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in

Llácer G. (ed.), Badenes M.L. (ed.).
First international symposium on loquat

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 58

2003
pages 113-116

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SUMMARY – The loquat (*Eriobotrya japonica* Lindl.) is a fruit tree of increasing interest in the Mediterranean area; however, there is scarce information respect to the seasonal demand for nutrients in order to set up a fertilization programme. In this work, we have studied the seasonal changes of nutrient concentrations in two types of leaves (summer and autumn) and fruits of the cv 'Algerie'. The contents of most mineral elements were maintained stable in the autumn flush leaves at the end of the flowering. For this reason, we suggested that the kind of leaves sampled in November could be the most adequate tissue and time for nutritional diagnosis.

Key words: Flooding/drip irrigation, macro/micro elements, leaves, fruits.

RESUME – *"Changements saisonniers des concentrations en éléments nutritifs chez le néflier (*Eriobotrya japonica *Lindl.)". Le néflier (*Eriobotrya japonica *Lindl.) est une espèce fruitière dont l'intérêt est croissant dans la zone méditerranéenne; cependant il existe peu d'informations concernant la demande saisonnière en éléments nutritifs qui contribuent à la mise en place des programmes de fertilisation. Dans cette étude nous présentons les évolutions de la concentration en éléments nutritifs des feuilles et des fruits dans le cv 'Algérie'. Etant donné que vers la fin de la floraison (novembre), les feuilles des pousses d'automne ont conservé la concentration de la plupart des éléments nutritifs à un niveau plus stable ainsi qu'un taux de réserve en nutriments mobiles élevé, nous recommandons cette saison ainsi que ce type de feuilles pour tout échantillonnage foliaire à but de diagnostic nutritionnel.*

Mots-clés : *Irrigation par inondation, irrigation goutte-à-goutte, macro-éléments, micro-éléments, feuilles, fruits.*

Introduction

The use of new technologies (drip irrigation, orchard under screen net, etc.) and the expansion of the loquat culture make necessary to know the basic aspects of the fertirrigation that contributes to maintain the yield and to improve the fruit quality. However, there is scarce available information about the doses and timing for the distribution of the fertilizers. There are few works about the seasonal variation in the content of the nutrients (Crescimano and Barone, 1980; Jaime *et al.,* 1987; Tuset *et al.,* 1989; Ding *et al.,* 1995). Therefore, in these studies there is no clear information about something so important like the kind of leaves sampled. For this reason, the objective of the present work was to evaluate the seasonal tendency of the concentrations of macro and micronutrients in the fruit and in the more representative flush leaves during a complete growth cycle. This information would help to know the kind of leaves and timing more adequate for leaf analysis and to establish a rational fertilization program.

Material and methods

The field trial was carried out in twelve orchards of the cv 'Algerie' located at Callosa d'En Sarriá (Alicante). The orchards were selected in representative areas with four cultural practices: 6 under flood irrigation, without or with screen net, 6 under drip irrigation, without or with screen net. The different orchards received the nutrients and water requirements according to the cultural practices used in the area. The experimental unit was replicate 3 times per treatment in a randomized block design with 20 trees per replication. The samples were taken every 21 days and consisted in 4 leaves from the summer vegetative and cluster flushes and a variable number of fruits per tree during the vegetative growth cycle. The concentration of nitrogen was measured by Kjeldahl method, phosphorous by colorimetry, potassium, magnesium, calcium and iron by atomic absorption spectrometry.

Results and discussion

The seasonal changes in the nutrients concentrations showed similar patterns for the four culture conditions studied (flooding and drip irrigation without or with screen net). For this reason, we only presented the results obtained under flooding and drip irrigation conditions without screen net (Fig. 1).

Seasonal changes in the mineral content in leaves

The concentration of the mobile elements (N, P, K and Mg) in summer flush leaves increased from the beginning of August until middle of September and then decreased with the development of the new autumn flush leaves (cluster leaves) in both irrigation conditions. These results showed that summer leaves performed as reserve organs for the new growing tissues. The potassium reduction was more pronounciated than in the other elements during flowering period. Jaime *et al*. (1987) also observed a decrease in these nutrients in the cluster leaves of the preceding cycle and in the new summer flush leaves, when the autumn flush leaves were full expanded. Therefore, Ding *et al*. (1995) found a similar pattern in the concentrations of these elements in spring flush leaves when the development of the summer flush leaves was initiated. By the other hand, the summer and autumn flush leaves accumulated these nutrients during fruit set. The concentrations decreased moderately in both kind of leaves during the growth and ripening fruit period (the decreases in the potassium content was higher than in the rest of elements). This suggests that the potassium accumulated in these leaves contributed noticeably to the fast growth and ripening fruit.

There was an accusated reduction in N and P concentrations in both types of leaves after fruit harvest, that was coincident with the development of the summer flush leaves of the new vegetative cycle. Similar patterns were also observed by Crescimanno and Barone (1980) and Jaime *et al*. (1987).

The concentrations of nutrients with scarce mobility (Ca and Fe) showed progressive increases a long of the growth cycle in both leaves and irrigation conditions. These elements did not decrease during development of autumn flush like nutrients of high mobility did. Ding *et al*. (1995) and Tuset *et al*. (1989) observed a similar tendency in the spring flush leaves when the summer flush leaves appeared.

The contents in Ca and Fe in the summer flush leaves were higher than those found in the autumn flush leaves for the culture conditions studied. However, the opposite tendency was found for the mobile elements. Generally, the nutrient concentrations in the trees under drip irrigation without or with screen net were slightly higher than those found in trees irrigated by flooding.

Seasonal changes in the mineral contents in the fruit

The decrease in the nutrient contents of the fruit was coincident with the enhances of the fruit size. This fact is associated to the dilution effect originated by the biomass increases that occurred during the fruit growing period.

The concentrations of N, P and K was higher to the values found in both leaves when the initial fruit growth was initiated; whereas, these values were similar (Mg) or lower (Ca and Fe) in all experimental conditions. In addition, N values were lower than in leaves at late stage of fruit ripening, P and K values were similar or higher than in leaves, respectively. These patterns were also observed by Tuset *et al.* (1989) and Ding et al. (1995). The behavior of the no mobile elements was quite different due to its scarce mobility in the tissues (Tuset *et al.,* 1989). These elements could be immobilized in leaves like quelates with different acids (oxalic, malate, succinic, etc.) and a lower translocation rate towards the fruits would take place.

The concentrations of N, P, Mg, Ca and Fe decreased an average of 70% for the four treatments studied, from the beginning of the fruit growth until the fruit ripening. However, the potassium content decreased only a 50%, possibly due to a higher rate of translocation from the both types of leaves.

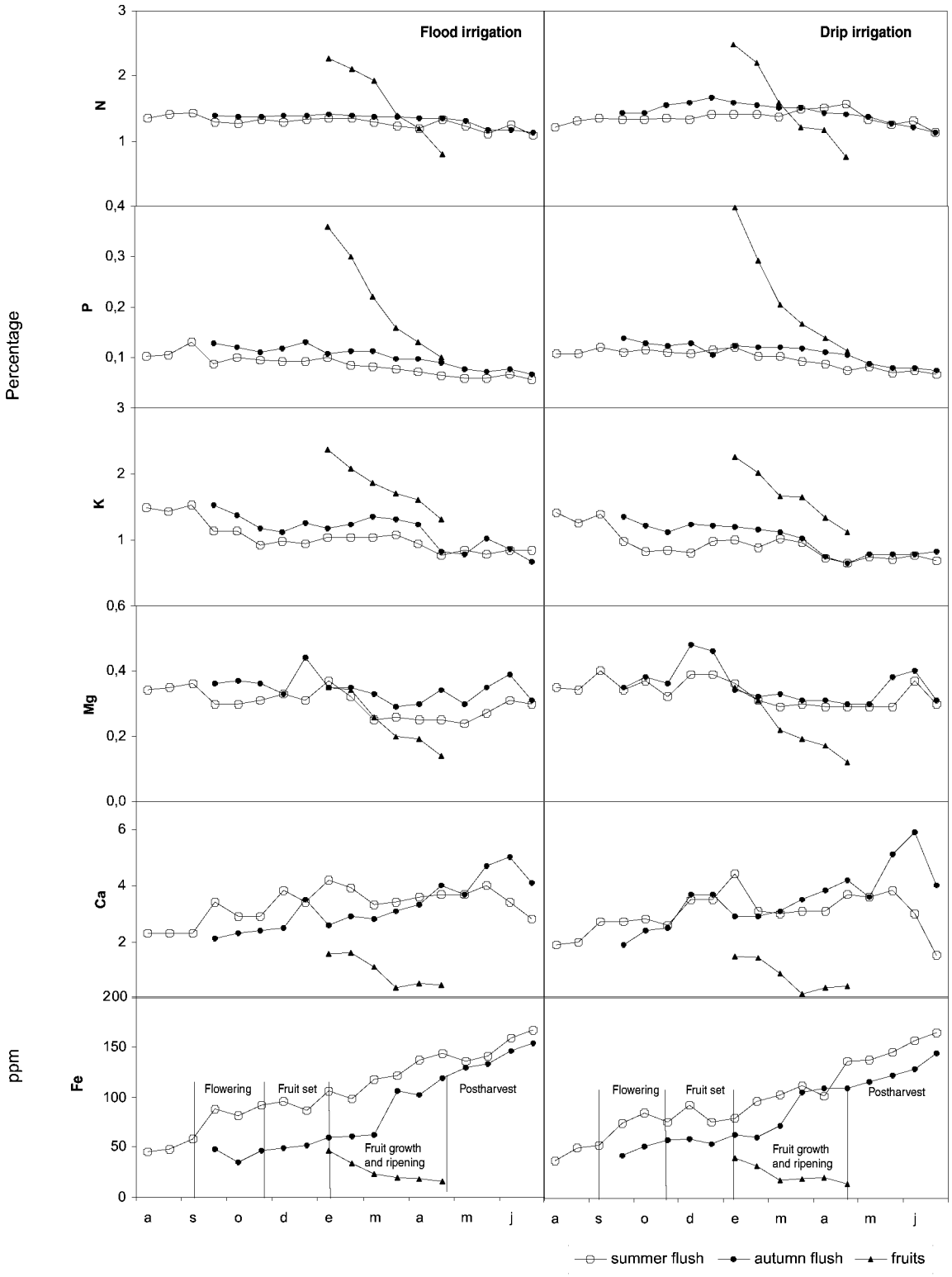

Fig. 1. Seasonal changes of the nutrient concentrations during the vegetative growth cycle (1999-2000). Each value is the mean of 3 orchards cv 'Algerie'.

Conclusions

(i) The nutrient demand for the development of new tissues can be met by the reserve organs and radical absorption in the case of the mobile elements (N, P, K and Mg). However, the roots uptake seems to contribute mainly to the development of the new organs in the case of Ca and Fe.

(ii) The information obtained about seasonal changes of the elements in the critical phenologic stages (development of the new flush leaves and fruit set process) could be very useful to establish a rational fertilization (the doses and timing for the fertilizer applications).

(iii) The mineral content in leaves remains stable towards the end of flowering (November), so this time could be the more adequate moment to sample.

(iv) The autumn flush could be the more representative leaves to be sampled for the nutritional purpose, since present a higher reserve in mobile nutrients in comparison to summer flush leaves.

Acknowledgements

This work was supported by the Cooperativa Agrícola de Callosa d'En Sarriá and by the Spanish Ministry of Science and Technology project to J. Bañuls. We would also like to thank to M.C. Prieto, J. Giner, B. Martín, A. Boix and J.B. Alberola for technical assistance.

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