Irrigation scheduling of an early maturing peach cultivar using tensiometers and diurnal changes in stem diameter

Claude Bussi[a*]
Jean-Gérard Huguet[b]
Jacques Besset[a]
Thierry Girard[a]

[a] Inra-Sriv,
domaine de Gotheron,
26320 Saint-Marcel-lès-Valence,
France

[b] Inra-UR EC.HO,
Centre de recherche d'Avignon,
84140 Montfavet, France

* *Correspondence and reprints*

Received 11 March 1998
Accepted 12 July 1998

Fruits, 1999, vol. 54, p. 57–66

RESUMEN ESPAÑOL, p. 66

Irrigation scheduling of an early maturing peach cultivar using tensiometers and changes in the stem diameter.

Abstract — Introduction. In peach orchards, it is difficult to judge precisely how much and when water should be applied. In comparison with the crop evapotranspiration method, soil and plant based methods provide potential alternatives for irrigation scheduling. Therefore, such two methods were tested to assess the effect of their use on fruit yield and quality for an early maturing peach cultivar. **Materials and methods**. An homogeneous experimental orchard of Royal Glory was divided in two halves; in one half, irrigation was scheduled according to tensiometer measurements, and, in the other half, according to micromorphometer measurements. **Results**. Compared to the tensiometric method, irrigation according to the micromorphometric method induced a significant reduction of the amount of applied water over 4 years (without affecting yield and average fruit weight), tended to enhance fruit total soluble solids, to decrease heterogeneity of fruit diameters within individual trees, and to reduce the peach tree trunk cross-sectional areas. Thus, water restriction in the orchard improved quality and therefore marketable value of peach production. **Discussion**. The micromorphometric method appeared well suited for optimizing irrigation scheduling in peach orchards. Taking these results into account, the tensiometric method has to be improved to be more adapted to peach water needs. (© Elsevier, Paris)

***Prunus persica* / water requirements / irrigation / forecasting /measuring instruments / cropping / fruit quality**

Pilotage de l'irrigation dans un verger de pêchers précoces à l'aide de tensiomètres et de mesures de variations de diamètre de tiges.

Résumé — Introduction. En verger de pêchers, il est difficile d'évaluer la quantité d'eau à apporter et le moment où il faut le faire. Outre la méthode de mesure de l'évapotranspiration, les méthodes basées sur l'observation du sol et de la plante peuvent également permettre de piloter l'irrigation. Par suite, deux telles méthodes ont été testées afin d'évaluer l'impact de leur utilisation sur le rendement et la qualité des fruits d'un cultivar de pêcher précoce. **Matériel et méthodes**. Un verger expérimental homogène de Royal Glory a été divisé en deux parties : dans l'une l'irrigation a été basée sur des mesures tensiométriques, dans l'autre, elle a été pilotée par mesures micromorphométriques. **Résultats**. Par rapport à la méthode tensiométrique, l'irrigation programmée par la méthode micromorphométrique induit une réduction significative de la quantité d'eau appliquée sur une période de 4 ans (sans affecter le rendement et le poids moyen du fruit) et tend à accroître les sucres solubles totaux du fruit, à diminuer l'hétérogénéité du diamètre des fruits à l'intérieur de l'arbre et à réduire les surfaces de section de tronc des pêchers. Ainsi la restriction d'eau occasionnée par l'utilisation de la méthode micromorphométrique dans le verger a permis d'améliorer la qualité et, par conséquent, la valeur commerciale de la production de pêche. **Discussion**. La méthode micromorphométrique apparaît efficace pour optimiser le pilotage de l'irrigation en verger de pêcher. En prenant en compte ces résultats, la méthode tensiométrique doit être améliorée de façon à être mieux adaptée aux besoins en eau du pêcher. (© Elsevier, Paris)

***Prunus persica* / besoin en eau / irrigation / technique de prévision / instrument de mesure / production / qualité du fruit**

1. introduction

In peach orchards, it is difficult to judge precisely how much and when water should be applied. Consequently, several methods have been proposed and used to irrigate to plant requirements [1, 2].

Among those methods, the reference crop evapotranspiration (ET_0) method is frequently used for irrigation scheduling [3]. However, since this method requires several adjustments in terms of canopy size and loss of water from the soil, it is complicated and may affect the accuracy of evaluation of plant water requirements [4]. In comparison with the ET_0 method, soil and plant based methods provide potential alternatives for irrigation scheduling [5, 6].

Soil water potential measurements have been used with success to evaluate plant water consumption [7]. Plant based methods used to schedule irrigation have included the continuous measurement of daily stem diameter variation which is referred to as a micromorphometric method. The micromorphometric method permits the assessment of the water status in the plant and gives estimates about its water needs [8]. Positive results with the micromorphometric method, i.e., fruit quality improvement without reducing yield, have been achieved with late season peach cultivars [9, 10]. Nevertheless, the measurement of stem diameter changes has never been used with an early maturing peach cultivar and important physiological differences have been pointed out between early and late peach cultivars [11].

Hence, it appears necessary to test the micromorphometric method for the use of irrigation scheduling with an early peach cultivar. The tensiometric method will also be used for irrigation scheduling in this experimental orchard.

2. materials and methods

2.1. orchard description

This study was carried out in a peach tree orchard planted in 1989, at Gotheron Experimental Station of the Institut National de la Recherche Agronomique, near Valence in the middle Rhône Valley in France. The soil was stony alluvial with 15% clay, 30% silt and 54% sand, considered particularly suitable for peach tree cropping [12].

Before the peach tree plantation, and to maintain soil fertility and the homogeneity of the experimental area, cereal crops had been sown for three successive years. Homogeneity of the experimental area was checked by weighing the grain harvest for each plot of the future peach tree experiment.

The area of the experimental orchard was approximately 0.5 ha. Royal Glory, an early maturing peach (*Prunus persica* (L.) Batsch) cultivar, grown on GF305 rootstock, was planted in an open vase training system (3.25 × 6.00 m). Approximate dates of flowering, beginning of stages 2 and 3, and harvest were March 15, May 20, June 10 and July 10, respectively. Before planting, K, P, Mg, Ca and organic matter were supplied according to soil fertility analyses and to meet the orchard's requirements [13]. In addition, K was supplied every year after planting because the first application of K had not been sufficient for the duration of the experiment [14]. N was also applied every year at the rate of 100 $kg \cdot ha^{-1}$. Weeds in the tree row were controlled manually by hoeing in the first year, and with one application of bromacil and further seasonal applications of paraquat, when needed in subsequent years. Rye grass was sown between rows to provide permanent ground cover.

A micro jet irrigation system was installed with 2 emitters per tree, in a distance of 1 m from the tree. Each emitter had a discharge rate of 30 $L \cdot h^{-1}$. Irrigation according to tensiometer and micromorphometer measurements was applied from 1992. The experimental orchard was divided in two halves; in one half, irrigation was scheduled according to tensiometer measurements, and, in the other half, according to micromorphometer measurements. Tensiometer devices were installed in the whole experimental orchard to control soil water potential variations in the two halves of this orchard.

Rainfall was assessed on the site and Et_0 calculated using Penman equation.

2.2. experimental arrangement and analysis

The experimental arrangement comprised two plots: tensiometer and micromorphometer. This arrangement was chosen because the homogeneity of the whole experiment had already been checked (see above). For statistical analysis, means were compared using the Newman and Keuls test [15].

2.3. scheduling by tensiometer

Tensiometers were installed in three sites of the tensiometric plot, at a distance of 0.50 m from the emitter, and in depths of 0.30, 0.50, 0.75 and 1.00 m. The trees were irrigated whenever the soil water potential (ψ soil) reached-40 kPa at 0.30 m depth. The volume of water applied in this plot varied with the ψ soil evolution, i.e., if the soil did not raise at 0.50 m depth after irrigation, more water was applied for the following irrigation or conversely. The field capacity was represented by a –10 kPa ψ soil. Throughout the season, trees were irrigated when ψ soil reached –40 kPa at 0.50 m depth. Tensiometers were also installed in the micromorphometric plot to compare the ψ soil in the two plots.

2.4. scheduling by micromorphometer

Stem diameter changes (accuracy ± 50 µm according to Katerji et al. [16]) were assessed with linear variable differential transformers (LVDT) mounted on an INVAR frame and installed upon four peach-tree branches in the micromorphometric plot of the orchard [9]. All sensors were connected to a specific "Pepista" microcomputer [17], that recorded data every 30 min and controlled irrigation. These recorded data allowed defining a Diurnal Growth Increase (DGI) and a Diurnal Stem Shrinkage (DSS) [9]. DGI was taken as the overall change in diameter over time, in 24 h units, since down. DSS was the difference between the maximum diameter usually observed in early morning and the minimum diameter, generally reached in mid-afternoon. Some nil DGI and a 70 µm DSS were both required for at least three sensors among the four installed to automatically start irrigation, according to previous results based on measurement of plant water status, e.g., leaf water potential [9, 18].

2.5. tree growth and yield

Inside each plot (tensiometer and micromorphometer), five single trees were chosen as replications. On these trees, 10 shoots were sampled on which fruit growth (about 150 fruits per plot) was followed. Twice a week, fruit diameters were assessed and, at harvest, their weight, firmness and total soluble solids were determined. Six other trees per treatment were sampled among the trees of the experimental orchard. After the total harvest at dates close to fruit maturity, all fruits from these six trees per treatment were divided into market size classes based on diameters, and their frequency was determined. Fruit yield was also determined at the firm-ripe stage for the rest of the production, i.e., for about 70 trees per plot, by weighing their total harvest. Average fruit weight was calculated on a representative sample of this fruit production (30% of the total harvest). Tree growth was partly evaluated every year in winter by measuring trunk circumference of all the trees at 0.30 m from the ground.

3. results

3.1. water applications according to experimental data

There was less water applied under the micromorphometric method than under the tensiometric method (*table I*). The first irrigation was delayed by one month under the micromorphometric method compared to the tensiometric method: irrigation started at the beginning of June for the ten-

Table I.
Comparison of water amounts applied ($m^3 \cdot ha^{-1}$) in an an early maturing peach cultivar orchard, according to the irrigation scheduling method used.

Year	Tensiometer	Micromorphometer
1992	2 100	0
1993	1 600	850
1994	2 350	1 080
1995	1 850	1 430

siometric method and in July for the micromorphometric method in 1995 (*figure 1*). However, in July and August 1995, water applications were 1 220 and 1 430 $m^3 \cdot ha^{-1}$, respectively, for the tensiometric and micromorphometric methods. Thus, during these 2 months, the amounts of water applied according to the two irrigation scheduling methods differed only slightly.

Nevertheless, the soil water tension was always higher with the tensiometric method, compared to the micromorphometric method, at all soil depths (*figure 2*). The greatest ψ soil differences between the two treatments were detected at 0.30 and 0.50 m in depth. As depth increased, the ψ soil curves resembled each other (*figure 2*). The latter values decreased until heavy rainfall in September (results not shown), showing an absence of irrigation excess in the whole experimental area.

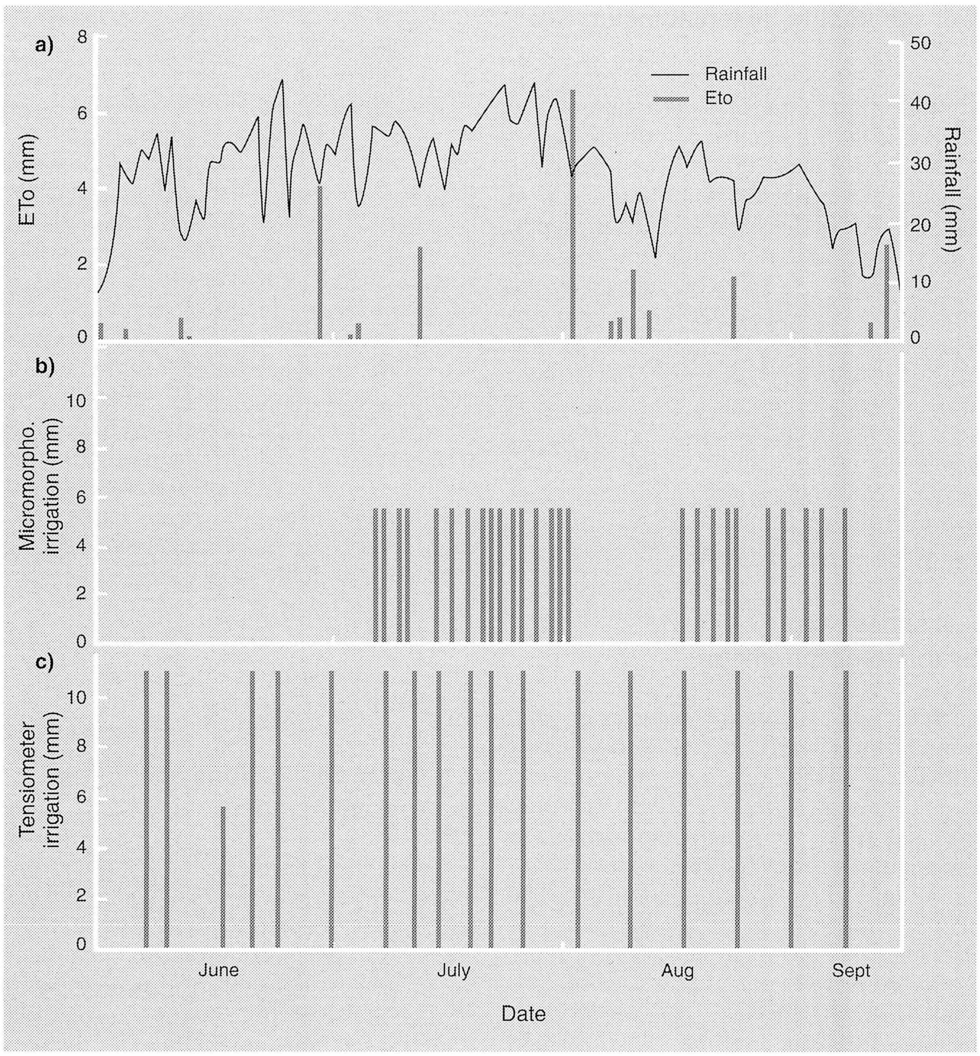

Figure 1.
Seasonal changes in 1995 in:
(a) reference crop evapotranspiration (ET_0) and natural rainfall,
(b) irrigation scheduling for micromorphometer plot,
(c) irrigation scheduling for tensiometer plot.

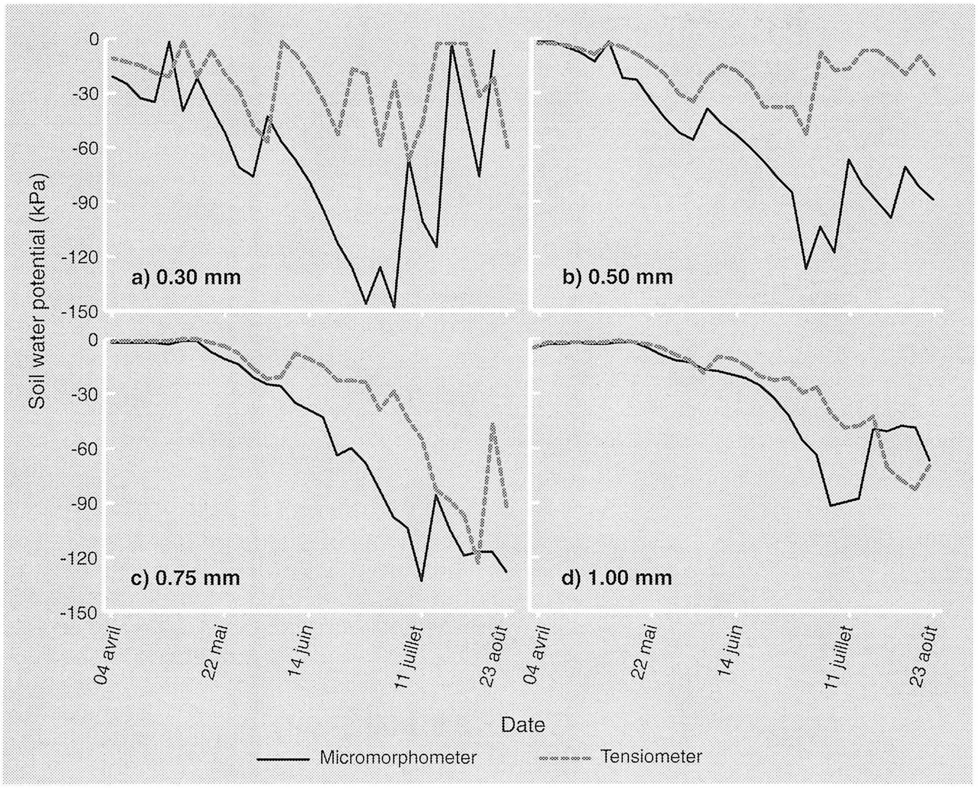

Figure 2.
Soil water potential readings in 1995 for tensiometer and micromorphometer plots. The represented tensions were the means of three readings (three sites) for each depth: 0.30 m (a), 0.50 m (b), 0.75 m (c) and 1.00 m (d).

Furthermore stem diameter variations differed little from one tree to another (*figure 3*). They displayed a rapid tree response after some irrigation: a DGI (Diurnal Growth Increase) enhancement and a DSS (Diurnal Stem Shrinkage) diminution, which pointed to a growth recovery (*figure 3*). On the other hand, water restriction was easily identified by a large DSS (about 70 µm) and a DGI near zero (*figure 3*); this tendency being observed just before an irrigation release.

3.2. tree growth and yield

Yield varied from 15.7 kg to 51.9 kg per tree according to the year (*table II*), bearing no relation to the amounts of water applied (*table I*). Such yield differences from year to year were probably due to climatic conditions, as already mentioned [19].

There were no significant differences in average fruit weight and yield from 1992 to 1995 (*table II*) between these two irrigation treatments, although about 50% more water was applied to the tensiometric plot than to the micromorphometric plot. These results agree with the fruit growth curves obtained (*figure 4*) where there was very little difference between the two treatments. However, there was a significant reduction in tree trunk cross-sectional area (TCA) (*table II*) of the trees irrigated by the micro-

Figure 3.
Irrigation effects on variations of branch diameter in 1993 for two peach trees (cv. Royal Glory). Irrigation was scheduled according to the micromorphometric method, arrows indicated water applications.

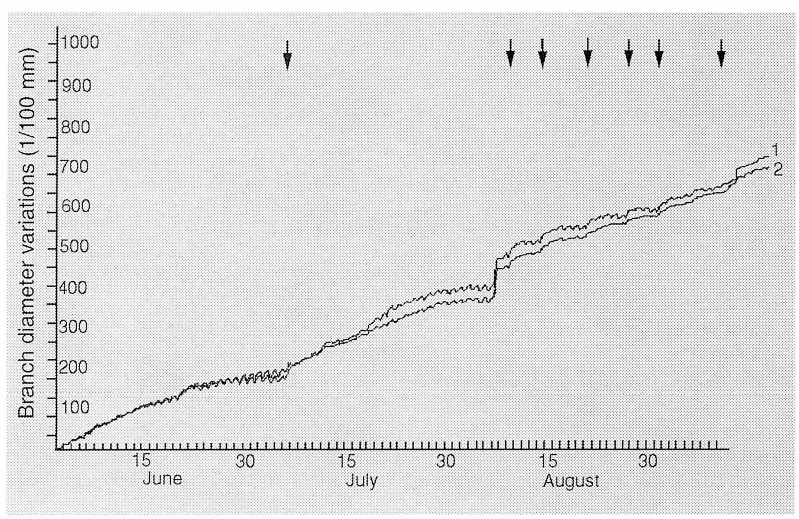

Table II.
Comparison of peach tree (cv. Royal Glory) production and growth according to the irrigation scheduling method used. Yield and average fruit weight were the mean of three replications, each composed of about 20 trees. Trunk cross-sectional areas were measured on every tree of the experimental orchard.

Year of the experiment	Yield (kg per tree)			Average fruit weight (g)			Trunk cross-sectional area (cm^2)		
	Tensio-meter	Micro-morphometer	Standard error ($p = 0.05$)	Tensio-meter	Micro-morphometer	Standard error ($p = 0.05$)	Tensio-meter	Micro-morphometer	Standard error ($p = 0.05$)
1992	43.0	39.0	4.3	165.0	166.0	8.0	113	111	11
1993	17.1	15.7	1.8	173.0	162.0	12.0	147 a	134 b	18
1994	51.9	51.0	2.5	170.0	165.0	11.0	177 a	163 b	23
1995	39.3	42.8	3.8	159.7	158.6	7.0	208 a	192 b	26

Data followed by different letters are significantly different at $p = 0.05$; these letters refer to the comparison between the two treatments for a same year.

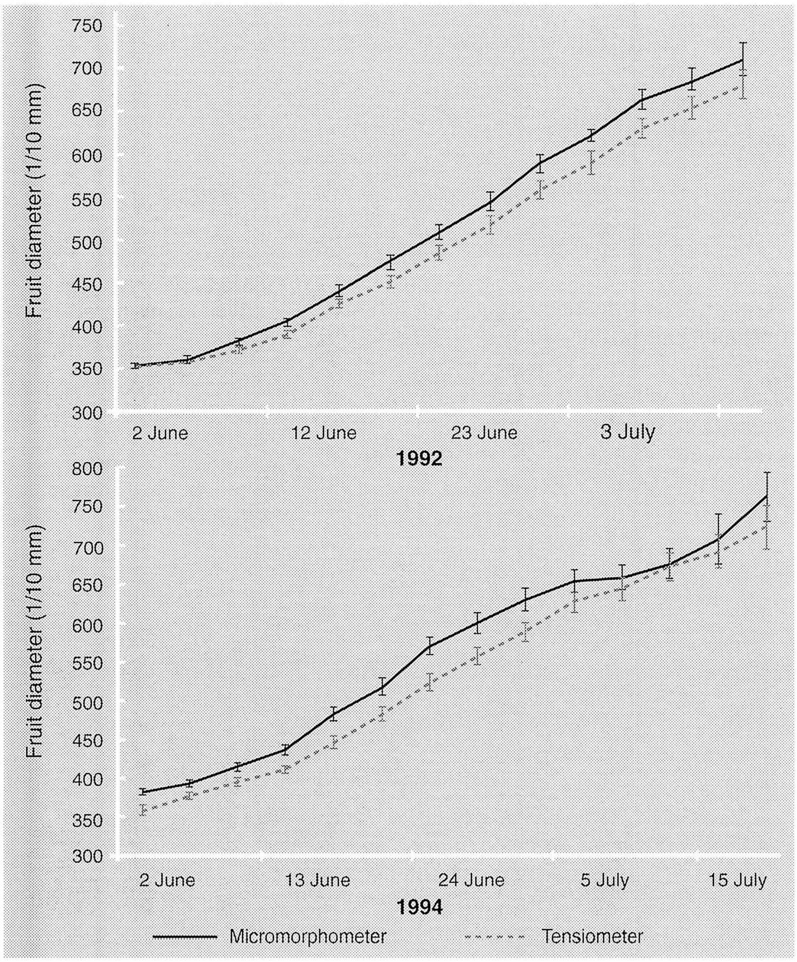

Figure 4.
Seasonal changes in peach diameters in 1992 (a) and 1994 (b) for tensiometer and micromorphometer plots. Figures are for at least 100 fruits for each treatment: Vertical bars denote LSD at $p = 0.05$

morphometric method compared with those irrigated by the tensiometric method, but this growth reduction did not exceed 4.5% of the total growth, and it did not appear to affect the productivity of the trees.

3.3. fruit quality

Every year, total soluble solids were higher in fruits from the micromorphometric treatment compared with those from the tensiometric treatment, significantly so in 1992, 1994 and 1995 (*table III*). The difference between the two treatments represented about 10% of total soluble solids; this difference was significant and represented a valid increase in fruit quality.

Fruit firmness, which is a good indicator of fruit maturity, was not affected by irrigation scheduling (data not shown). This result demonstrated that fruits had been harvested at the same firm-ripe stage over the whole experimental area. Fruit from the tensiometric treatment displayed a small delay (24 to 48 h) in maturity in comparison to fruit from the micromorphometric treatment based on the date of picking (results not shown). This trend was confirmed for the fruit growth curves showing that the micromorphometric fruit diameters were effectively larger than the tensiometric ones (*figure 4*).

Fruit grading (for the sampling of six trees per treatment) showed differences in the fruit diameter partitioning according to

Table III.
Total soluble solids (%) in peach, according to the irrigation scheduling method used in the orchard.

Year	Tensiometer	Micromorphometer	Standard error ($p = 0.05$)
1992	8.1 b	8.7 a	0.5
1993	10.4 ns	11.1 ns	0.9
1994	8.8 b	10.4 a	1.1
1995	9.0 b	9.6 a	0.5

Figures followed by different letters are significantly different at $P = 0.05$.
These letters refer to the comparison between the two treatments for the same year.
ns: not significative difference.

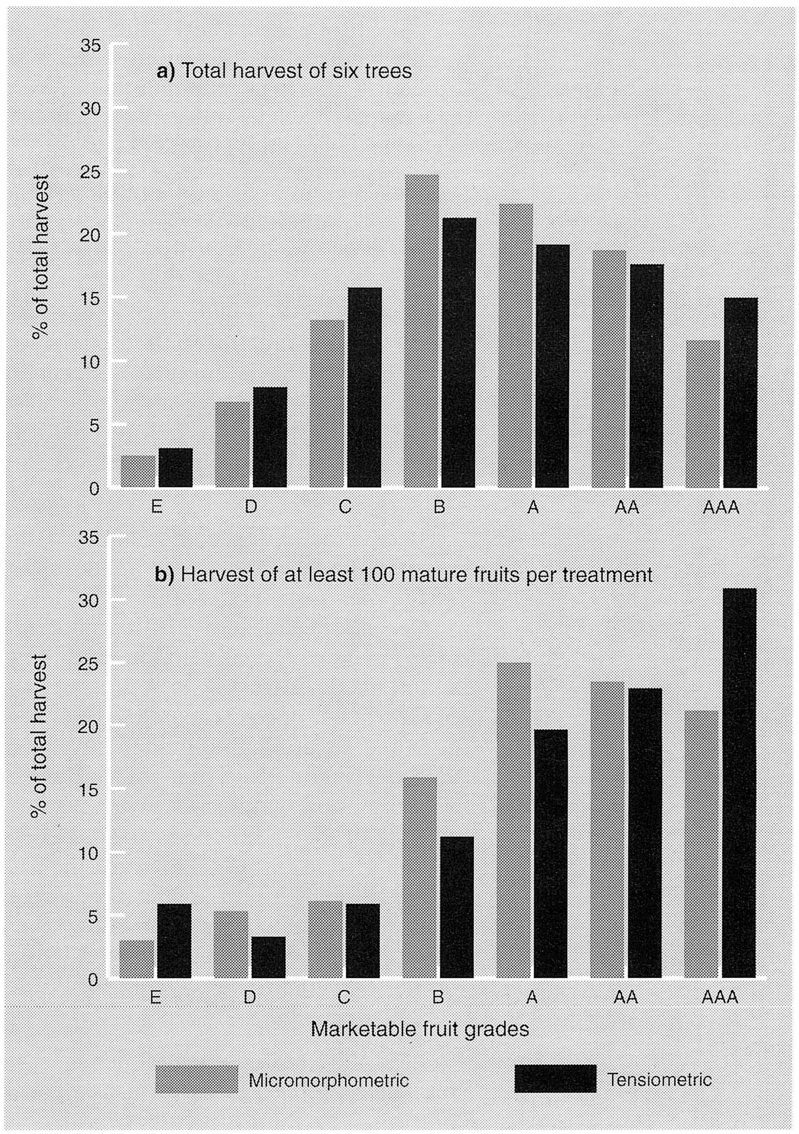

Figure 5.
Peach grade partitioning for irrigation scheduling according to micromorphometric and tensiometric measurements. The sample was constituted by the total harvest in 1995 of six trees (a) or of at least 100 mature fruits (b) per treatment.
Marketable grades correspond to fruit diameters:
E, 45–51 mm; D, 51–56 mm; C, 56–61 mm; B, 61–67 mm; A, 67–73 mm; AA, 73–80 mm; AAA, > 80 mm.

the irrigation schedule (*figure 5a*). The micromorphometric method increased the percentage of the intermediate grades B (61 to 67 mm diameters), A (67 to 73 mm) and AA (73 to 80 mm). The fruit numbers in these three grades were, with the micromorphometric method, 8% higher than those with the tensiometric method. On the contrary, the largest and smallest fruit in AAA (> 80 mm), C (56 to 61 mm) and D (51 to 56 mm) grades were, with the micromorphometric method, 7% less numerous than those with the tensiometric method. Similar results were obtained with other fruit (from ten shoots sampled per tree on five trees) (*figure 5b*), the differences between treatments being accentuated (10% variation between treatments). Furthermore, such results had also been detected for the other years of experimentation (data not shown). The micromorphometric method seemed to contribute to reducing the heterogeneity of the fruit diameters within individual trees.

4. discussion

Compared with tensiometers, micromorphometer used for irrigation scheduling allowed water to be saved in an early maturing peach cultivar Royal Glory (*table I*). This water economy was sufficient to maintain the peach tree rootzone at a lower soil with the micromorphometric method (*figure 2*), particularly at 0.30 and 0.50 m in depth, i.e., where these roots are the most abundant [20]. Despite this water restriction, peach tree performance was equal to greater than the performance obtained with the tensiometric method except for trunk cross-sectional area which was slightly reduced (*tables II, III*). With late maturing peach cultivars, it has been established that optimizing irrigation with the micromorphometric method induced no difference in peach yield and average fruit weight with a small increase in peach total soluble solids, compared to the tensiometric method [9, 20]. These findings were confirmed with an early maturing peach cultivar. Those results corroborate well with other experiments concerning irrigation practice in peach tree orchards which showed little difference in growth, production and fruit average weight when some minimum water was supplied [1, 21]. Important differences were only detected when differences between treatments were emphasized [22, 23].

It has been established that fruit soluble solids are positively correlated with fruit growth rates measured during the latest fruit growth phase [24, 25]. Under our experimental conditions, higher total solids with the micromorphometric method compared to the tensiometric method were effectively linked with a larger fruit diameter increase during the last month before maturity (*figure 4*). This may explain the higher fruit quality obtained.

There were differences related to the fruit grade partitioning (*figure 5*). The micromorphometric method appeared to result in some homogenization of the fruit diameters. That is particularly important as, first, the intermediate grades (B, A and AA) are sold at a better price compared to the lower (C, D and E) and higher grades (AAA) [26, 27]; these intermediate fruit sizes are effectively preferred by the consumers. Second, the fruit diameter homogeneity decreases the fruit sorting cost [28]. However, the fruit diameter homogenization which seemed to be obtained in parallel with irrigation optimization had never been detected before and must be confirmed with other cultivars [11, 29, 30].

Our studies indicate that reducing irrigation water supplies in peach orchards can contribute to improve fruit production. Chalmers and Wilson [31], and Boland et al. [32] showed that the regulated deficit irrigation (RDI) is a valid strategy to reduce irrigation without limiting peach yield. RDI is based on the manipulation of vegetative and fruit growth by strategic application of water stress at critical periods. Our aim was different as including application of reduced water throughout the season with the micromorphometric method and comparing with a classical method of irrigation scheduling based on tensiometry. However, RDI and micromorphometry both led to a reduction of vegetative vigour, without decreasing fruit production and quality. The chosen standards for the micromorphometric method (DGI = 0 and DSS = 70 μm) appear well-suited for optimizing irrigation scheduling in peach orchard, for an early or a late cultivar. However, the tensiometric method has not to be neglected because easy to use. Furthermore, it has to be ameliorated according to the presented data. The soil water potential chosen to start irrigation should obviously be diminished in order to reduce soil at the root periphery and, therefore, to improve fruit quality with the tensiometric method used for irrigation scheduling.

références

[1] Reeder B.D., Effect of trickle irrigation on peach trees, HortScience 14 (1979) 36–37.

[2] Garnier E., Berger A., Testing water potential in peach tree as an indicator of water stress, J. Hort. Sci. 60 (1985) 47–56.

[3] Elfving D.C., Crop response to trickle irrigation, Hort. Rev. 4 (1982) 1–48.

[4] Decroix M., Puech J., Le pilotage de l'irrigation à la parcelle, in: Inra, conférence internationale « Les besoins en eau des cultures », Inra-Press, Paris, France 11–14 septembre 1984, 693–742.

[5] Klein I., Drip irrigation based on soil matric potential conserves water in peach and grape, HortScience 18 (1983) 942–944.

[6] Huguet J.G., Li S.H., Lorendeau J.Y., Pelloux G., Specific micromorphometric reactions of fruit trees to water stress and irrigation scheduling automation, J. Hort. Sci. 67 (4) (1992) 602–610.

[7] Hendrickx J.M.H., Wierenga P.J., Nash M.S., Variability of soil tension and soil water content, Agr. Water Manage. 18 (1990) 135–148.

[8] Huguet J.G., Appréciation de l'état hydrique d'une plante à partir de variations micrométriques de la dimension des fruits ou des tiges au cours de la journée, Agronomie 5 (1985) 733–741.

[9] Li S.H., Huguet J.G., Bussi C., Irrigation scheduling in mature peach orchard using tensiometers and dendrometers, Irr. Drain. Sys. 3 (1989) 1–12.

[10] Li S.H., Huguet J.G., Schoch P.G., Response of peach tree growth and cropping to soil water deficit at various phenological stages of fruit development, J. Hort. Sci. 64 (5) (1989) 541–552.

[11] DeJong T.M., Doyle J.F., Day K.R., Seasonal patterns of reproductive and vegetative sink activity in early and late maturing peach cultivar, Physiol. Plant. 71 (1987) 83–88.

[12] Bornand M., Étude pédologique dans la vallée du Rhône, Centre de recherches agronomiques du Midi, Inra Éditions, Montpellier, France, 1968.

[13] Huguet J.G., Pratique de la fertilisation minérale des arbres fruitiers, Invuflec (Éd.), Paris, France, 1978.

[14] Remy J.C., Marin-Laflèche A., L'analyse de terre : réalisation d'un programme d'interprétation automoatique, Ann. Agron. 24 (4) (1993) 607–632.

[15] Pearce S.G., Field experimentation with fruit trees and other perennial plants, in: Technical communication n° 23 of the commonwealth bureau of horticulture and plantation crops, Commonwealth Agricultural Bureau, East Malling, Maidstone, Kent, 1953.

[16] Katerji N., Tardieu F., Berthenod O., Quetin P., Behavior of maize stem diameter during drying cycles: comparison of two methods for detecting water stress, Crop Sci. 34 (1994) 165–169.

[17] Pelloux G., Lorendeau J.Y., Huguet J.G., Pepista: translation of plants behaviour by the measurement of diameters of stem or fruit as a self-adjusted method for irrigation scheduling, in: Proceeding of 3rd International Congress for Computer Technology, Deutsch Landwirtschafts-Gesellschaft, Frankfurt-am-Main, Germany, 1990, 229–235.

[18] Simonneau T., Habib R., Goutouly J.P., Huguet J.G., Diurnal changes in stem diameter depend upon variations in water content: direct evidence in peach trees, Exp. Bot. 44 260 (1993) 615–621.

[19] Bussi C., Huguet J.G., Besset J., Girard T., Effects of nitrogen fertilization applied during trickle irrigation on the growth and fruit yield of peach, Eur. J. Agro. 3 (3) (1994) 243–248.

[20] Li S.H., Huguet J.G., Production, qualité des fruits et croissance de pêchers soumis à différents régimes d'alimentation hydrique, Fruits 44 (4) (1989) 225–232.

[21] Daniell J.W., Effect of trickle irrigation on the growth and yield of 'Loring' peach trees, J. Hort. Sci. 57 (1982) 393–399.

[22] Feldstein J., Childers N.F., Effect of irrigation on fruit size and yield of peaches in Pennsylvania, Proc. Am. Soc. Hort. Sci. 69 (1957) 126–130.

[23] Horton B.D., Wehunt J.H., Edwards J.H., Bruce R.R., Chesnee J.L., The effects of drip irrigation and soil fumigation on 'Redglobe' peach yields and growth, J. Am. Soc. Hort. Sci. 106 (1981) 438–443.

[24] Genard M., Bruchou C., Souty M., Variabilité de la croissance et de la qualité chez la pêche et liaison entre croissance et qualité, Agronomie 11 (1991) 829–845.

[25] Genard M., Bruchou C., Multivariate analysis of within-tree factors accounting for the variation of peach fruit quality, Sci. Hortic. 52 (1992) 37–51.

[26] Layne R.E.C., Tan C.S., Influence of cultivars, ground covers, and trickle irrigation on early growth, yield, and cold hardiness of peaches on Fox sand, J. Am. Soc. Hort. Sci. 113 (4) (1988) 518–525.

[27] Aulagnier M., La production de pêches de qualité gustative supérieure, Informations techniques du Cemagref n° 85, feuillet 6, Paris, France, 1992, 8 p.

[28] Layne R.E.C., Tan C.S., Long-term influence of irrigation and tree density on growth, survival, and production of peach, J. Am. Soc. Hort. Sci. 109 (1984) 795–799.

[29] Chalmers D.J., van den Ende B., A reappraisal of the growth and development of peach fruit, Aust. J. Plant. Physiol. 2 (1975) 623–634.

[30] Mitchell P.D., Chalmers D.J., The effect of reduced water supply on peach tree growth and yield, J. Am. Soc. Hort. Sci. 107 (1982) 853–856.

[31] Chalmers D.J., Wilson I.B., Productivity of peach tree, tree growth and water stress in relation to fruit growth and assimilate demand, Ann. Bot. 42 (1978) 285–294.

[32] Boland A.M., Mitchell P.D., Jerie P.H., Goodwin I., The effect of regulated deficit irrigation on tree water use and growth of peach, J. Hort. Sci. 68 2 (1993) 261–274.

Pilotaje de la irrigación en un vergel de melocotoneros precoces con ayuda de tensiómetros y de mediciones de variaciones de diámetro de tallos.

Resumen — **Introducción**. En vergel de melocotoneros, resulta difícil evaluar la cantidad de agua que aportar y el momento en que hay que hacerlo. Además del método de medición de la evapotranspiración, los métodos basados en la observación del suelo y de la planta pueden igualmente permitir pilotar el riego. Más tarde, se sometieron a prueba semejantes métodos a fin de evaluar el impacto de su utilización en el rendimiento y la calidad de los frutos de un cultivar de melocotonero precoz. **Material y métodos**. Un vergel experimental homogéneo de Royal Glory fue dividido en dos partes: en una de ellas el riego fue basado en mediciones tensiométricas, en la otra, fue guiada por mediciones micromorfométricas. **Resultados**. En comparación con el método tensiométrico, el riego programado por el método micromorfometrico induce una reducción significativa de la cantidad de agua aplicada en un período de 4 años (sin tener influencia sobre el rendimiento y el peso medio del fruto) y tiende a incrementar los azucares solubles totales del fruto, a disminuir la heterogeneidad del diámetro de los frutos dentro del árbol y a reducir las superficies de sección de tronco de los melocotoneros. Asimismo la restricción de agua provocada por el uso del método micromorfometrico en el vergel permitió mejorar la calidad y, por consiguiente, el valor comercial de la producción de melocotones. **Discusión**. El método micromorfometrico aparece eficaz para optimizar el pilotaje del riego en vergel de melocotón. Al tomar en cuenta estos resultados, el método tensiométrico debe mejorarse de manera a adaptarse mejor a las necesidades de agua del melocotonero. (© Elsevier, Paris)

Prunus persica **/ necesidades de agua / riego / tecnicas de predicción / instrumentos de medición / rendimiento / calidad del fruto**