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Improvement of loquat fruit quality

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SUMMARY – Fruit size represents one of the most important quality factors in loquat. As for other types of fruit crops, there is an inverse relationship between the number of loquat fruits produced per tree and the individual fruit size. Accordingly, fruit size can be improved by thinning the fruit manually, but this task amounts to 25-30% of the total crops, and for this reason chemical thinning has been attempted using several substances. However, fruit size can also be improved by increasing carbohydrate availability or sink strength of developing fruits, by girdling or applying synthetic auxins, respectively. On the other hand, loquat fruit is very sensitive to purple spot, a physiological disorder that seriously affects outward appearance and fruits cannot be marketed. This article summarises our results as regards increasing fruit size and characterizing purple spot.

Key words: Fruit size, chemical thinning, girdling, synthetic auxins, purple spot.

RESUME – *"Amélioration de la qualité des fruits du néflier". La taille du fruit représente un des plus importants facteurs de qualité des nèfles. Comme pour d'autres cultures fruitières, il existe une relation inverse entre le nombre de nèfles produites par arbre et la taille du fruit individuel. De la même façon, la taille du fruit peut être améliorée par un éclaircissage manuel des fruits, mais cette tâche représente 25-30% de la culture totale, et pour cette raison l'éclaircissage chimique a été testé en utilisant plusieurs substances. Cependant, la taille du fruit peut également être améliorée en augmentant la disponibilité en hydrates de carbone ou la force sur le puits pour le développement du fruit, par annélation (girdling) ou en appliquant des auxines synthétiques, respectivement. D'autre part, les nèfles sont sensibles à la tache violette, un trouble physiologique qui affecte sérieusement l'apparence extérieure, le fruit étant commercialement rejeté. Dans cet article sont résumés nos résultats pour augmenter la taille du fruit et caractériser la tache violette.*

Mots-clés : *Taille du fruit, éclaircissage chimique, annélation, auxines synthétiques, tache violette.*

Introduction

By 1998, the worldwide loquat fruit production had exceeded 200,000 tonnes. China is the major producing country of the world (102,000 tonnes), followed by Spain (40,000 tonnes), Algeria (22,000 tonnes), Japan (18,000 tonnes) and others (Llácer *et al*., 1995; Lin *et al.,* 1999).

The trade in loquat is mainly for fresh consumption and fruit quality is of prime importance for good returns. Among aspects related to quality, fruit size and outward appearance are the main factors deciding purchase.

Fruit size

Chemical fruit thinning

Loquat trees flower profusely in compressed panicles and although set percentages are low, the fruit size is commonly considered too small for the market demand. As with other types of fruit crops, there is an inverse relationship between the number of loquat fruits produced per tree and the individual fruit size. Accordingly, farmers increase the average fruit size by thinning the fruits manually. This task amounts to 25-30% of the total costs. For this reason chemical thinning has been attempted using different chemical products (Eti *et al*., 1990).

Our experiments (Agustí *et al*., 2000) show that application of NAA to 'Algerie' loquat trees reduced the number of fruits per panicle by 20-45%, and increased the average fruit diameter at

harvest by 2.5-5 mm, depending on the concentration applied (Fig. 1) and on the date of treatment (Fig. 2). Optimum results were obtained with 20 mg/l applied 10-15 days after full bloom. The thinning effect decreased as the number of visible (set) fruits increased (Fig. 2), the best result being obtained when 2-3 fruits per panicle were visible. A reduction of 30% of the number of fruits per panicle and an increase of 10% of fruit diameter at harvest were obtained (Fig. 1). The increment in fruit diameter compensated for the reduction of the number of fruits cropped per tree. In hand-thinned trees the diameter of the fruit at harvest increased up to 8.5% (43.6 mm), while the yield decreased. Thus NAA was effective in comparison to hand thinning.

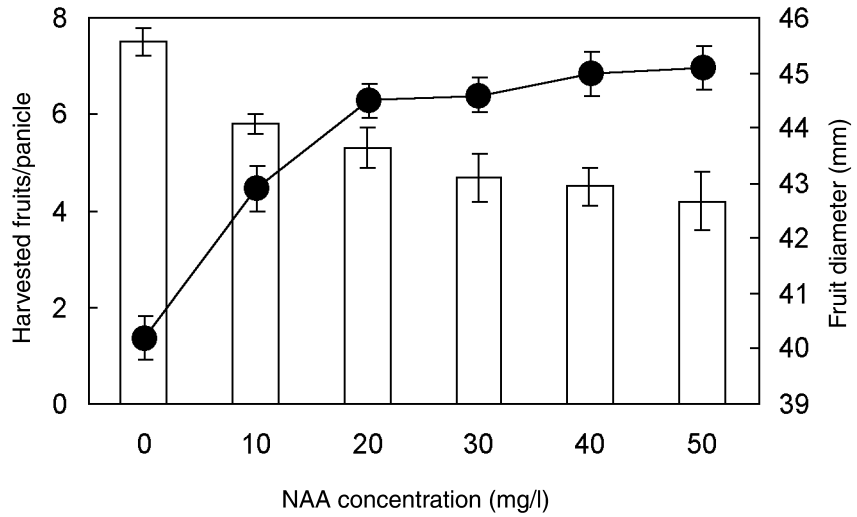

Fig. 1. Effect of NAA concentration on fruit thinning and fruit diameter of 'Algerie' loquat trees at harvest. Values of thinning (boxes) expressed as number of harvested fruits per panicle. Treatments were applied at 2-3 visible fruits per panicle (10-15 days after full bloom) (source: Agustí *et al.,* 2000).

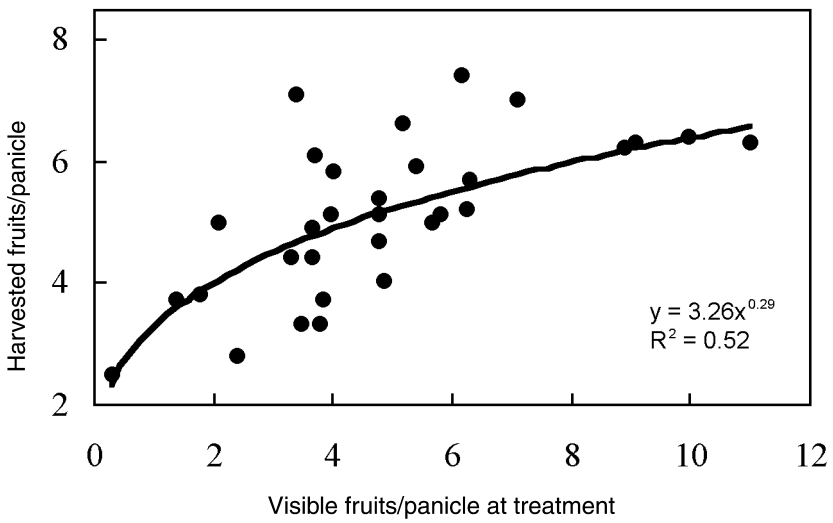

Fig. 2. The relationship between number of visible fruit per panicle at treatment and number of harvested fruits per panicle in 'Algerie' loquat trees. Effect of NAA (20 mg/l) (source: Agustí *et al.,* 2000).

The distribution of commercially acceptable fruits produced by hand-thinned trees is, in spite of their lower average diameter, better than the distribution of commercial fruits produced by NAA-thinned trees. This is due to the growers ability to decide on the number and the position of remaining fruits in the inflorescence in contrast to the non-selective effect of NAA.

Fruit characteristics were significantly altered by the treatment. Flesh resistance to puncturing was reduced and TSS concentration increased at harvest; fruit colour was also increased by treatments. Since fruit size, colour and TSS concentration are the factors that determine the appropriate harvesting date, their increase advanced commercial harvest.

Stimulation of fruit growth to increase fruit size

Application of synthetic auxin at the onset of cell enlargement fruit stage increases final fruit size consistently. The mode of action of these plant growth regulators has been studied in citrus, but it is important to note that their effect is through an enhancement of cell enlargement, not cell division (El-Otmani *et al*., 1993; Agustí *et al*., 1996). Sink strength of developing fruit is increased as a result of auxin treatment. But fruit size can be also increased by increasing carbohydrates availability; changes in translocation and accumulation of carbohydrates as a result of girdling have been reported (Wallerstein *et al*., 1974) and this technique is used successfully to increase fruit size of citrus (Cohen, 1981), apples and pears (Dennis, 1968), peaches and nectarines (Dann *et al*., 1984; Agustí *et al*., 1998).

The application of 2,4-dichlorophenoxypropionic acid (2,4-DP) increases final fruit size of loquat fruit cv. 'Algerie'. The response magnitude depends on the concentration applied and treatment date. When applied at the 702-704 phenological growth stage (Martínez-Calvo *et al*., 1999), 25 mg/l was the most effective treatment for increasing fruit size. Similar results have been obtained by girdling branches in the same date. In both cases, final fruit diameter was increased by 5-7% (Fig. 3).

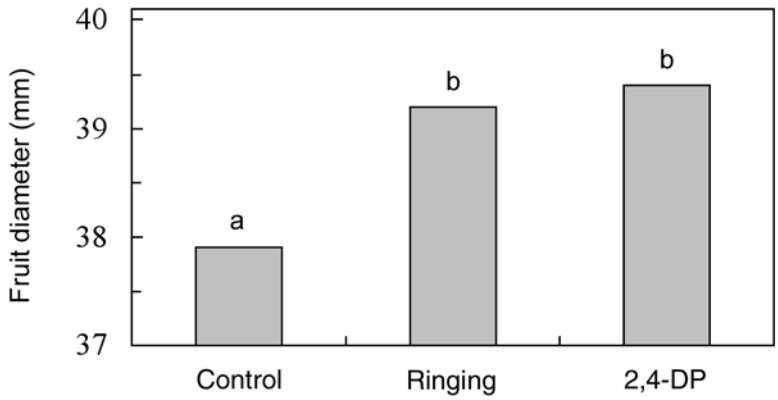

Fig. 3. Effect of 2,4-DP (25 mg/l) and ringing branches of loquat cv. 'Algerie' on the average fruit diameter at maturity. Date of treatment: 702-704 phenological growth stage of BBCH scale. Before treatments a hand thinning was performed. Different letters indicate significant differences.

Outward appearance: Purple spot

Loquat fruit is higher sensitive to purple spot, a physiological disorder that affects crops all over the world. Purple spot is characterized by an extensive area of slightly depressed surface, of purple colour and irregular in shape, that affects up to 30% of the exposed face of the fruit.

It is accepted that the disorder only affects the epidermal fruit tissue (Ojima *et al.*, 1976). Injured areas of fruits with symptoms of purple spot involve several layers of the deepest rind cells (Gariglio *et al*., 2002). They show a fringe of compact and empty cells in cross-section, limited by flesh cells on the internal side and by healthy hypodermal cells on the outward side.

As the symptoms of the disorder aggravate, the number of damaged hypodermal cell layers increases, reaching to total rind tissue of fruits with more severe symptoms of purple spot (Gariglio *et*

al., 2002). Areas of fruit with severe symptoms of purple spot show epidermal and hypodermal cells empty or filled with a mass of shrunken material; consequently cells appear flattened with deformed but not disrupted walls. From then, the surface of fruits shows an undulating appearance in cross-section. In spite of that, cuticle of affected area had a regular morphology with no signs of disruptions and water permeability of isolated cuticles did not show consistent significant differences between injured and healthy fruit (Gariglio *et al*., 2002).

At fruit colour break, that is, at the onset of purple spot appearance, flesh tissue did not show significant differences in mineral composition between healthy and affected fruit. Thus, low calcium concentration does not appear to be the cause of purple spot, as was suggested (Tuset *et al*., 1989; Caballero, 1993).

In loquat, as for other species, fruit thinning reduces competition among developing fruits, thus increasing fruit sugar concentration and significantly modifying fruit development. This new partitioning of photosynthates on behalf of fruit due to thinning is the reason why growers use thinning to improve final fruit size (Faust, 1989; Agustí *et al*., 2000). But fruit thinning also causes a significant increase on the proportion of fruit affected by purple spot, and it means a dependence of purple spot appearance on sugar availability. In fact, in our experiments we found a strong correlation between the proportion of purple spot affected fruit and total sugar concentration (R^2 = 0.961) that allows to conclude that competition for carbohydrates among developing fruits may be responsible for the incidence of purple spot.

Differences in sugar accumulation and purple spot incidence among fruits from trees differing in thinning intensity, suggest an osmotic gradient between flesh and rind tissues as the origin of the damage, it aggravates at fruit colour break, that is, when fruit accumulates almost 90% of sugars (Hirai, 1980). It is also supported by our results showing that purple spot is caused by cellular dehydration originated by endogenous fruit-tree water relationship and not by a water loss from the epidermis out to the atmosphere (Gariglio *et al*., 2002).

Accordingly, application of mineral salts at the onset of fruit colour break increases water potential of epidermal cells (data not shown) and significantly reduces the proportion of purple spot affected fruit (Table 1).

Table 1. Effect of several mineral salts on the proportion of loquat fruit cv. 'Algerie' affected by purple spot at harvest. Date of treatments: 10 March. Values are the average of five replica of 200 fruit each

Treatment	Purple spotted fruit (%)
Control	26.8a
Calcium nitrate (2%)	15.0b
Potassium nitrate (3%)	15.3b
Ammonium nitrate (1%)	16.4

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