	2.4	0.5	0	0	0.4	3.3
Retail	370	37,600	4,200.0	1.2	0.5	2.5	2.9**	0.3	0.3	0.2	6.2**
Consumer		1,516	172.6	5.6	0.4	7.4	1.1	0	1.1	0.1	9.7
1981–1983											
Wholesale	73	7,109	828.5	1.4	0.6	2.3	0.7	0	<0.1	0.3	3.3
Retail	1,508	156,850	17,100.0	1.2	0.3	1.9	3.9	0.3	0.2	0.3	6.6
Consumer		4,682	536.6	3.5	0.2	4.5	1.0	0	1.1	<0.1	6.6

[z]Number of fruit retailed based on average fruit count and number of cartons displayed during test period.
[y]Includes rots caused by *Botrytis, Cladosporium, Rhizopus, Geotrichum, Penicillium, Alternaria* and unidentified fungi.
[x]Fruit damaged by insects, freezing, growth cracks, overripeness, soft and immature fruits.
**,*Within each year, significantly different from wholesale at 1% and 5% levels, respectively, by Student's *t* test.

The retail losses undoubtedly included fruit that would have been culled at wholesale if inspections there were more stringent or acceptable condition tolerances were eliminated. Mechanical injury was the only important category where significant differences were found between wholesale and retail losses each year. These differences accounted for most of the differences in total cull losses between both levels for the entire study (Table 1).

The significant increase in loss from mechanical injury during retailing could be accounted for by the excessive handling of fresh produce in self-service stores and supermarkets. The merchandizing of loose nectarines in bulk, rather than in prepackaged displays, provides increased opportunity for impact bruises and cuts to occur. Selling fruit in bulk probably accounted for the small desiccation loss (0.3%) in retail stores. Internal breakdown always occurred at retail and consumer levels near or at the end of the marketing season for California nectarines. This non-parasitic condition manifests itself through discoloration of the flesh and the loss of flavor. It usually occurs when nectarines are held in refrigerated storage for more than 3 weeks (8).

Consumer waste consisted mainly of defective tissue trimmings, and these losses by weight ranged from 4.9% to 9.7% yearly and averaged 6.6% for the 3-year study (Table 1). Decay, mainly brown rot, caused approximately two-thirds of the total loss. Brown rot caused an average of 3.5% loss of the fruit in consumer samples during the 3 marketing seasons. The substantial increase of brown rot noted in 1983 consumer samples may have been due to unfavorable growing conditions and/or to the increasing tolerance of the rot organism to fungicides (9). While only 4.5% loss could be accounted for by pathogenic activity during the study, 12.1% of all nectarines in the consumer samples were rotted to some degree. By contrast, 14.3% of the sampled fruit required some trimming because of physical injury, but the total loss was only 1.0%. The remaining 1.1% loss was due to internal breakdown, which nearly always caused culling of the entire fruit.

Projecting our loss figures on the volume of domestic nectarines received in metropolitan New York, retailing losses for the area are estimated at 660 MT annually with a similar additional yearly loss at the consumer level for the study period.

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