Leaf cultivar influences composition and ripening of apples

POMOLOGICAL literature contains two reports of the influence of grafted scions on the size, colour and ripening season of apples borne on the stock portions of topworked trees[1,2]. The experiment reported here, initiated as part of of a larger study of apple ripening control mechanisms, confirms those reports.

Buds from a Lodi apple tree were grafted into branches of several Golden Delicious apple trees. When the Lodi scions bore fruit, half the scion branches were defoliated in early July, one month before the normal Lodi ripening season. Thereafter, these Lodi fruits received synthates translocated from Golden Delicious leaves. In late July, gas-sampling tubes (8 mm in diameter × 40 mm) were secured with grafting wax to the intact calyx ends of these Lodi fruits; the open end of each tube was fitted with a serum cap. Similar tubes were also secured to Lodi fruits borne on the other scion branches which still had Lodi leaves attached. The atmosphere inside the gas-sampling tubes equilibrated with apple internal atmospheres. A 1-cc syringe was used on alternate days to withdraw gas samples from the tubes and ethylene present in the samples was determined as described previously[3]. The ethylene analyses indicated the Lodi apples fed with synthates translocated from Golden Delicious leaves ripened slightly earlier than Lodi apples fed with synthates translocated from their own leaves.

In the second season, half of the Lodi-fruited branches were girdled in early July to prevent translocation of synthates from Golden Delicious leaves. On the same date, all the leaves were removed from the remainder of the fruited Lodi limbs. Lodi fruits on defoliated limbs received synthates translocated from Golden Delicious leaves. To ensure comparable accumulation of Golden Delicious leaf synthates in Lodi apples on the defoliated scions, bark girdles were located a few side branches below the Lodi graft unions. A similar procedure was followed in mid-September for limbs bearing Golden Delicious fruits.

Lodi fruits were judged to be ripe when the ethylene in the gas-sample tubes reached 10 p.p.m. or higher; or when, in a few cases, the fruits abscised or split open. Golden Delicious fruits, which ripen with lower levels of ethylene, were judged to be ripe when ethylene in the gas-sample tubes was 4.5 p.p.m. or higher. The data (Fig. 1) indicate that Lodi and Golden Delicious apples fed with synthates translocated from Golden Delicious leaves ripened 5–7 d earlier than comparable apples fed with synthates translocated from Lodi leaves. Although the source of the synthates influenced the time of fruit ripening, the source of the synthates did not seem to influence the level of ethylene in the apples once they began to ripen on the tree.

During the Golden Delicious ripening season, red stripes appeared on fruits fed with Lodi leaves. An analysis of skin composition indicated that, in comparison with similar fruit fed with Golden Delicious leaves, fruit fed with Lodi leaves contained higher levels of anthocyanin and flavonols, but similar levels of soluble carbohydrates, starch and flavolans (Table 1).

Table 1 Skin composition of Golden Delicious apples from girdled limbs fed with synthates from Golden Delicious or Lodi leaves

Leaves	Soluble carbohydrate (mg cm^{-2}) (4)	Starch (mg cm^{-2}) (4)	Anthocyanin (nmol cm^{-2}) (5)	Flavonols (nmol cm^{-2}) (6)	Flavolans as monomers (µmol cm^{-2}) (5)
Golden Delicious	3.0	0.69	0.84	47.9	0.95
Lodi	2.9	0.75	4.09	101.0	0.90

Reference numbers in parentheses.

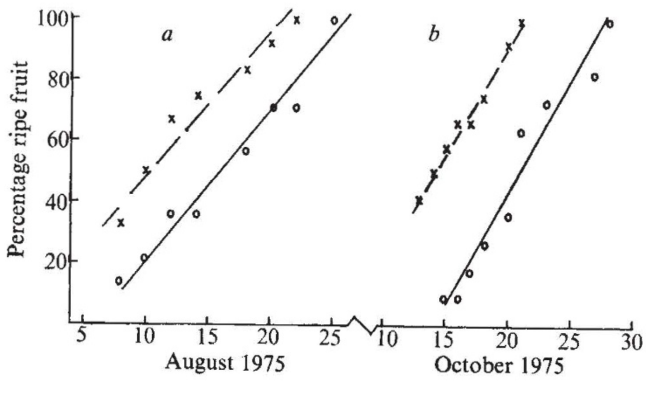

Fig. 1 Ripening of *a*, Lodi and *b*, Golden Delicious apples borne on limbs fed with synthates from Golden Delicious (×) or from Lodi (○) leaves. In each of the four treatments there was a total of 16 fruits on 6–10 trees.

In summary, our analytical study verified orchard observations made in 1880 and 1927 that the cultivar of apple leaves may influence the composition and the time of ripening of apple fruits.

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Watering converts a CAM plant to daytime CO_2 uptake

THREE different photosynthetic options have been identified in plants[1,2]: (1) most plants have the reductive pentose phosphate or C_3 pathway, where CO_2 is incorporated into ribulose-1,5-diphosphate (RuDP) to yield two molecules of 3-phosphoglyceric acid, a three-carbon compound; (2) the C_4 mode, where the first photosynthetic products are four-carbon dicarboxylic acids like oxaloacetate and malate formed following CO_2 incorporation into phosphoenolpyruvate (PEP); and (3) crassulacean acid metabolism (CAM), found in many succulent plants growing in arid regions. In the last, stomatal opening and net CO_2 uptake occur at night, CO_2 being incorporated by way of PEP carboxylase into organic acids. The tissue acidity decreases as the organic acids are decarboxylated