Acid fog injury

These experiments indicated that most crops are quite tolerant to acid fog, but would be injured at acidity levels near pH 3. Most injury occurred on the most exposed portion of the plant canopy. Injury became more severe as acidity increased toward pH 2. A single two-hour exposure to acidic fog at pH 2.8 or greater caused low injury to most plants. Marketability of several crops (cauliflower, spinach, lettuce) was reduced at acidity levels of pH 2.4 to 2.6. Acidities greater than pH 2 were required to reduce crop yield, and then only after repeated exposure. Celery and onions were injured but had no loss in yield after several exposures to fog as great as pH 1.6. Injury to foliage after eight total hours of intermittent exposure to fog over several weeks is illustrated in figures 1 to 4.

Examination of acidity at leaf surfaces of plants exposed to acid fog revealed that leaf tissue was able to neutralize acidic input. Neutralization capacity varied with plant species. As expected, leaves neutralized less acidic fogs more readily than those with high amounts of acidity. The mechanism of this neutralization was not determined in these studies, but neutralization apparently takes place at the leaf surface where buffering chemicals are transferred from inside the leaf. Species varied in susceptibility to injury from acidic fog even though they demonstrated similar capacities to neutralize acidity.

Conclusions

Although injury to vegetable crops can occur from exposure to acidic fog, ozone still accounts for most yield loss from air pollutants in California.

A more subtle effect of acid fog may be host/pest or host/disease interactions. In our field studies, severity of insect and disease injury to crops appeared to be influenced by exposure to acidic fog. Incidence of bacterial soft rot on lettuce, Rhizoctonia basal stalk rot on celery, and cabbage looper feeding on spinach were all increased at low pH fog treatment levels. The mechanisms for these interactions were not determined in these studies. Our results suggest, however, that exposure of crops to acid fog may affect pest management strategies by increasing the need for pesticides for insect or disease control.

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Persimmons for California

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Oriental persimmons were probably introduced into Europe from Japan by early silk and tea traders. Europeans, especially the Italians, refer to the persimmon, *Diospyros kaki* L. (Ebenaceae family), by the Japanese name kaki. This is because the name persimmon is strictly American, of Algonquian origin. In 1856, Commodore Matthew C. Perry obtained persimmon seeds when the American naval fleet visited Japan. He had them planted on the grounds of the Naval Observatory, near Washington, D.C., but none of the seedlings survived.

Later, the U.S. Department of Agriculture (USDA) imported from the Orient a large number of cultivars as well as the species *D. lotus*, which is commonly used as a rootstock for *D. kaki* cultivars. These and other cultivars brought over by Japanese and Chinese immigrants before 1919 were propagated at the USDA Plant Introduction Garden then in Chico, California. The USDA station at Beltsville, Maryland, also assembled many cultivars, which were distributed primarily to the southern states.

In 1919, a quarantine was imposed on the importation of persimmons to prevent introduction of diseases and insect pests. Many cultivars from the Chico Plant Introduction Garden were repropagated on the University of California campus at Los Angeles and at the UC Wolfskill Experimental Orchards in Winters. Part of the UCLA collection was moved to the UC South Coast Field Station in Santa Ana in 1960.

The distribution of cultivars from these sites, nurseries, and individual growers provided the nucleus of the persimmon industry in California. Some cultivars assembled at the Chico Plant Introduction Garden were subsequently discovered to have been mislabeled, misspelled, or carried under the provincial names of their points of origin in China, Korea, or Japan when they were introduced. Researchers in California, Italy, and Israel noticed that a cultivar presumed to be Fuyu that was distributed from Chico occasionally bore male flowers, whereas other Fuyu trees did not. Male flowers have never been reported on the original Fuyu trees in Japan. In Italy and Israel, the cultivar that bears male flowers is referred to as the California Fuyu, because the cultivar was initially sent to these countries from California.

Although the fruits of Fuyu and California Fuyu or Cal-Fuyu are indistinguishable in shape, size, and color, the two clones should be marketed as separate cultivars. During our attempt to clear up the confusion in names and identification of other persimmon cultivars, we found these two clones to be genetically different. Leaves sampled from trees growing in the two campus collections were analyzed for isozyme patterns using starch gel electrophoresis (as described by Tao and Sugiura, *HortScience* 22:932-35, 1987). Cal-Fuyu and Fuyu differ from one another in their GPI (glucose-phosphate isomerase) patterns but are nearly alike in their PGM (phosphoglucomutase) patterns (fig. 1). GPI patterns of Fuyu and Jiro are indistinguishable, but the

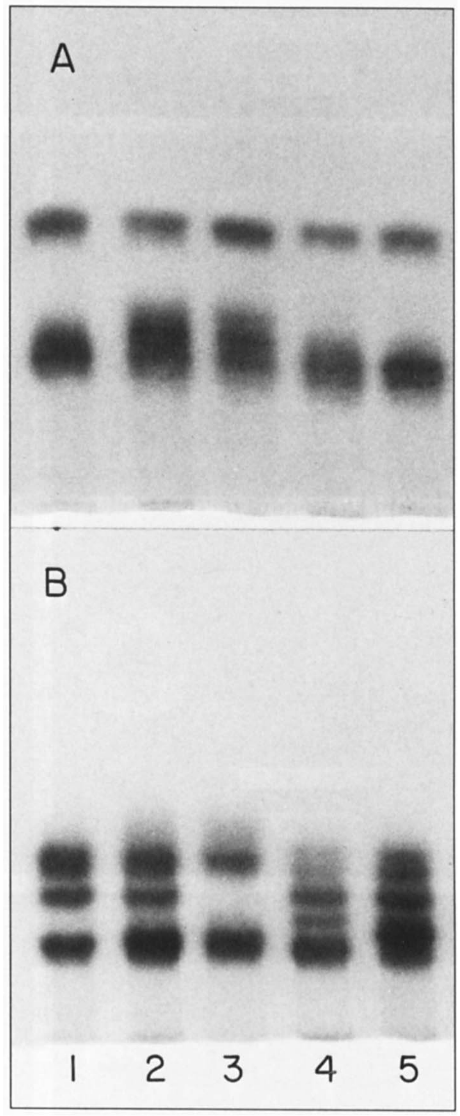

Fig. 1. Genetic differences and similarities in persimmon cultivars are apparent in leaf isozyme patterns of glucose-phosphate isomerase (A) and phosphoglucoisomerase (B) for California Fuyu (1), Fuyu (2), Jiro (3), Hana Fuyu (4), and Gosho (5).

Although the name 'persimmon' is American, of Algonquian origin, the major cultivars grown commercially in California belong to a species first brought to the United States from Japan in the 1800s. Most of these cultivars have distinct differences in fruit size, shape, and color.

PGM isozyme patterns of these two cultivars are distinctly different. The differences and similarities in isozyme patterns among Fuyu, Jiro, and Gosho are the same as gel patterns obtained from the persimmon collection at Kyoto University, Kyoto, Japan.

Classifications

Asian persimmons are classified as either pollination-constant or pollination-variant (table 1). The flesh of pollination-constant fruits, such as Fuyu and Cal-Fuyu, remains orange-yellow even though they have seeds. The flesh of pollination-variant types, such as Chocolate, turns brown around the seed.

Each group is further divided into astringent and nonastringent types, based on their flavor at maturity. Japanese horticulturists have subdivided the pollination-variant group into the two types according to the degree of browning of the flesh. By this classification, which is subjective, Zenji Maru is nonastringent and Hachiya is astringent. The classification is also arbitrary, because nonastringent cultivars, such as Fuyu, tend to be slightly astringent if they are grown where summers are short and cool, as in northern Japan. The astringency cannot be removed from fruits grown in these districts by treatment with ethanol fumes or ethylene as it can be with other astringent cultivars.

Persimmons are also classified as (1) pistillate-constant if only female flowers are borne; (2) staminate-constant if male flowers are produced consistently; or (3) staminate-sporadic if the clone bears male flowers in some seasons and not in others. Of the cultivars listed in table 1, Chocolate, Gosho, Hana Gosho, and Zenji Maru are staminate-constant; Cal-Fuyu is staminate-sporadic; the others are pistillate-constant. Seedlings that produce only male or mostly male flowers may exist in the wild, but they are not cultivated.

Cultivar information

California Fuyu or Cal-Fuyu. This cultivar was introduced as Fuyugaki syn. Fuyu kaki and labeled PI 26491 on the map of the former USDA Plant Introduction Gardens at Chico, California. Unlike Fuyu, some Cal-Fuyu trees bear male flowers sporadically on isolated branches. Cal-Fuyu has been marketed as Fuyu because of their similarity.

California Maru. This cultivar was introduced as PI 83790 but mislabeled as Jiro. Jiro is pollination-constant, has entirely different fruit characteristics, and differs genetically (as indicated by isozyme patterns) from California Maru. It is being renamed California Maru, because its origin cannot be traced. Currently there is no other cultivated persimmon with its eating quality. The ripe fruit is juicy and has a crisp texture, unlike that of Zenji Maru or Hyakume, which tend to be more buttery. Seeded fruits of California Maru have the shape of Zenji Maru; the skin color of California Maru is orange, while that of Zenji Maru is more reddish.

Chocolate. The size, shape, and coloration of this cultivar match those of Tsuru-no-ko. Chocolate produces many male flowers, however, while Tsuru-no-ko is reported to be pistillate-constant. Chocolate should be an excellent pollenizer for the pollination-variant cultivars, California Maru, Hyakume, and Zenji Maru, which require seed formation for the flesh to turn brown.

Fuji. This cultivar is considered the same as Hachiya in Japan, because fruits and leaf isozymes appear identical. Fruits of Fuji frequently produce the browning reaction around the seeds, as do those of Hachiya. Fuji trees grown at the Wolfskill Experimental Orchard always set a better crop than do Hachiya trees.

Fuyu. The leaf isozyme patterns and fruit size and eating quality indicate that this cultivar is identical to the original cultivar Fuyu, widely grown in Japan. Trees tend to bear in alternate years, producing large quantities of small fruit in the "on" year and a modest crop of large fruit in the "off" year. In Japan, the crop is thinned early in the on year to obtain large fruit at harvest.

Gosho or Gosho-gaki. Even seedless fruits of Gosho size well and have a reasonably good storage life, but the seeded fruits with slightly darker flesh color develop better flavor.

Hachiya. This cultivar was the basis of the persimmon industry in California until recently, when nonastringent types like Fuyu and Jiro became more popular. Hachiya fruits frequently produce brown flecking around the seeds in some seasons and areas but not in others; as a result, it has been reclassified as pollination-variant. Hachiya is eaten fresh, frozen, or as a dried product, and is used in puddings and cookies.

Hana Fuyu. Labeled Jumbu at Wolfskill, Hana Fuyu is marketed as Giant Fuyu in California. The fruit is large but it softens very soon after harvest and lacks flavor, being almost insipid.

Hyakume. The light yellow skin of Hyakume forms concentric cracks around the apex at maturity. When seeded, the brown flesh has a spicy flavor and a firm nonmelting texture.

Jiro. This cultivar has also been propagated and sold as Fuyu in California. Jiro fruits are more truncated and squarish in cross-section than those of Fuyu. Leaves of Jiro trees, more so than Fuyu leaves, appear chlorotic in the early spring, especially after a cold, wet winter.

Saijo. Fruits are small and are a dull yellow when mature. The flavor of a ripe Saijo fruit is ranked among the best by gourmets. The mature fruits are attractive when dried, especially if they are treated with sulfur dioxide before dehydration to prevent browning.

Zenji Maru. A Japanese Buddhist monk introduced Zenji Maru in about 800 AD to provide dessert fruit for the poor. The cultivar is an alternate bearer. The fruits develop a deep red color but tend to become soft and juicy when fully ripe. If harvested in prime condition, the brown flesh of the seeded fruits has an excellent flavor and texture.

The cultivars Hana Gosho, Hiratanenashi, Izu, Maekawa Wase Jiro, Matsumoto Wase Fuyu, and Suruga (table 1) have been imported by nurseries and private growers. These cultivars are established under quarantine in the National Germplasm Repository on the UC Davis campus and will not be available for distribution until January 1989.

TABLE 1. Classification of Asian persimmons by flesh color and astringency

Pollination-constant		Pollination-variant	
Astringent	**Nonastringent**	**Astringent**	**Nonastringent**
Saijo	California Fuyu	Fuji	Chocolate
Tamopan	Fuyu	Hachiya	California Maru (PI 83790)
Tanenashi	Hana Fuyu (syn. Yotsudani, Jumbu, Giant Fuyu)	Hiratanenashi	Hyakume (syn. Ama-hyakume)
Tsuru	Gosho		Zenji Maru
	Hana Gosho		
	Izu		
	Jiro		
	Maekawa Wase Jiro		
	Matsumoto Wase Fuyu		
	O-Gosho		
	Suruga		

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