HORTSCIENCE 31(1):162. 1996.

Fruit Characteristics of 'Hosui' Asian Pears after Deficit Irrigation

Horst W. Caspari[1], M. Hossein Behboudian, and David J. Chalmers[2]
Department of Plant Science, Massey University, Palmerston North, New Zealand

Brent E. Clothier
HortResearch, Private Bag 11030, Palmerston North, New Zealand

Fritz Lenz
Institut für Obstbau und Gemüsebau, Universität Bonn, Bonn, Germany

Additional index words. Pyrus serotina, Nashi, irrigation management, fruit quality

Regulated deficit irrigation (RDI) has been used successfully to control the canopy size of various fruit crops, including Asian pear (*Pyrus serotina* Rehder) (Caspari et al., 1994). No reductions in fruit size and yield ensued. The most-often reported effect of RDI on fruit quality is an increase in the soluble solids concentration (SSC) (Ebel et al., 1993). For apple (*Malus domestica* Borkh.), water deficit advances fruit maturity as indicated by either internal ethylene concentration (Ebel et al., 1993) or color development (Mills et al., 1994). Data on fruit acidity, flesh firmness, and mineral concentration are, however, inconsistent.

We have been interested in using deficit irrigation to control the vegetative growth of the vigorous Asian pear 'Hosui'. Before deficit irrigation can be recommended commercially for 'Hosui', however, an understanding of its effects on tree growth, fruit growth, quality, and storage life is required. Caspari et al. (1994) has reported the effect of deficit irrigation on tree growth, fruit growth, and yield. Here, we present information on the effect of these irrigation treatments on fruit quality at harvest and following storage.

Twelve 5-year-old 'Hosui' Asian pear trees grafted on *Pyrus serotina* seedling rootstock and trained to a Tatura trellis were grown in 12 large drainage lysimeters at the research orchard of Massey Univ., near Palmerston North, New Zealand. During the 1991–92 growing season, three irrigation treatments were applied: a fully irrigated control, regulated deficit irrigation before (RDI) and during rapid fruit growth [late deficit irrigation (LDI)]. For RDI and LDI, irrigation was adjusted to maintain soil water content at ≈50% and 75% of pot capacity, respectively. The RDI was applied from 42 to 115 days after full bloom (dafb) and LDI from 126 to 159 dafb. Outside these periods, trees of RDI and LDI were irrigated similar to the control. Caspari et al. (1994) gave a full description of irrigation treatments.

Full bloom was on 14 Sept. 1991. The fruit were thinned 53 dafb to ≈18 fruit/m^2 canopy surface area. The first fruit were harvested 150 dafb. Harvest was based on New Zealand color charts, and fruit were picked at color grades 3 and 4. All remaining fruit were harvested 158 dafb.

From the first harvest only, a minimum of 20 fruit per treatment were analyzed for fruit quality at harvest and after 4, 8, and 12 weeks of storage at 0C. Fruit were weighed and flesh firmness was determined at two locations after skin removal. The fruit (380) were cut open and visually examined for disorders. The SSC (percent) was measured with a hand-held refractometer on two samples from the outer cortex in the equatorial region of the fruit.

At each sampling time, five fruit samples per treatment were taken for analysis of simple carbohydrates. Sample preparation followed the procedure of Pesis et al. (1991). Glucose, fructose, sucrose, and sorbitol concentrations (fresh weight basis) were determined by high-pressure liquid chromatography using a carbohydrate column (HPX87C; Bio-Rad Aminex, Hercules, Calif.) with a de-ashing guard column.

Three mixed samples, each comprising tissue taken from the outer cortex in the equatorial region of five fruit, were taken after 12 weeks of storage at 0C for mineral analysis. After freeze-drying, total P and N were determined following Kjeldahl digestion by colorimetric autoanalysis methods. The concentration of K, Ca, Mg, Zn, and Mn was determined following nitric acid digestion by atomic emission or absorption spectrophotometry. Minerals were based on dry weight.

There was no significant difference in either fruit size distribution or color grade distribution between treatments (data not shown). However, 82% of fruit were harvested at the first harvest for RDI, but only 66% and 67% of fruit were harvested for the control and LDI.

Fruit firmness and SSC, averaging 37.5 N and 11.9%, respectively, were not influenced by the irrigation regimes. Fruit only softened during the first 4 weeks of storage as firmness significantly ($P = 0.004$) dropped from 37.5 N to ≈32 to 33 N. The concomitant increase in SSC was nonsignificant ($P = 0.087$). Starch levels in mature fruit are very low so that further increases in soluble sugars after harvest are insignificant (Lallu, 1990).

Neither the concentration of fruit sugars nor the concentration of fruit minerals was affected by irrigation treatments. Mean sucrose, glucose, fructose, and sorbitol concentrations were 1.9, 11.8, 40.0, and 16.4 mg·g^{-1}, respectively. Mean N, P, K, Ca, and Mg concentrations were 3.50, 0.83, 13.81, 0.25, and 0.56 mg·g^{-1}, and Zn and Mn were 7.00 and 4.20 mg·kg^{-1}, respectively. Behboudian and Lawes (1994) also found no effect of an early or late water deficit on the mineral concentration of 'Nijisseiki' Asian pears. In contrast, Griffiths et al. (1992) found RDI fruit contained less N and K than control fruit, while P, Ca, and Mg levels were not affected by irrigation.

No fruit disorders were detected; thus, RDI or LDI did not lead to disorders. This finding is similar to results from Griffiths et al. (1992), who found no effect of RDI on the incidence of flesh spot decay in 'Nijisseiki' Asian pears. In contrast, Behboudian and Lawes (1994) reported that water stress during early fruit growth promoted flesh spot decay in 'Nijisseiki' Asian pears, but a late water stress reduced it. The fact that disorders were absent in 'Hosui' fruit harvested in either 1992 or 1991 (data not shown) supports the observation by Lallu (1990) that 'Hosui' fruit are only slightly susceptible to flesh spot decay and watercore, while 'Nijisseiki' is highly susceptible to both. Thus, the difference in results likely is explained by the difference in cultivars.

Except for fruit size (Caspari et al., 1994), there were no significant differences in fruit quality between irrigation treatments. No disorders were observed in any of the fruit at harvest or following storage at 0C for ≤12 weeks. Because of the negative effects of a late water deficit on fruit size (Caspari et al., 1994), water should be readily available for 'Hosui' Asian pears at least until 1 week before harvest. In contrast, RDI can be used to control vegetative growth during early stages of fruit growth without detrimental effects on either fruit size or fruit quality.

Literature Cited

Behboudian, M.H. and G.S. Lawes. 1994. Fruit quality in 'Nijisseiki' Asian pear under deficit irrigation: Physical attributes, sugar and mineral content, and development of flesh spot decay. N.Z. J. Crop Hort. Sci. 22:393–400.

Caspari, H.W., M.H. Behboudian, and D.J. Chalmers. 1994. Water use, growth, and fruit yield of 'Hosui' Asian pears under deficit irrigation. J. Amer. Soc. Hort. Sci. 119:383–388.

Ebel, R.C., E.L. Proebsting, and M.E. Patterson. 1993. Regulated deficit irrigation may alter apple maturity, quality, and storage life. HortScience 28:141–143.

Griffiths, K.M., M.H. Behboudian, and M. Dingle. 1992. Irrigation management and fruit quality in Asian pear. HortScience 27:627. (Abstr.)

Lallu, N. 1990. Fruit growth, handling, and storage, p. 53–59. In: A.G. White (ed.). Nashi—Asian pear in New Zealand. DSIR Publishing, Wellington, New Zealand.

Mills, T.M., M.H. Behboudian, P.Y. Tan, and B.E. Clothier. 1994. Plant water status and fruit quality in 'Braeburn' apples. HortScience 29:1274–1278.

Pesis, E., P. Long, and E. Hewett. 1991. Compositional changes in kiwifruit infected with *Botrytis cinerea* 1. In vivo studies. N.Z. J. Crop Hort. Sci. 19:405–412.

Received for publication 1 Sept. 1995. Accepted for publication 25 Oct. 1995. H.W.C.'s research was supported by a grant from Gottlieb Daimler und Karl Benz Stiftung, Ladenburg, Germany. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

[1]Current address: HortResearch, Marlborough Research Centre, Private Bag 1007, Blenheim, New Zealand.
[2]Current address: RMB 6107, Longwood, Vic. 3665, Australia.