20 Preharvest Factors Affecting Peach Quality

C.H. Crisosto[1] and G. Costa[2]

[1]*University of California, Davis, Department of Plant Sciences; located at Kearney Agricultural Center, Parlier, California, USA*

[2]*Department of Fruit Trees and Woody Plant Sciences, University of Bologna, Bologna, Italy*

20.1 Introduction

This chapter describes and discusses exclusively the impact of preharvest factors on peach fruit flavour and postharvest life (storage and shelf-life). It does not include the role of environmental factors and the use of plant growth regulators on peach quality; these topics are covered well in other chapters in this book. The present chapter begins by emphasizing quality definitions from the consumer point of view and follows with a series of short sections that update knowledge on preharvest orchard factors. The relationship between maturity and quality is covered, and the role of genotype (cultivar and rootstock) on fruit flavour and postharvest life potential is described. Then the effect of mineral nutrition on peach quality is discussed with detailed attention on N and Ca as the most studied nutrients. Updated information on the effect of foliar nutrient application on fruit quality including foliar Ca sprays is also reported. Detailed practical information on the effect of different irrigation regimes on fruit quality is described next, followed by a section on canopy management. The canopy management section describes practical information on leaf removal, girdling techniques, and the use of reflective materials to improve fruit size and enhance red skin colour. Examples that illustrate the influence of crop load and canopy position on fruit quality and postharvest storage potential are presented.

20.2 Quality Definition

Fruit 'quality' is a concept encompassing sensory properties (appearance, texture, taste and aroma), nutritive value, mechanical properties, safety and defects. Altogether, these attributes give the fruit a degree of excellence and an economic value (Abbott, 1999). Everyone in the peach production and marketing chain from the grower to the consumer looks for fruit with no or few defects. However, in each step of this chain, the term 'quality' takes on different meanings and the economic relevance of the various quality traits is largely variable. For example, the grower is interested in high yield, in fruit with large size and high disease resistance, and in the opportunity to reduce the number of pickings. The definition of 'quality' for packers, shippers, distributors and wholesalers is mainly based on flesh firmness, which is considered a good indication to predict fruit potential storage and market life. Peaches and nectarines ripen and deteriorate quickly at ambient temperature and cold storage is required to slow down these processes, especially for some cultivars and/or long-distance market situations. However, firmness is an erroneous and incomplete way to estimate peach postharvest potential for domestic distribution. In fact, in some production areas such as California and Chile, the development of internal breakdown symptoms such as lack of flavour, flesh mealiness and flesh browning limits the storage life and the postharvest quality of tasty cultivars. For retailers, red colour, size and firmness have historically represented the main components of fruit quality, as they need fruit that are attractive to the consumer, resistant to handling and have a long shelf-life. From the consumer's point of view, in general peach fruit quality has declined, mainly because of premature harvesting, chilling injury and lack of ripening prior to consumption, resulting in consumer dissatisfaction. In addition, quality is badly defined and the only parameters being considered are fruit size and skin colour. Other characters such as flesh firmness, sugar content, acidity and aroma, which are perceived by the consumer as fruit quality, are completely disregarded by the grower and other individuals along the chain. In fact, the grower, identifying fruit quality almost exclusively with the fruit size, does not consider that these are only the first characters perceived by the consumer and they orient him just in his very first choice. As soon as he realizes that the fruit, even with good size and attractive colour, is tasteless, with low sugar content, poor aroma and rapidly perishable, he redirects his interest towards other types of fruit. As a consequence, it is imperative for the grower and other individuals in the delivery chain to direct their attention to fruit quality from the consumer's perspective in order to regain the confidence of the consumer.

In addition, there is now an increasing appreciation that 'quality' of fruit also includes nutritional properties (e.g. vitamins, minerals, dietary fibre) and health benefits (e.g. antioxidants); and these are becoming important factors in consumer preferences. Experimental, epidemiological and clinical studies provide evidence that diet has an important role in the prevention of the chronic degenerative diseases such as tumours, cardiovascular diseases and atherosclerosis. It is supposed, in fact, that the consumption of fresh fruit and vegetables exerts a protective role against the development of such pathologies (Doll, 1990; Ames *et al.*, 1993; Dragsted *et al.*, 1993; Anderson *et al.*, 2000).

Changes in quality definition that are focusing more on consumer demand can increase peach consumption if marketing promotion and education programmes are well executed. Because the consumer quality of peaches cannot be improved after harvest, it is important to understand the role of preharvest factors in consumer acceptance and market life (Kader, 1988; Crisosto *et al.*, 1997).

20.3 Maturity and Quality

Peaches and nectarines are climacteric fruit characterized by a sharp rise in ethylene biosynthesis at the onset of ripening, which is associated with changes in sensitivity to the hormone itself and changes in colour, texture, aroma and other biochemical features (Fig. 20.1/Plate 226).

Ethylene plays a key role in peach fruit ripening by coordinating the expression of ripening-related genes responsible for flesh softening, colour development and sugar accumulation, as well as other processes such as abscission (Ruperti *et al.*, 2002; Trainotti *et al.*, 2003, 2006).

The definition of the proper harvest time is essential, as fruit maturity at harvest greatly influences peach fruit market life potential and quality. Recently, the most important peach-producing countries in Europe have lost considerable market share mainly due to excessive early harvesting. A delayed harvest could lead to a better fruit organoleptic quality but also to faster softening and a shorter shelf-life. In fact, different from other species, in peach fruit there is a close link between 'on-tree physiological maturity' and evolution of key traits responsible for peach quality during the postharvest phase. On the other hand, melting flesh peaches and nectarines undergo a rapid softening after harvest, which leads to dramatic losses in the marketing chain, as soft fruit are easily bruised during handling and more susceptible to decay. Therefore, they are often picked at an early stage of ripening, and they never reach their full flavour and aroma potential.

Modulation of pre- and postharvest peach fruit ripening by the means of chemicals that interfere with ethylene biosynthesis and/or perception, such as aminoethoxyvinylglycine and 1-methylcyclopropene, has already been reported (Mathooko *et al.*, 2001; Bregoli *et al.*, 2002, 2005; Ziosi *et al.*, 2006). A better understanding of the physiological basis of the peach fruit ripening process should make it possible to develop further strategies to regulate ripening. Such strategies need objective parameters able to accurately describe fruit ripeness stages and internal quality changes occurring in pre- and postharvest conditions.

Until recently, few studies have been carried out on this topic, and mainly by using traditional fruit quality traits (flesh firmness, soluble solids concentration (SSC) and titratable acidity (TA)) which are assessed with simple devices such as penetrometers, refractometers and titrators. Early studies carried out in Europe and the USA have associated peach fruit consumer acceptance with high SSC (Mitchell *et al.*, 1990; Parker *et al.*, 1991; Ravaglia *et al.*, 1996; Anon., 1999). In California,

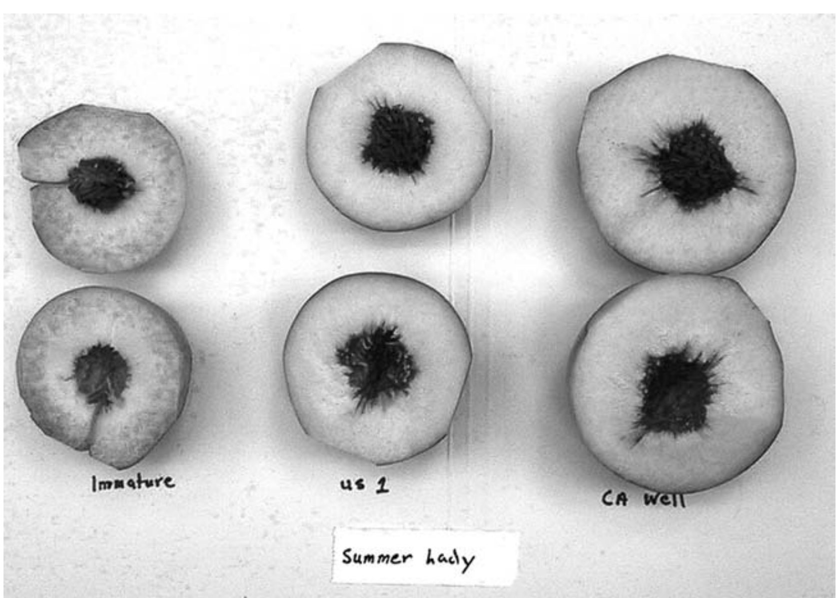

Fig. 20.1. Peaches picked at different maturity levels.

a minimum of 10% SSC for yellow-fleshed peaches and nectarines was proposed as a quality standard (Kader, 1995). In France, a minimum of 10% SSC for low-acidity (TA <0.9%) and 11% SSC for high-acidity (TA ≥0.9%) peaches was proposed as part of their quality standard (Hilaire, 2003). In Italy, a minimum of 10% SSC for early-season, 11% for mid-season and 12% for late-season cultivars was suggested for yellow-fleshed peaches (Testoni, 1995; Ventura *et al*., 2000). In preliminary studies carried out in California by using trained panels and 'in-store' consumer acceptance tests on 'Ivory Princess' (white flesh/low TA), 'Elegant Lady', 'O'Henry' and 'Spring Bright' (yellow flesh/high TA) peaches and 'Honey Kist' (yellow flesh/low TA) nectarine, it was shown that acceptance correlated well with ripe soluble solids concentration or the ratio of ripe soluble solids concentration to ripe titratable acidity; it was also shown that the relationship was strictly dependent on cultivar and/or maturity and that consumer acceptance was not a linear relationship (Crisosto and Crisosto, 2005).

The analyses of traditional fruit quality traits are cheap and fast, but they do not consider other fundamental aspects of quality, such as antioxidant capacity, aroma volatile emission, soluble sugars and organic acids content. A more accurate definition of fruit quality would require sophisticated analyses (high-performance liquid chromatography, gas chromatography or mass spectrometry) that are not usually run because they should be carried out only in well-equipped laboratories with trained personnel. In any case, simple or more complex destructive analyses can be performed only on samples of a limited number of fruit, often not fully representative of the entire lot (Costa *et al*., 2002, 2003b). In recent years, extensive research has been focused on the development of non-destructive techniques for assessing internal fruit quality attributes. These techniques offer a number of advantages, including: the possibility to extend the assessments on a large number of, or even on all, the fruit in a lot; to repeat the analysis on the same samples, monitoring their physiological evolution; and to achieve real-time information on several fruit quality parameters at the same time (Abbott, 1999). Among the non-destructive techniques, near infrared spectroscopy can be used efficiently for determining traditional peach fruit quality traits and concentrations of the main organic acids and simple sugars. In addition, this technique allowed definition of a new maturity index strictly related to the fruit ethylene emission and ripening stage. This index, called 'absorbance difference' (AD), can be effectively used for determining harvest date and for grouping harvested fruit into homogeneous classes which show different ripening rates during shelf-life (Costa *et al*., 2006).

As a final consideration, as new plantings are based on new cultivars with different organoleptic characteristics (low- and high-acid, high SSC, highly aromatic, non-melting, etc.) and since new markets and consumer groups with different ethnic backgrounds are being reached (Liverani *et al*., 2002; Crisosto, 2003), it is important to understand which characters are determining consumer acceptance and segregate cultivars into different organoleptic categories prior to proposing any quality index (Crisosto, 2002, 2003).

As a long-term solution, it is expected that breeding programmes will include quality characteristics in their screening process. The creation of peach categories with their own quality indices according to an organoleptic description may help marketing and promotion.

20.4 Genotype

Genotype (cultivar and/or rootstock) has an important role in flavour quality, nutrient composition and postharvest life potential. SSC and acidity are determined by several factors such as cultivar (Crisosto *et al*., 1995, 1997; Frecon *et al*., 2002; Liverani *et al*., 2002; Byrne, 2003) and rootstock (Reighard, 2002). Reduction of physiological disorders and even decay and insect losses can be achieved by choosing the correct genotype for given environmental conditions. Extensive harvest quality and postharvest storage potential evaluations have been carried out since 1970 by several researchers in all the main important peach cultivation areas, such as the USA, Italy, Spain, France, Chile and South Africa. Brown rot and grey mould resistance have not been successfully included in recently released cultivars. These are the main diseases, although other ones have been investigated (Frecon *et al*., 2002; Reighard, 2002), but current breeding programmes are constantly creating new cultivars with improved production and visual appearance attributes. Unfortunately, an ideal cultivar(s) with all of the current consumer quality attributes for domestic and long-distance shipping has (have) not been developed yet.

20.5 Mineral Nutrition

Nutritional status is an important factor of quality and postharvest life potential. Deficiencies, excesses or imbalances of various nutrients may result in disorders that can limit storage life. Fertilization rates vary widely among growers, locations and cultivars, and generally depend upon soil type, cropping history and field testing results.

Nitrogen

This is the nutrient that has been studied the most. N has the single greatest effect on peach quality. Detailed and extensive research performed since the early 1990s at the Kearney Agricultural Center (Parlier, California, USA) has evaluated the role of N in peach and nectarine production and quality under California conditions (Daane *et al*., 1995). Based on this work, in California, N should be kept between 2.6 and 3.0% leaf N for best fruit quality without reduction in production or size (Table 20.1). Similarly, optimal fruit quality in nectarines in the Eastern Po Valley area (Italy) was obtained in trials having 3.0% leaf N concentration (Tagliavini *et al*., 1997; Scudellari *et al*., 1999). Response of peach and nectarine trees to N fertilization is dramatic; high N levels stimulate vigorous vegetative growth, causing shading out and death of lower fruiting wood. Although high-N trees may look healthy and lush, excess N does not increase fruit size, production or SSC. Furthermore, excessive N delays peach maturity because it induces poor visual red colour development (Fig. 20.2/Plate 227) and inhibits ground colour change from green to yellow. As growers delay harvest waiting for fruit colour changes from green to yellow and red colour development, high-N fruit are picked soft especially when measured on the softest position on the fruit such as tips, which generally ripen faster than the rest of the fruit in warm production areas. These fruits then have fast softening rates during postharvest handling and are more susceptible to bruising and decay development. N deficiency leads to small fruit with poor flavour and unproductive trees. Fruit water loss from fruit with the highest N rate (3.6% leaf N) was greater than that from the lowest rate (2.6% leaf N). The relationship between fruit N concentration and fruit susceptibility to decay produced by brown rot (*Monilinia fructicola* (Wint.) Honey) has been studied extensively on stored fruit (Daane *et al*., 1995). Wounded and brown rot-inoculated fruit from 'Fantasia' and 'Flavortop'

Table 20.1. Relationship between leaf nitrogen and per cent of fruit surface that is red, yield and fruit size (mean for 3 years) on 'Fantasia' nectarine. (Adapted from Daane *et al*., 1995.)

N-fertilization treatment (kg N/ha)	Leaf N (%)	Fruit visual redness (%)	Yield (kg/tree)	Fruit weight (g)
0	2.7[a]	92[a]	132[a]	131[a]
112	3.0[b]	80[b]	207[b]	166[b]
196	3.1[c]	72[c]	193[b]	168[b]
280	3.5[d]	69[c]	222[b]	169[b]
364	3.5[d]	70[c]	197[b]	167[b]

[a,b,c]Values within columns with unlike superscript letters were significantly different by the Least Significant Difference test ($P < 0.05$).

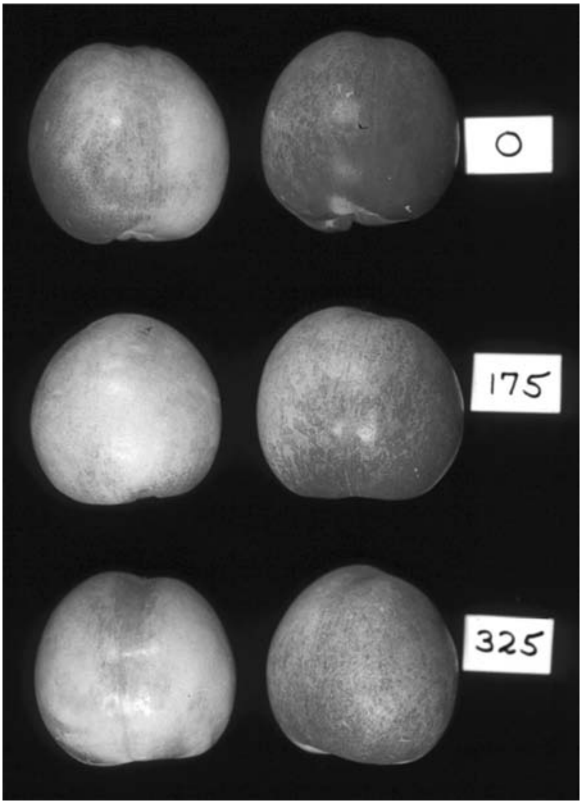

Fig. 20.2. Influence of increased nitrogen fertilization (kg/ha) on red skin coloration of 'Fantasia' nectarine.

trees having more than 2.6% leaf N were more susceptible to brown rot than fruit from trees with 2.6% leaf N or less. Fruit anatomical observations and cuticle density measurements indicated differences in cuticle thickness among 'Fantasia' fruit from the low, middle and high N treatments. These changes in cuticle and epidermis anatomy can partially explain the differences in fruit susceptibility to this disease and water loss.

Calcium

The nutrient Ca is involved in numerous biochemical and morphological processes in plants and has been implicated in many disorders of considerable economic importance to production and postharvest quality. While Ca accumulation in apple, kiwifruit and grape occurs predominantly in the first stages of fruit development, in peaches, owing to their ability to maintain significant transpiration rates, Ca continues to accumulate until harvest (Tagliavini *et al.*, 2000). Foliar Ca sprays have not been successful and are not used commercially to maintain peach fruit quality. Over the last decade, trials carried out in California using several commercial Ca foliar sprays on peach and nectarine (applied every 14 days, starting 2 weeks after full bloom and continuing until 1 week before harvest) showed no effect on fruit quality of mid- or late-season cultivars (Crisosto *et al.*, 2000). These foliar spray formulations and new formulations did not affect fruit SSC, firmness, decay incidence, fruit flesh Ca concentration or postharvest disorders. Fruit flesh Ca concentration measured at harvest varied among cultivars from 200 to 300 μg/g dry weight basis. A lack of decay control was also reported on 'Jerseyland' peaches, grown in Pennsylvania, treated with ten weekly preharvest Ca sprays of $CaCl_2$ at 0, 34, 67 or 101 kg/ha (Conwall, 1987). Even fruit treated at a rate of 101 kg/ha, which had 70% more flesh Ca (490 versus 287 μg/g dry weight basis) than untreated fruit, showed no reduction in decay severity. Our recent research suggests that any Ca spray formulations and timing on peaches and nectarines should be treated with caution because their heavy metal content (Fe, Al, Cu, etc.) may contribute to peach and nectarine skin discoloration (Crisosto *et al.*, 1999). A moderate and cultivar-dependent effect of Ca sprays on the reduction of skin russeting development has been reported for nectarines in Italy (Scudellari *et al.*, 1995).

Potassium

K is the major nutrient present in peaches (about 2–2.5 kg/t fresh weight basis), where it accumulates progressively as fruit approach maturity (Tagliavini *et al.*, 2000). Optimal K nutrition usually leads to high photosynthetic rates and reallocation of sugars and organic acids that will enhance fruit quality.

Iron

Fe, as a micronutrient, is taken up by fruit trees in relatively small amounts; however, its deficiency not only affects fruit yields but also peach fruit quality (Álvarez-Fernández *et al.*, 2003). In a study carried out in Spain, only 47% of fruits from Fe-deficient trees had optimal fruit size compared with 95% from green trees (Álvarez-Fernández *et al.*, 2003). Peach fruit colour could also be affected by Fe deficiency: in a red-skin peach cultivar ('Babygold') Fe deficiency caused decreases in the mean 'a' colour coordinate and increases in the mean 'L' and 'b' colour coordinates (Álvarez-Fernández *et al.*, 2003).

20.6 Irrigation

Despite the important role of water in fruit growth and development, few specific studies have been done on the influence of the amount and the timing of water applications on peach quality at harvest and postharvest performance (Prashar *et al.*, 1976). An early report indicated that when trees were allowed to grow without irrigation during the growing season on a shallow soil under California conditions, yield and fruit size were reduced, SSC increased and fruit developed an abnormal texture (Uriu *et al.*, 1964). Reducing the amount of applied water after harvest of early-season peaches (postharvest stress) has shown no negative effects on yield in California; however, timing of the water deficit interval is important. An increase in fruit defects such as deep suture and double-fruit formation has been reported for early-season 'Regina' peaches as a consequence of imposing a postharvest water stress (50% evapotranspiration; ET) in mid- and late summer during the previous season (Fig. 20.3/Plate 228). These defects reduced the final packout for the next season's crop (Johnson *et al.*, 1992).

The regulated irrigation deficit (RID) technique has been evaluated for peach performance in different production areas (Chalmers *et al.*, 1981; Ben Mechlia *et al.*, 2002; Girona, 2002; Goldhamer *et al.*, 2002). In general, this technique imposes a moderate stress (30–50% ET) to reduce vegetative growth and save water use (4–30%) at a given physiological stage without affecting yield. Researchers agree that the water stress-tolerant phases in peach, which has a double-sigmoid fruit development pattern, have been identified as stage II, the lag phase of fruit growth and the postharvest period (Goldhamer *et al.*, 2002). In some situations, besides saving water, the RID technique also increased fruit size and SSC. Researchers claim that consistency of the benefits of the RID technology will depend on the understanding of local climatic conditions, soil depth and composition, identification of the fruit growth stages and fruit crop load (Berman and DeJong, 1996; Girona, 2002). In California, during three seasons, the influence of three different irrigation regimes applied 4 weeks before harvest on 'O'Henry' peach quality and postharvest performance was evaluated: (i) normal irrigation (100% evapotranspiration); (ii) over-irrigation (150% ET); and (iii) RID irrigation (50% ET) (Crisosto *et al.*, 1994; Johnson and

Fig. 20.3. Water stress late in the summer causes fruit defects such as deep sutures and double-fruit formation.

Handley, 2000). Yield, flesh firmness, per cent red surface, acidity and pH were not altered at harvest by any of these irrigation regimes in any season. Average fruit size, measured as fruit weight, was lower but SSC was higher for fruit from 50% ET than from the other treatments. Ripe yellow-fleshed peaches and nectarines with 10% SSC or higher with low to moderate TA (<0.7%) are highly acceptable to consumers. Although fruit from the 50% ET treatment were smaller, they had higher SSC and consumers would probably prefer their eating quality over fruit from the other two treatments. An economic study showed that peaches with a higher SSC may have a higher retail value (Parker *et al.*, 1991). The irrigation regimes (100%, 50% and 150% ET applied 4 weeks before harvest) did not affect 'O'Henry' peach postharvest storage potential based on internal breakdown development during 2, 4 and 6 weeks in cold storage at 0°C or 5°C. Fruit from 50% ET had a lower water loss rate than fruit from 150% ET or 100% ET. Fruit from 150% ET lost nearly 35% more water than fruit from 50% ET or 100% ET after 24 h. Light microscopy studies indicated that fruits from 50% ET and 100% ET had a continuous and much thicker cuticle and a higher density of trichomes than fruits from the 150% ET. These differences in exodermis structure may explain the higher percentage of water loss from fruit from 150% ET compared with the others (Crisosto *et al.*, 1994).

Recently, RID and partial root zone drying (PRD) were evaluated on white-fleshed peach growing under California conditions (Goldhamer *et al.*, 2002). PRD involves inducing partial stomatal closure by exposing some part of the root zone to continual soil drying. After 2 years of evaluations, yield and fruit quality were affected equally by the PRD and the RID treatments. Except for a few studies which have comprehensively tested a broad range of water management practices and conditions and their impacts on postharvest quality, it is often difficult to generalize about the effects of water management from the site-specific irrigation regimes that have been reported.

20.7 Canopy Manipulation

In most cultivars, fruitlet thinning increases fruit size while also reducing total yield, thus a balance between yield and fruit size must be achieved. Some cultivars must not be thinned too much because their fruit will crack easily. In some cases, fruit size, SSC and TA are modified without affecting fruit cracking. In other cultivars the fruit do not ripen properly when trees are carrying too high a fruit load. In general, the number of fruit that can ripen on a tree will depend on the cultivar and orchard conditions. Thus detailed information about cultivar response to crop load adjustment and potential benefits should be developed for each specific situation. Historically, maximum profit does not occur at maximum marketable yield since larger fruit bring a higher market price. Furthermore, new market trends for highly tasty fruit may force a review of this topic. The crop load and fruit quality relationship has been studied by researchers in various countries (Forlani *et al.*, 2002; Giacalone *et al.*, 2002; Luchsinger *et al.*, 2002; Costa *et al.*, 2003a). Leaving too many fruit on a tree reduces fruit size and SSC in the early-season 'May Glo' nectarine and late-season 'O'Henry' peach (Fig. 20.4). Crop load on 'O'Henry' peach trees affected the incidence of internal breakdown. In general, the overall incidence of mealiness and flesh browning in fruit from the high crop load was low, intermediate in fruit from the commercial crop load, and the highest in fruit from the low crop load (Crisosto *et al.*, 1997).

Fruit quality measured at harvest and during storage for several peach and nectarine cultivars varied according to fruit canopy position in different production areas (Marini *et al.*, 1991; Crisosto *et al.*, 1997; Iannini *et al.*, 2002). Large differences in SSC, acidity and fruit size were detected between fruit obtained from the outside and inside canopy positions of open-vase trained trees (Marini *et al.*, 1991; Crisosto *et al.*, 1997). During the last decade, we have observed that fruit grown under a high light environment (outside canopy) has

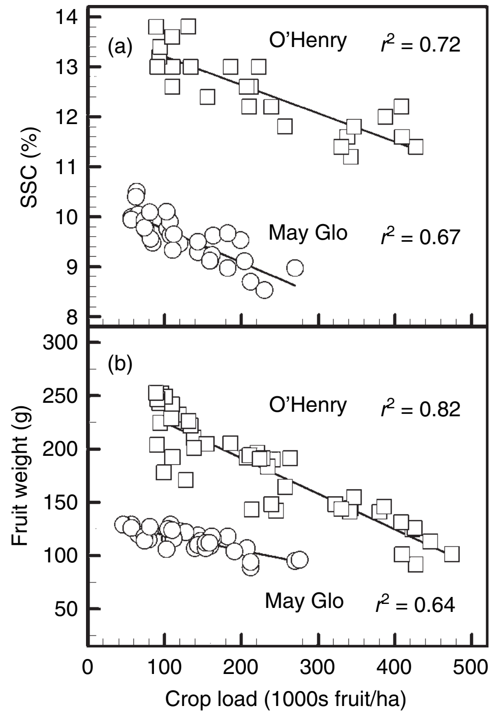

Fig. 20.4. Relationship between (a) crop load and soluble solids concentration (SSC) and (b) crop load and fruit weight for 'O'Henry' peach and 'May Glo' nectarine. (Adapted from Crisosto *et al.*, 1997.)

a longer shelf-life (storage and market) than fruit grown under a low light environment (inside canopy). During our work, we found that fruit that developed in the more shaded inner canopy positions have a greater incidence of internal breakdown than fruit from the high light, outer canopy positions (Fig. 20.5/Plate 229). Thus, fruit from the outer canopy have a longer potential market life, especially for cultivars susceptible to internal breakdown. The use of more efficient training systems which allow more sunlight penetration into the centre and lower canopy areas is recommended to reduce the number of shaded fruit, thus extending postharvest life (Crisosto *et al.*, 1997).

Summer pruning and leaf removal around the fruit increase fruit light exposure and, when performed properly, can increase fruit colour without affecting fruit size and

Fig. 20.5. Canopy position affects fruit size, red colour development and storage potential.

SSC (Fig. 20.6/Plate 230). Excessive leaf pulling or leaf removal executed too close to harvest can reduce both fruit size and SSC in peaches and nectarines (Crisosto *et al*., 1997; Day, 1997). Girdling (removal of bark) 4–6 weeks before harvest is performed to increase peach and nectarine fruit size (Fig. 20.7/Plate 231) and to advance and synchronize maturity (Day, 1997). Girdling increases fruit SSC in some cases but also increases fruit acidity and phenolics, so the flavour resulting from the additional SSC may be masked. Girdling can also cause the pits of peaches and nectarines to split, especially if it is done too early during pit hardening. Fruit with split pits soften more quickly than intact fruits and are more susceptible to decay.

Reports on the benefits of using different reflective materials to improve peach red colour and fruit size and speed up maturation varied according to cultivar, orchard situation and location (Layne *et al*., 2001; Fiori *et al*., 2002). Under California's long and hot growing season, canopy manipulations including water sprout removal and leaf removal around fruit become necessary to achieve the benefit of red colour development in vigorous orchards. Also, even when reflected light was reaching fruit in the canopy, but temperatures remained high during that maturation period, improvement in red colour development was not observed.

In spite of the limited literature available on the role of preharvest factors in consumer quality, there is strong evidence that fruit flavour quality, market life and physiological disorders are related to preharvest factors. We therefore encourage more detailed work on

Fig. 20.6. Leaf removal around the fruit improves red colour but may decrease fruit size.

Fig. 20.7. Peach girdling (removal of a strip of scaffold bark) at the main scaffolds advances maturity and increases fruit size.

this subject with an emphasis on consumer satisfaction. In order to maximize 'orchard quality potential', all of the preharvest factors influencing quality must be investigated by physiologists and understood by pomologists. Detailed information on how these factors are controlling peach consumer quality combined with an effective marketing programme will help to increase peach consumption (Crisosto, 2002).

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